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### **An Interview Study**

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## 1 INTRODUCTION

Seaports are considered as multifunctional socio-economic spaces and integrated logistics centres, which are primary elements of the global transport system (Montwiłł 2014). With the progress of the world economy, seaborne shipments are noticing a noticeable growth. For instance, in 2016 the world seaborne trade increased by 2.6 percent and the total volume of shipped cargo reached 10.3 billion tons, an addition of 260 million tons cargo compared to the previous year (UNCTAD 2017).

A seaport is a complex network of upstream and downstream partners to enhance the competitive advantage, added value, agility and profitability at the same time (Zsidisin and Ritchie 2009). Ports and related premises such as storage facilities are often located close to areas which are densely populated. Seaports play as well an essential role in modern trade and mobility and are expected to continue growing also in upcoming decades in terms of volume and complexity.

At the same time, seaports have to follow strict principles and have to burden enormous efforts in order to guarantee safety and security to themselves as well as to its bordering entities. As a result already today and even more in future, seaports face an extremely difficult situation, supporting global trade on the one hand and ensuring safe and secure operations for its internal actors and its external environment (see also e.g. Polemi 2018 and Ahokas 2019).

In particular, seaports are confronted with risks from different areas, such as the operational, technical and economic dimension (Alyami et al. 2016). Examples for these risks include flooding, oil spills and fire explosions (Becker et al. 2015; Valdor et al. 2015). The only way to cope with these major challenges is to install and maintain a proper risk management in the seaports and its actors involved in the daily operations.

Due to their complex nature, seaports require special risk management processes and measures that in many cases span across multiple entities and organizations (Nagi et al. 2017), which is not addressed by most traditional risk management approaches.

The interviews conducted in BSR seaports will provide the basis for better understanding the risk management methods currently employed by all relevant seaport internal actors, such as private firms, rescue services, and civil protection agencies. The study supports a cross firm investigation by conducting expert interviews in the Port of Hamburg (Germany), several ports in Finland, the Port of Klaipėda (Lithuania), and the Port of Tallinn (Estonia).

The report is structured as follows. Chapter 2 presents an overall background regarding the Baltic Sea Region and TEN-T core seaports. Chapter 3 provides essential fundamentals of risk management. Chapter 4 elaborates on the methodology of the paper. Chapter 5 presents the identified risks and the requirements of risk management in the studied seaports. Chapter 6 shows the results of the risk management phases according to ISO 31000. Chapter 7 elaborates on the risk management co-operation aspects and the communication means. The conclusions drawn from the conducted work are laid out in Chapter 8.

## 2 BACKGROUND

“The Baltic Sea continues to be one of Europe's most vulnerable areas. Algae bloom each summer, and more and bigger ships move through its narrowest and shallowest straits. Divisions from the past are still being overcome. Research, innovation and trade links need to be reinforced, while transport and energy connections have big gaps—the eastern and northern parts of the Region are still too often isolated from the rest of the EU” (Europäische Kommission 2012).

The following Chapter 2 gives an overview of the background of the topics related to the HAZARD project. In detail, the Baltic Sea Region (2.1), the TEN-T Core Seaports that are considered in this study (2.2) as well as the fundamentals of risk management (3) are discussed.

### 2.1 The Baltic Sea Region

#### 2.1.1 Introduction to the term “Baltic Sea Region”

This subsection is intended to give the reader a short overview regarding the term “Baltic Sea Region” (BSR). In this context, the development of the term "Baltic Sea Region" and the current geographical delamination of the region will be shortly explained.

The Baltic Sea is an inland sea and bordered by 10 states: Denmark, Norway, Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland and Germany (see **Figure 1**) (Europäische Kommission 2010). Generally spoken, there is no uniform limitation regarding the maritime boundaries of the Baltic Sea Region (BSR) since multiple perspectives and clusters of boundaries are possible. According to (Klemeshev et al. 2017), three definitions of the Baltic Sea Region are possible: a broad, an extended and a narrow one. These approaches differ for example in their purposes and characteristics (Klemeshev et al. 2017). This paper is pursuing the extended definition of the Baltic Sea Region by (Klemeshev et al. 2017)

The Baltic Sea is connected to the North Sea by five narrow straits, named Öresund, the Great Belt, the Little Belt, the Kattegat, and the Skagerrak (Klemeshev et al. 2017).

In the 11th century, the German chronicler Adam of Bremen was probably the first to introduce the term of the “Baltic Sea” (Kasekamp 2011). This term described a part of today's Baltic Sea during the time, the scope, role and understanding of this area has changed. The whole Baltic



**Figure 1: Baltic Sea Region**  
(Investitionsbank Schleswig-Holstein 2018a)

Sea Region is united by the sea and is characterized by a high diversity in terms of culture, environment and economy. Concurrently, the countries in the Baltic Sea Region use a wide range of common resources. Furthermore, a specific level of interdependency between the countries could be identified: the behaviour of one regional part could influence other parts of the region or the whole region in general (Brodzicki 2005; Europäische Kommission 2010). The use of the Baltic Sea by wind turbine parks, fishing, aquaculture, recreation and maritime transport on a high level represents also other regional influential factors (ICES annual science conference 2008).

The Baltic Sea Region could be seen as “one of the most developed and well-formed regions of international co-operation” (Klemeshev et al. 2017). The population of the BSR counts 85 million inhabitants (17 percent of EU population), whereby the southern part of the BSR is considered as the most populated part of the region (ICES annual science conference 2008). However, the northern and western parts of the region show a high innovative level whereas the eastern and southern areas could be categorized on a more developing stage.

### **2.1.2 Opportunities and Challenges**

*The Baltic Sea Region faces different opportunities as for example being a platform for the formation of new projects and collaborations between different parties (e.g. public authorities, firms or cities), while on the other side, the region also has to handle upcoming challenges such as environmental and economic unsolved problems (Europäische Kommission 2010). Therefore, relevant opportunities as well as challenges of the Baltic Sea Region are presented in this part of the second chapter.*

#### **Opportunities**

In general, the Baltic Sea Region has potential to develop. But to strengthen this development, relevant chances need to be identified and perceived. Concerning the relevant chances of the BSR, especially the high-qualified knowledge of employees in the region should be mentioned. A well-educated employee-level ensures and creates a baseline for further growth of the region's expertise in innovation. This is valuable for the whole region since fostering innovation creates the basis for a dynamic economic environment. (Brodzicki 2005; Europäische Kommission 2010).

One important pillar of the prospective growth in the knowledge-based industry in the BSR is the networking between the states with the aim of supporting research, knowledge transfer and clustering (Europäische Kommission 2010)). Fisheries, agriculture and forestry could be seen as the key sectors of the BSR. In the light of potential upcoming economic crisis within the European Union (EU), the BSR is obliged to strengthen their key sectors. Therefore, trade barriers are about to be reduced so that the benefit from an established and expanded internal market generate valuable profit for the region. The reduction of trade barriers also contains a better

integration and inclusion of the labour market and a decrease of social exclusions as well-trained workforces need to be present, available and motivated to enter the labour market (Europäische Kommission 2010).

By the reduction of barriers to trade, the region's attractiveness could be set up and local firms as well as investors from other countries could be encouraged to invest more and stronger into the BSR. Simultaneously, the competitiveness and profitability of the key sectors are supported and their value for the economy and a long-lasting development of the region is growing (Europäische Kommission 2010; Lindholm and Behrends 2012). Behind all this, the BSR's general objective of strengthening general security and protection of the region should not be neglected.

### **Challenges**

Several challenges influence the development of the Baltic Sea Region. For giving some examples of challenging fields, the both of environment and economic could be named. The challenging impacts limit the BSR in their possibility to grow and develop.

Regarding the environmental field, the ecological balance in the Baltic Sea is disrupted by factors as for example overfishing, a high level of nutrients in the water that leads to a strong algae growth, land-caused pollution or an increase in the temperature of the sea as a result of the climate change. In fact, the region is confronted with numerous impacts that are partly responsible for the current environmental state of the region. Industrial pollution, large livestock farms and used agricultural techniques, the cities' sewage treatment as well as the activities of the population in the region are only a few examples of these impacts (Europäische Kommission 2010; Lindholm and Behrends 2012).

Furthermore, the broad use of the Baltic Sea for wind turbine parks or maritime transport constitute two important influence factors. Especially the maritime transport, which represents a significant trade factor of the Baltic Sea Region, include some relevant negative influencing factors: hazardous substances as heavy metals or organic contaminants are challenging the region's environment as well as ballast water or illegal oil discharge. A good maritime trading and handling could improve the environmental situation in the BSR in a large impact (ICES annual science conference 2008).

Regarding the economical field, the region is for example faced with the further development of research and innovation fields as mentioned in the previous sections. Moreover, some economical parts of the region are still energy isolated and contain a lack of logistical infrastructure to ensure a sustainable transportation mode and a common level of accessibility. Reasons for a low level of accessibility could be for example region-size-based, therefore causing long time and distances for travel or challenging terms regarding geographical and climate factors. Due to a not sufficient level of infrastructure or service density, high transport prices could arise. Sweden and Finland could be mentioned as countries that have to handle these

kinds of large-region-based challenges. To control and eliminate the challenge of organized crime in the region, the BSR is required to reduce risks from a variety of sources. Therefore, another economical challenge is presented by the increase of the general safety level among the whole Baltic Sea Region (Brodzicki 2005; Europäische Kommission 2010).

### 2.1.3 Projects in the Baltic Sea Region

*To improve the economic and ecological situation of the region as well as to support the realization of the region's opportunities, various projects and subprojects have been initiated. In the following, the ideas behind the "Interreg Baltic Sea Region Programme 2014-2020", "EU Strategy for the Baltic Sea Region (EUSBSR)", "Europe 2020 Strategy" and "HAZARD" are presented as examples of initiatives, that strongly influences the development of the region.*

#### EU Strategy for the Baltic Sea Region (EUSBSR) and Europe 2020 Strategy



The aim of the EU Strategy for the Baltic Sea Region (EUSBSR) is to jointly exploit the opportunities offered by the Baltic Sea Region by identifying, analysing and eliminating the challenges for the region (Europäische Kommission and Europäische Union 2016b)

In 2009, the European Council approved the European Union Strategy for the Baltic Sea Region. The project is considered as a pioneer of a macro-regional European strategy. The main objectives of the strategy are connecting the region (concerning transport and energy), saving the sea (concerning hazards, nutrition, bio-economy, ships and safety) and increasing prosperity (concerning culture, tourism, innovation, education, health and security). Each objective has multiple sub-objectives. In general, the objectives and sub-objectives, which influence each other, are also the greatest challenges for the European strategy (Europäische Kommission and Europäische Union 2018a, 2016b)

Participating countries include the EU member states Finland, Denmark, Sweden, Germany, Estonia, Latvia, Lithuania and Poland. Furthermore, the EU neighbouring countries Belarus, Iceland, Norway and Russia are also involved in the strategy. The implementation of the XY strategy takes place in joint processes and projects (which are called Flagships), by means of which the progress and the realization of the strategy goals can be made visible and measured. For example, the strategy is fully aligned with the 2020 Strategy, which is briefly explained below (Europäische Kommission and Europäische Union 2016b, 2018a)

The Europe 2020 Strategy is the next step in the improvement process of the Baltic Sea Region. In comparison to EUSBSR, the Europe 2020 Strategy covers all EU member states. The strategy

addresses general EU level challenges and focuses on 3 priorities: smart growth, sustainable growth and inclusive growth. The fact, that EUSBSR is fully aligned with the Europe 2020 Strategy, ensures that the development of the BSR will continue to be promoted and expanded also in future years (Europäische Kommission und Europäische Union 2016a; Investitionsbank Schleswig-Holstein (IB.SH) 2018b).



**Figure 2:** Strategic programme for Europe 2020 and the EU Strategy for the Baltic Sea Region (Europäische Kommission und Europäische Union 2016b)

For a general overview of the structure and the relation between the EUSBSR and the Europe 2020 strategy the strategic programme is pictured below (see **Figure 2**).

### **Project HAZARD**

The subtitle of the project HAZARD is “Mitigating the Effects of Emergencies in the Baltic Sea Region Ports”. The HAZARD project, which is subordinated to the EU funding programme Interreg Baltic Sea Region, considers the safety in Baltic Sea ports. In general, project partners from six countries in the Baltic Sea Region are involved in the project, which brings logistics operators, established knowledge partners, rescue services and several other authorities together with a view to mitigate the effects of emergencies in the BSR.

Seaports are often found in inhabited areas. This poses a risk to people and the environment in the event of accidents. Accidents in the port area include, for example, explosions or fire. The aim of HAZARD project is to mitigate the consequences of accidents in seaports in the Baltic Sea region in order to adapt maritime safety standards (Europäische Kommission und Europäische Union 2018b, 2018c). The timeframe of the project, which does have a total budget of 4.3 million euros, is spring 2016 until spring 2019.



## 2.2 TEN-T Core Seaports

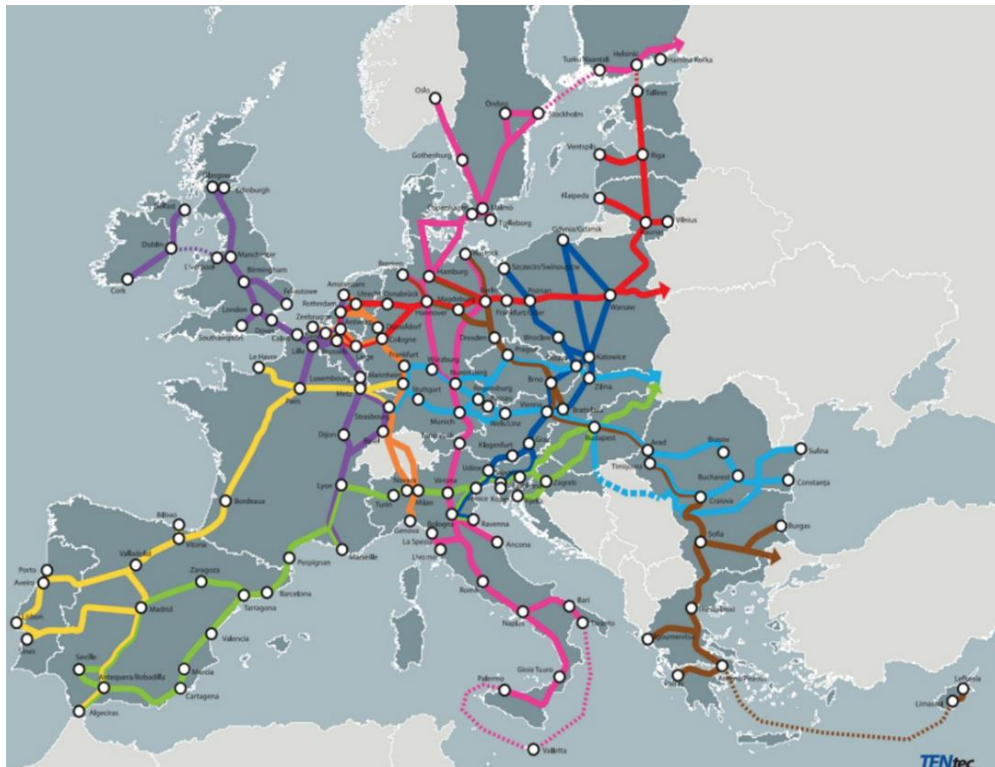
### 2.2.1 Introduction to the Trans-European Transport Network (TEN-T)

*The concept and idea of the Trans-European Transport Network is presented below. In this context, the policy of the network as well as the individual corridors and the structure of the entire network is described more detailed.*

Like any association of states, the European Union must also rise to challenges in order to enable their further development in the future. The Trans-European Transport Network (TEN-T) supports this intention regarding logistical and transport-related factors with the goal to establish a common transport area in Europe (Europäische Kommission 2018d). The TEN-T network is part of a wider concept of Trans-European networks (TENs). The more general concept includes the transport network, a telecommunications network (eTEN) and an energy network (TEN-E). The first action plans for the Trans-European Networks were approved by the European Commission in 1990 (Europäische Kommission 2016; 2018a; 2018c; 2018e; 2018h; Ten Telecom 2018).

The policy of TEN-T aims to be achieved both by modernizing existing platforms and infrastructures and by creating new ones. Also, the implementation of innovative digital technologies as well as the use of alternative fuels and general standards are important during the realization of the set goals. In general, the network comprises two network structures: first, a comprehensive network, which covers all European regions and second, a more detailed network, called “core network”, which contains the network’s most important routes and also connect the most significant nodes.

The European Commission's "Trans-European Transport Network (TEN-T)" directive was created with the aim of designing and introducing a Europe-wide network of railway lines, roads, inland waterways, maritime shipping routes, ports, airports and rail-road terminals. More specifically, the main aims are to remove technical barriers between the transport networks of the member states, to form a stronger linkage and to isolate bottlenecks. In addition, it is necessary to strengthen the community of the network in terms of territorial, social and economic aspects in general (Europäische Union 2018; The Greens in the European Parliament 2018).



**Figure 3:** TEN-T Core Network Corridors (Europäische Kommission 2018c)

In order to implement and support the idea of the TEN-T Core Network, nine core network corridors were defined, which have two focal points: Motorways of the Sea and the ERTMS (the European Rail Traffic Management System) deployment. Motorways of the Sea relates to all maritime member states, whereas ERTMS relates to all member states with railways. These two priorities, Motorways of the Sea and ERTMS, should support the implementation of the goals within the specified project timeframe from 2014 to 2020 (Europäische Kommission 2014).

Since January 2014, the project represents the new transport infrastructure policy of the European Union and connects the European continent between North, South, East and West. The funding period is from 2014 to 2010. The funding, which amounts to approximately 500 billion euros, is based on a combination of various funds. Nowadays, the core network amounts to 12,880km of inland waterways, 34,401km of roads and 50,762km of railway lines. In comparison, the comprehensive network amounts to 23,506km of inland waterways, 136706 km of roads and 138,072km of railway lines. (Europäische Kommission 2014; Europäische Union 2018; The Greens in the European Parliament 2018).

The previous image (see **Figure 3**) shows the nine core network corridors of the Trans-European Transport Network: Baltic Adriatic, North Sea-Baltic, Mediterranean, Orient-East Med, Scandinavian-Mediterranean, Rhine-Alpine, Atlantic, North Sea-Mediterranean and Rhine-Danube. The corresponding member states and colour are listed in Error! Reference source not found..

**Table 1:** *Corridors of the Trans-European Transport Network (Europäische Kommission 2018c)*

<b>Corridor</b>	<b>Member States</b>	<b>Colour</b>
Baltic-Adriatic	Poland, Slovakia, Czech Republic, Austria, Slovenia, Italy (6)	Deep blue
North Sea-Baltic	Netherlands, Belgium, Germany, Poland, Lithuania, Latvia, Estonia, and Finland (8)	Red
Mediterranean	Spain, France, Italy, Slovenia, Croatia, Hungary (6)	Green
Orient/East-Med	Germany, Czech Republic, Slovakia, Austria, Hungary, Romania, Bulgaria, Greece, Cyprus (9)	Khaki
Scandinavian-Mediterranean	Finland, Sweden, Denmark, Germany, Austria, Italy, Malta (7)	Pink
Rhine-Alpine	Netherlands, Belgium, Germany, France, Italy (5)	Orange
Atlantic	Portugal, Spain, France, Germany (4)	Yellow
North Sea-Mediterranean	Ireland, United Kingdom, France, Netherlands, Belgium (5)	Violet
Rhine-Danube	France, Germany, Austria, Czech Republic, Slovakia, Croatia, Hungary, Romania, Bulgaria (9)	Light blue

### 2.2.2 Motorways of the Sea

*To underline the importance of maritime corridors in an international context, the maritime pillar of the TEN-T Network, Motorways of the Sea (MoS), will be shortly discussed in more detail below.*

In 2016, around 340 ports in America, 629 ports in South America, 348 ports in Africa, 89 ports in Middle East and 848 Ports in Far East were directly connected with different European ports and the trend of increasing traffic and size of ships continues. This shows, that shipping has to work properly within the territories of the European Union to ensure the continued competitiveness of the European shipping territories (Europäische Kommission 2018g).

The aim of Motorways of the Sea is to reduce barriers within the European maritime transport space and to strengthen the connections and maritime links between the core network corridors and European Member States. As a result, a more sustainable, more efficient and more commercially profitable type of transport will be developed, which represents simultaneously an alternative transportation form to road-based transports. Therefore, the road systems will

be relieved as well, and a structural change could be realized where the maritime transport constitutes the international trade's backbone.

Maritime infrastructures, short-sea routes as well as ports and appropriate facilities and equipment are exemplary factors which are integrated into Motorways of the Sea to realize for example new door-to-door integrated transport systems within new maritime based and intermodal supply chains (Europäische Kommission 2018g).

### 2.2.3 North Sea-Baltic Corridor and its Core Seaports

As a part of the further elaboration of this paper, ports of the Baltic Sea region will be the subject of consideration. The Baltic Sea Region falls into the North Sea-Baltic Corridor according to the TEN-T subdivision. 2,186km inland waterway, 5,947km railway network and 4,029km road describe the corridor. The beginning of the corridor is marked by the port of Helsinki.

It continues through Estonia (Tallinn), Latvia (Riga) and Lithuania (Klaipėda) and finally ends in Warsaw. The corridor in the East-West Corridor is continued by passing cities such as Poznań, Łódź and Berlin to the North Sea ports of Bremen, Bremerhaven, Hamburg, Rotterdam, Amsterdam, Moerdijk and Antwerp.



**Figure 4: North Sea-Baltic Corridor**  
(Europäische Kommission 2018b)

The entire North Sea-Baltic Corridor links these North Sea ports of the Netherlands, Belgium and Northern Germany with the Baltic Sea ports of this corridor (see **Figure 4**) (Europäische Kommission 2018b; 2018f).

In the following, the seaports Hamburg, Gdańsk and Gdynia, Klaipėda, Tallinn and Turku within the Baltic Sea Region and the North Sea-Baltic Corridor are briefly introduced in terms of geographic location, nationality, turnover rate, size of the port area and function.

#### Hamburg



The Port of Hamburg in Northern Germany is one of the largest container ports in the world (Statista GmbH 2016). With a handling volume of 8.9 million TEUs and a total sea cargo handling turnover of 138.2 million tons in 2017, it is the third largest port in Europe based on container handling. The seaport has an area of approx. 7,105 ha (Hamburg Port Authority 2017). It functions as a universal port, which means that different goods can be handled in this port. Universal ports belong to the multifunctional ports and have versatile action functions as

well as high performance capacities. They are therefore characterized by a broad range of services. The port of Hamburg specializes primarily in container handling and bulk goods (Fiche 2010; Hamburg Port Authority 2017).

Although the port of Hamburg has direct access to the North Sea via the Elbe, it is also called the westernmost Baltic Sea port, as it also has a connection to the Baltic Sea via the “Kiel-Canal”. Furthermore, the Port of Hamburg represents an important hub of the German rail network. The node facilitates access to countries such as Poland, inland countries within Europe and eastern Germany (Fiche 2010; Hamburg Port Authority 2017).

### **Gdańsk**



The port of Gdańsk is the largest port in Poland and an international traffic node. The port covers a land area of 652 ha and a water area of 412 ha (Port of Gdansk Authority SA 2018). This Polish port is located in the north of the country and is one of Poland's ice-free ports. Furthermore, the port plays an important role in the central part of the southern Baltic Sea area, which is growing rapidly. In 2017 the port had a total turnover of 40,614 thousand tons and a handling volume of around 1.6 million TEU (Port of Gdansk Authority SA 2018).

The port structure is mainly divided into two sections with different functions: The inner port comprises mainly transshipment facilities and terminals, whereas the outer port is equipped with facilities that can primarily handle energy raw materials such as coal or liquefied petroleum gas (Fiche 2010; Port of Gdansk Authority SA 2018)

### **Gdynia**



The port of Gdynia is located in the north of Poland. As a modern universal port, the port of Gdynia specializes in the handling of general cargo (mainly container general cargo). The total turnover of the port in 2017 was 21,225 thousand tons and the handling volume was 710,698 TEU (Port of Gdynia Authority S.A. 2018). The well-developed multimodal transport networks, such as hinterland and good ferry connections, make it possible for the port of Gdynia to represent an important link in the European transport corridor (Fiche 2010; Port of Gdynia Authority S.A. 2018).

### **Klaipėda**



Klaipėda is the main port in Lithuania and predominantly an export port. The port area covers 1,415.9 ha (Klaipėda State Seaport Authority 2018). As Lithuania has a lack of natural resources and hardly any high technology, the port and the logistics sector have a special role to play. A large part of the goods for the country are imported by sea. The port in Klaipėda is located in the north-west of Lithuania and is the only Baltic Sea port in the country and one of the few ice-free ports in northernmost Europe (Klaipėda State Seaport Authority 2018; Litauen.info 2018).

As The port of Klaipėda had a total turnover of 43.17 million tons and a handling volume of 472 thousand TEU in 2017 (Klaipėda State Seaport Authority 2018). The port specializes primarily in the handling of bulk goods such as oil products and fertilizers. The port is an universal port with an important rail node oriented towards the South East with hinterland connections to Belarus, Ukraine as well as to Poland ( Fiche 2010; Klaipėda State Seaport Authority 2018)

### Tallinn



The port of Tallinn is one of the leading seaports in the Baltic Sea Region and the largest port in Estonia. The port has a port area of 1732.6 ha and is located in the north of Estonia (Port of Tallinn Authority 2018). As many traffic flows have been transferred to other locations due to a lack of capacity, the port has lost importance (Port of Tallinn Authority 2018). The total cargo traffic of the port of Tallinn included in 2017 4999,7 thousand tons and a handling volume of 54,516 TEU (Port of Tallinn Authority 2018).

The port of Tallinn is also a universal port and has several terminals. In general, the port structure is divided into five parts: the old city port, Muuga port, Paldiski port, Paljassaare port and Saaremaa port. Basically, the port's specialization lies in the field of liquid goods and in its function as a ferry port to other countries in the Baltic Sea region. In addition, the various terminals have different sub-specializations (e.g. passenger traffic or handling of different types of goods) (Fiche 2010; Port of Tallinn Authority 2018).

### Turku



The port of Turku is located in Southwest Finland, in the country's sixth largest city. The port has an area of about 1256 ha and is an important link in the logistics chains of Finnish imports and exports. Also, the port of Turku is connected to the Helsinki area by good road connections. The port's turnover in 2017 was 2.7 million tons with a handling volume of 2,200 TEU (Port of Turku Authority 2018).

The port is characterized in particular by frequent liner shipping and, as already mentioned, good transport connections to the Helsinki area, the west coast of Finland and the wider hinterland. The port of Turku is also divided into several areas. For example, there are the passenger harbour, the Linnanaukko area (e.g. for unitised cargo transports), the West harbour (e.g. for international container transports), the Free Zone Firm and the Ovako area (e.g. various load services, railway connections) as well as the Pansio Harbour (e.g. oil) (Port of Turku Authority 2018).

### 3 FUNDAMENTALS OF RISK MANAGEMENT

#### 3.1 The Term of Risk and Risk Classification Approaches

*The following section's focus is set by the expression of the term risk and the consideration of different risk classification approaches. It is pointed out, what large impact the risk subject does have for firms and in what context and field risks in the corporate environment can be considered.*

A large number of definitions of the term "risk" are cited in the literature. It can be seen that the definitions have become increasingly detailed and complex over time. The original link between opportunity and risk has developed into an important component, which is influenced by elements such as vulnerability and exposure (Alexander 2000; Thywissen 2006).

Despite a comprehensive consideration of the risk problem by many authors, a uniform definition of terms does not exist. In principle, risks can disrupt a service provision process (Thom 2008). The various risk definitions differ both in research areas and in areas of focus. Thus, (Schlatta 2008) define risk with regard to the supply chain as "a loss assessed by its probability of occurrence [...] whose occurrence affects more than one firm in the supply chain and whose causes lie within a firm, within its supply chain or in its environment".

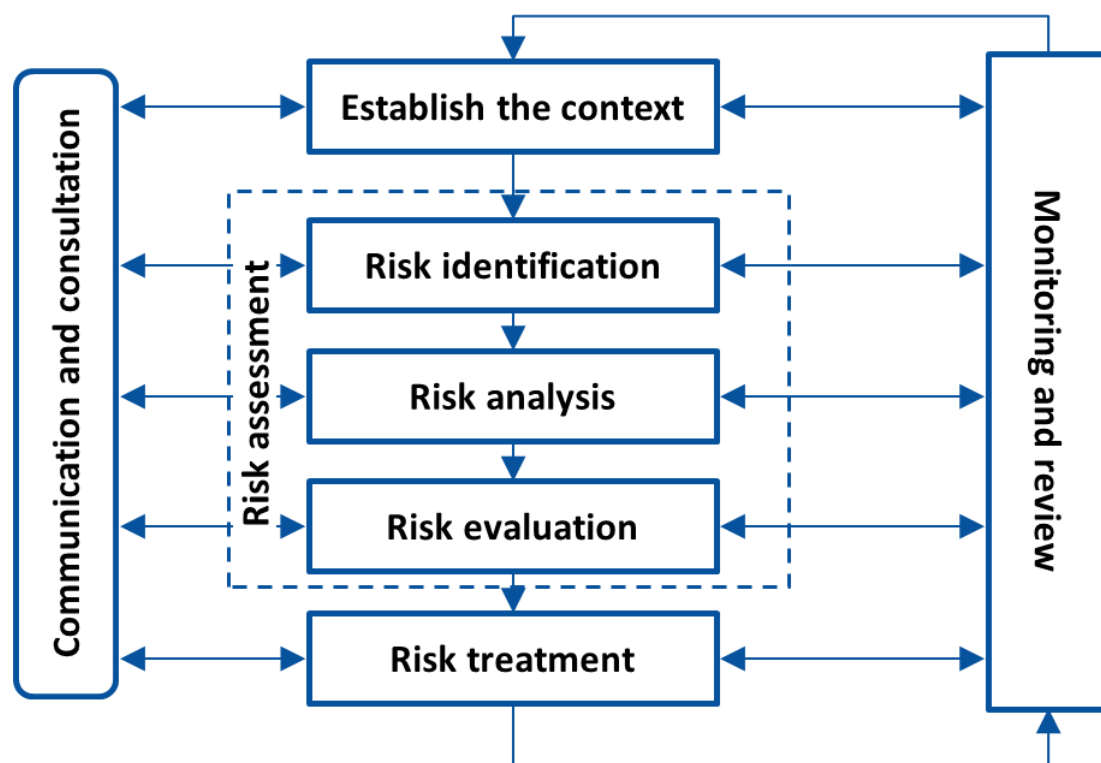
Risks in a supply chain arise from various causes. Power and dependence structures, the flow of goods and information as well as the actors themselves represent components of the supply chain that can be influenced by risks (Huber 2014). To manage the various risks, a classification, e.g. with regard to their origins, helps. In accordance with the classification, action and control measures can also be derived in order to be able to deal with the risks in line with the situation. In view of a classification of risks, various approaches are also available in the literature.

While (Rogler 2002) subdivides risks according to their source of risk (e.g. operational risks are allocated to the sources of procurement, production and sales (Rogler 2002; Pfohl and Aberle 2002) categorize risks into exogenous risks arising in the environment of the value creation network and endogenous risks originating from the supply chain (Pfohl and Aberle 2002). The WORLD ECONOMIC FORUM is an international organization for public-private co-operation. In the 2012 industry report, triggers for global supply chain disruptions are again subdivided into the areas of environment, geopolitics, economy and technology (World Economic Forum 2012). In a dynamic competitive environment, a firm is exposed to risks which, as the competitive environment is, are dynamic and constantly changing. A one-sided view of the concept of risk is therefore out of date. The change is driven above all by strongly interlinked co-operation between firms in value creation networks, increasing globalization and a pronounced focus on efficiency on the part of the networks. An increasing intensity of competition and permanently changing external conditions are to be monitored (Schlatta 2008).

With regard to the subject matter of this paper, the risk definition of (Schlatta 2008) and the risk classification according to (Pfohl and Aberle 2002) are taken up as a fundamental basis with regard to the concept of risk. In principle, a port is exposed to various risks which can be caused by the actors in a supply chain and those operating ones in the port area. Furthermore, the risks occurring in the port's surroundings also affect the port's current situation. A more detailed consideration of the concept of risk in the context of ports is given in the further course of this chapter.

### 3.2 Risk Management based on ISO 31000

This chapter represents the risk management approach based on ISO 31000. After a general introduction into the ISO approach and the idea and concept behind, the ISO 31000 is explained. ISO 31000 relates to the risk management and is explained within this subsection.



**Figure 5:** Risk management process according to ISO 31000:2009 (International Organization for Standardization 2018c)

Firms as well as all other business enterprises and institutions are dependent on managing the uncertainties in their environment in order to be able to meet their service provision processes in the future and to continue to be successful (Hohrath 2013). Since risks that influence the organization and operation also have an impact on their performance in an economic context as well as their environment, they should be a permanent object of consideration in the context of corporate management (International Organization for Standardization 2018d).



The definition of risk management is based on ISO 31000, the International Organization for Standardization (ISO), a worldwide association of national standardization bodies. This association develops standards that are internationally valid (except in the fields of electronics, electrics and telecommunications) (International Organization for Standardization 2018a). ISO 31000, which relates to risk management, is intended to support decision-making, the setting and achievement of goals, the management of risks and thus also the improvement of performance, and to protect the organization or operation. In general, risk management takes into account both external and internal factors influencing operations and should be anchored in all activities of an organization (International Organization for Standardization 2018b).

A defined framework for risk management is needed to ensure aspects such as a generic approach, consistent processes, efficiency, coherence and effective risk management. In addition, principles and guidelines are thus made available (Thywissen 2006). The created framework reflects the precautions and principles in which risk management is embedded at all levels of the organization.

Basically, the ISO 31000-norm is defined as follows: The "ISO 31000:2018, Risk management—Guidelines, provides principles, framework and a process for managing risk. It can be used by any organization regardless of its size, activity or sector. Using ISO 31000 can help organizations increase the likelihood of achieving objectives, improve the identification of opportunities and threats and effectively allocate and use resources for risk treatment" (International Organization for Standardization 2018b).

However, it should be kept in mind that the ISO standard cannot be used for certification purposes. Instead, it can be used as a guideline for the implementation of external and internal investigation procedures, so-called audits. In this way, sound principles for effective corporate management can be created. The general clauses in ISO 31000 are: Scope of ISO 31000, Terms and Definitions, Principles, Framework and Process (International Organization for Standardization 2018b).

Since this report deals intensively with the subject of risk management, in the following, the risk management process is described in more detail. Once the firm's objectives, the corporate environment, stakeholders and the diversity of risk criteria have been identified, in other words, after the scope and context have been defined, a risk assessment is then carried out. The assessment is divided into the three components risk identification, risk analysis and risk evaluation and is influenced by the factors of communication and consultation as well as monitoring and review.

### **3.2.1 Risk identification**

In general, it has to be pointed out, that a risk event can have multiple effects on different areas within the firm at the same time. In addition, the event of one risk may also affect another risk.

For identifying risks, the most accurate information has to be used. The best strategy can be developed by using timely, factual and accurate data. Furthermore, different factors have to be considered to identify the potential risks to your organization. These factors could include for example the likelihood and consequence of an occurring risk, the already existing procedures and capabilities of risk management, tangible and intangible sources of risks, internal and external changes and their influences on the firm (International Organization for Standardization 2018c).

### **3.2.2 Risk analysis**

In order to conduct a risk analysis, a wide variety of information should be considered. In risk analysis, for example, the probability, level and nature of a risk are considered, as well as internal and external influences and resources. The analysis enables decisions to be made regarding the correct treatment of risks and how to proceed. Various techniques can be used for a risk analysis. For example, quantitative, semi-quantitative, qualitative techniques or a mix of the three techniques can be used.

Which method is ultimately used depends, for instance, on which risk criteria are considered and which measurement options are available for the organization's risks. However, in general, it should be mentioned that the risks can be perceived subjectively and that different parties within the organization can perceive risks differently (International Organization for Standardization 2018c).

### **3.2.3 Risk evaluation**

Finally, there is the risk evaluation, which should not be underestimated: Since risk management is a dynamic process, the strategy can be adapted and improved in line with the situation by means of continuous risk evaluation. As part of the risk evaluation, for example, it is assessed to what extent the chosen strategy corresponds to the corporate objectives, which risks have which degree of priority or which next steps are to be initiated. The results and success of the risk analysis process are also reflected (International Organization for Standardization 2018c).

### **3.2.4 Risk treatment**

The risk treatment relies on the results of the risk assessment process. Based on the evaluation stage, specific treatment measures are applied in order to mitigate the identified risks. Different treatment options can be applied, such as changing the likelihood and/or severity of consequences. The treatment process should be assessed for effectiveness in order to decide if a new risk treatment is necessary (International Organization for Standardization 2018c).

### **3.2.5 Communication/Consultation & Monitoring/Review**

The risk assessment process is influenced both by the factors "Communication/Consultation" and "Monitoring/Review". Throughout the process it is extremely important that the various steps and results are communicated accordingly and comprehensively between the parties involved. Without a clear communication and information structure in the risk management process, for example, misunderstandings and misinformation can occur, which can lead to a delay and obstruction of the process. Furthermore, documentation and reflection of the results and the course of the process is necessary.

This makes it possible to make any necessary changes to the assessment in good time and to improve the entire process structure and future processes (International Organization for Standardization 2018c).

### **3.2.6 Summary**

In the end, an approach and concept of the risk treatment is stated. As risks can be better assessed through their identification, analysis and evaluation, it is possible to identify a certain risk handling approach. Risks should thus be made manageable. A firm's willingness to take risks has a major influence on the firm's risk management. The firm has to decide to what extent it wishes to maintain risks or not.

An appropriate balance must be found between the benefits (e.g., competitive advantage) of risk retention and the potential disadvantages (e.g., costs). Basically, risk treatment is not a rigid process, but a dynamic process that can change over time. Various measures must be taken in the context of risk treatment. For example, appropriate treatment options must be formulated, selected and implemented. In addition, residual risks must be evaluated, and the long-term effectiveness of the risk treatment reflected (International Organization for Standardization 2018c).

Furthermore, the importance of recording and reporting in the whole risk management process should not be neglected. Recording and reporting represents the last stage of the risk management process. Continuous monitoring and review of the various processes and risks leads to more stable and successful risk management in the long term. The regularity of the review may vary from firm to firm and from management to management. For example, the reviews can take place weekly, monthly or annually.

The PDCA (Plan, Do, Check, Act) concept can be applied very well in this context of recording and reporting. Risks change. If this is the case, the risk handling should be reviewed and changed if necessary. If changes are necessary, subsequent steps and measures should be planned and implemented anew. The measures taken should then be re-examined and the organization has

to act accordingly. Then, the process starts all over again (Srivannaboon 2009; International Organization for Standardization 2018b).

### **3.3 Risk Management in the Context of a Port and Maritime Environment**

*In this sub-chapter of this report, the significance of risk management in the context of ports and a maritime environment will be explained in more detail. Furthermore, a better framework of understanding for the evaluations of the interviews following in the next chapters will be represented.*

From a historical perspective, seaports were initially not subject to comprehensive regulation and security monitoring. In the course of time, various risk management approaches have developed to counter the problems in ports. Port security must be considered within the framework of organizational structures, risks and vulnerability analyses as well as the management of security operations (Christopher 2015).

Seaports as passenger and cargo transport systems are unique from a historical perspective, as they have developed into a function of a geographical interface between modes of transport of seagoing vessels and land transport (Christopher 2015). The development of a port area is fundamental for risk and safety management; actors must take a close look at the environment in which they operate in order to be able to derive the lowest possible risk measures.

Although the issue of risk management has become omnipresent in the consciousness of port operators and has developed into a significant consideration factor in port processes, there is no uniform risk management that can be applied in every port (Huber 2014; Christopher 2015). In principle, it should be noted that risk management is very port-specific. This may be due, for example, to different geographical and economic conditions in the ports. In the various ports there are different risk management systems and approaches on the part of the players, which specify and describe the process of handling risks and emergency situations (Christopher 2015).

Seaports are a critical component of the global transport infrastructure (Christopher 2015). It contains a dynamic competitive environment that is exposed to risks. Ports embody a unique environment in which they act as an interface between global maritime trade, transport networks and a wide range of facilities and geography (Gluckler 2007; Christopher 2015).

The diversity of infrastructure, business management, politics and other functions in the port environment distinguish security operations from those of other industries and forms of transport. The rules, regulations and tariffs of the organizational structure of port operations are very complex and represent a certain risk and conflict potential. The aim of port security and risk management is to provide maritime professionals, state law enforcement agencies, officials and, above all, port operators, workers, users and stakeholders with a basic awareness and understanding of port risk and security management. Management and employees need a

broad foundation to understand the scope and scale of potential threats to seaports (Christopher 2015).

The different parties in the port carry out several tasks, so that they are confronted with different risks that need to be handled. Basically, risk management in the port begins with an understanding of the target environment whose hazards must be identified, assessed and managed (Christopher 2015). Risk management supports the allocation of resources and the implementation of measures under uncertainty. Challenges in developing port-specific risk management plans include improving risk assessment procedures and strategic thinking, measuring and assessing risks, lack of common methodologies and promoting public-private partnerships (Christopher 2015).

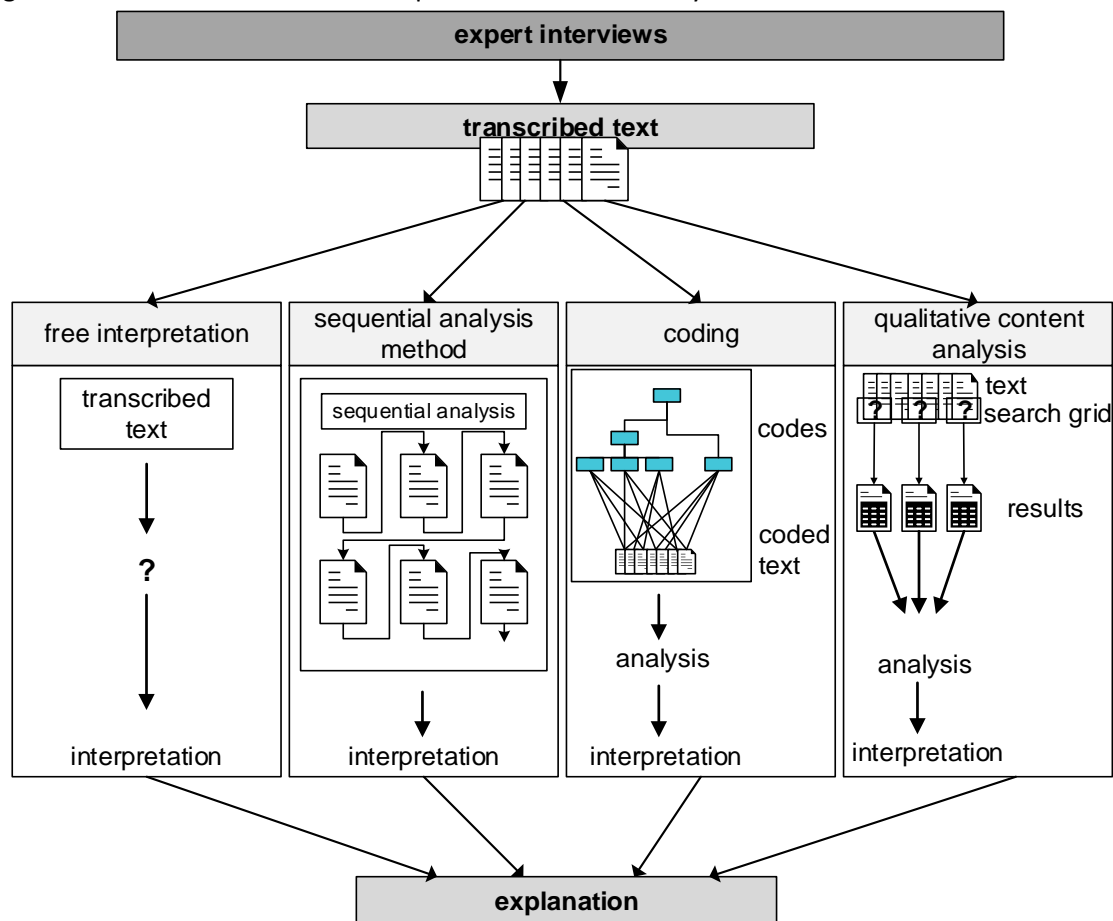
In principle, influences that endanger maritime safety can be sub-divided into three hazard sources: The events that are assigned to the area of external factors are, for example, incidents that are committed intentionally and mostly for political reasons by terrorists or individuals (Talley 2009). Another subdivision is represented by ship accidents, for example. These events do not occur intentionally, and their prevention is part of operational safety. The third subdivision is arising from piracy, which is usually caused by the theft of goods.

Basically, it can be said, that the need to develop a sustainable risk management process and an included work with federal, state, local and private firms as well as to develop both routine and emergency response mechanisms increases (Christopher 2015). The dependencies and relationships between risk analysis and the coordination among the different processes and stakeholders involved in a holistic risk management create a framework for the understanding of the central role of clearly and well-defined processes within the risk management and their organization.

#### 4 METHODOLOGY

The methodological approach in this report is conducting interviews with experts in the field in order to reveal the current status of risk management at major BSR seaports. For ensuring a qualitative and detailed analysis, a comprehensive and suitable approach for the collection and analysis of the obtained empirical data is required. This section explains the approach employed to prepare and analyse the interviews carried out with the scope of assessing the current status of risk management in major BSR seaports.

A structured interview guideline was prepared to cover all aspects of interest related to risk management in seaports. These include scope and type of risks, requirements, the phases of risk management process as well as the co-operation and communication aspects. The interview guideline serves as a basis for the qualitative content analysis.



**Figure 6:** Approaches for the analysis of interviews (Gläser and Laudel 2010)

A qualitative content analysis according to Gläser and Laudel (2006, p.42) can be used to analyse the transcribed text from the interviews conducted. Qualitative content analysis is one of the research methods used to analyse text data (Hsieh and Shannon 2005, p. 1278). The qualitative content analysis uses the answers of the interview guideline to search for certain categories and pattern through the text in specific fields (see **Figure 6**).

Three distinct approaches for qualitative content analysis can be used: conventional, directed, or summative. Coding categories are extracted directly from the text data using the conventional approach. A theory or research findings are the basis for the directed approach whereas the summative approach relies on counting and comparisons.

The conventional approach is appropriate in the explorative analysis of the interviews for the HAZARD project. The data are read carefully to extract codes by highlighting a set of words from the text that reflect a key concept, process or thoughts. The researcher continues to make initial notes with labels for codes emerging from the text which serve as a basis for the initial coding scheme. Related codes are then linked together to form categories. These categories are then used to organize the set of codes and interpret the findings from the interviews (Hsieh and Shannon 2005, pp. 1278–1279).

The qualitative content analysis is carried out for all 38 interviews in each seaport (interview partner are listed in the Annex). These interviews were analysed based on specific codes related to the aspects mentioned in the interview guide. Microsoft Excel was used to aggregate several interviews with help of special separation to enhance the level of analysis.

The aggregation is based on the main topics developed in the interview guide such as the methods used for the risk identification, analysis and evaluation as well as the way and process of handling the risks. Other set of interviews were coded directly in the interview guide. The interviews, at first, are analysed and documented in each seaport. Afterwards, similarities and differences among the seaports with regards to the activities related to risk management are elaborated.

This report extensively analyses and summarises the status of risk management in BSR major seaports based on 38 interviews. These interviews have been carried out by the following HAZARD partners:

1. Estonia—Viimsi Municipality
2. Finland—University of Turku
3. Germany—Hamburg University of Technology
4. Lithuania—Vilnius Gediminas Technical University

In Estonia, six interviews were conducted at the port of Tallinn in Estonia. Additionally, nine interviews were gathered from nine different ports in Finland. In Germany, specifically at the port of Hamburg, 15 interviews were carried out with different categories of stakeholders such as authorities and terminal operators. In Lithuania, eight interviews were conducted with different stakeholders at the port coming from different backgrounds and hold different responsibilities.

A frequency analysis is carried out to analyse and summarise the results in each covered aspect. This includes, for instance, counting the number of times a method was mentioned by the interview partners in the corresponding seaport. A graphical representation is then used to extract the core risks, requirements and methods covered by the interviewed stakeholders.

For the classification of different categories, both assumed and inferred approach were used. Assumed categories are based on the initial literature review, whereas inferred categories emerge from the empirical interview data. Defining a unit of analysis is essential to enable adequate judgments about what to be counted and analysed. Phrases, sentences, paragraphs, subjects or themes can be used as a unit of analysis. In this study, the interviewed stakeholder as a subject is used as a unit of analysis in order to identify and analyse the risk types, requirements, and methods at seaports (Saeed and Kersten 2017).



## 5 SCOPE OF COVERED RISKS AND REQUIREMENTS FOR RISK MANAGEMENT

The results are based on the analysis of interviews carried out in Germany, Finland, Estonia and Lithuania. The analysis is subdivided according to the corresponding port. The findings then are compared at the end of each subsection. This section starts with reporting the identified risks using the experts experience (Chapter 5.1). Thereafter, the regulations and requirements of risk management for the examined seaports are presented (Chapter 5.2).

### 5.1 The identified Risks in the studied Seaports

This subsection gives an overview about the internal and external risks covered in the corresponding seaport along with their main categories, such as operational, environmental and safety risks.

#### 5.1.1 Port of Hamburg

Due to different parties using the port area for different purposes, there are many potential risks that can lead to interruptions in the service provision process of the individual actors. Depending on the occurrence of the damage, the actors act differently and are involved in different processes. Most of the interviewed partner only consider risks which influence the internal environment occurring from the organization and the natural disasters such as flood or storm.

According to the interviewed stakeholders, the risk management process is focused on internal risks within the premises of the organization such as the handling of dangerous foods within the container terminal. External risks are those who are not linked with daily operational and organizational activities of an organization. Examples include natural disasters, political and legislative risks. For several stakeholders, the priority is placed on internal risks, then external risks are considered utilizing a cooperative approach with partners within the seaport.

Several stakeholders categorize the risks based on the type of threat such as technical failure, human error or environmental influences. These categories represent the scope of the covered risks and are evaluated based on their likelihood and consequence.

“We consider only the risks that might occur at our premises” (#POH3).

“On the risk side, we have five major threats: Technical failure, human error, environmental influences and organizational negligence” (#POH11).

After conducting the interviews in the port of Hamburg, the risk sources in **Table 2** are further differentiated with collected examples. The most frequent risk source, which is mentioned in most of the interviews, is the risk source associated with dangerous goods in case of the explosion of hazardous gases and chemicals.

**Table 2:** *Extracted example for risk sources at the port of Hamburg (own illustration)*

Risk source	Example
Natural disasters	Hydrological and metrological risks such as flood and hurricanes
Fire on passenger ships	Fire as a result of the explosion of dangerous goods e. g. flammable materials
Explosion of gas and chemicals	Dangerous goods are the main source of hazards. Their risk are associated with fire and explosions with an associated impact on health, safety and the environment. Labelling of containers play an important role to analyse the substances inside them. E.g. Tank container with combustible substances.
Cyber attack	Denial of service attacks through massive requests to overload the line. Lost containers through well-organized cyber-crime by installing WLAN techniques in multiple power strips or by hacking into the computer controlling shipping containers.
IT risks	Systems and software failures. Examples include the failure of a hard drive or a software failure
Leakages	Oil spills and leakages of dangerous materials
Collisions	Collision of a cargo ship with a concrete quay wall

“The careful consideration of containers with flammable substances. It is prohibited to place any ignition sources near such containers. Furthermore, specific regulations must be followed concerning the quantity that can stored in containers and whether they can be stored” (#POH3).

“Cotton, as an example, is a dangerous good. In case of fire, cotton continues to burn even if it was put under water since air and oxygen are present in the cotton fibres, and the fire always gets the oxygen again and continues to burn” (#POH4).

“According to the transportation law and the framework of approval, we know which dangerous goods we are allowed to transship. We transship all of them, except class 62, which are contagious and infectious substances” (#POH6).

“Typical risks that can occur are situations associated with dangerous hazardous substances which are available in large quantities” (#POH12).

### 5.1.2 Ports of Finland

The interviewed Finnish port firms do have a wide field of covered risks. But the risks are different from firm to firm and are also related to the branch and working area the firms are acting in.

“The term risk is a vast concept encompassing multiple types of risks” (#POF1).

“Starting point for every action and task is to identify the risks involved and how to prevent those risks from actualizing or mitigating their impact to as low as possible” (#POF5).

“Port has a risk management plan, including extensive sources of risks” (#POF8).

**Table 3:** *Type of covered risks (based on Parra et al. (2018))*

Type of source	Source category	Examples of sources
<b>Natural</b>	Hydrological	Flooding risk
	Metrological	Extreme weather conditions (e.g. snow, ice, wind)
<b>Man-Made</b>	Operational	Railroad-related risks, Loading/Unloading activities, Movement of containers, usage of vehicles/carriers/cranes, Handling of hazardous goods, Large cargo volumes
	Safety	IT/Data/cyber-related activities, Occupational Health and Safety (OHS), Leakage of stored and transported materials
	Technical	Electrical blackout, Failure of IT systems
	Organizational	Unskilled personnel (lack of know-how, training), Unclear definition of risk management processes and strategies, Weak management support/guidelines
	Environmental	Chemical/Oil spills, Transportation of hazardous goods, Nearby facilities, Dust/noise level, Limited expansion possibilities (zoning risks)
	Political/Legislative	Political decisions, Law making
	Economic/Commercial Risks	Contract negotiations and reliability, Cash flow valuation
	Competitive Risks	Price and quality competition

The risks under consideration include, for example, those arising in the context of maritime transport and the work associated with it. Risk management is also often divided into two categories, which consider security aspects that take into account the occupational safety of personnel as well as those that refer to international security regulations such as the

International Ship and Port Facility Security Code (ISPS-Code). **Table 3** presents examples of risks based on the associated hazard source (Parra et al. 2018).

The interview study identified the three risk categories Safety, Technical and Operational for Finnish ports as three exemplary categories that are very relevant for firms in Finnish ports.

“The largest emphasis is on the risks related to handling of dangerous goods” (#POF1).

“[There is a] rising importance of people-related security risks” (#POF2).

“Cyber security is of increasing importance” (#POF3).

“Risk of an electrical blackout is substantial, and actualization would have severe consequences” (#POF4).

### 5.1.3 Port of Klaipėda

Examples for internal and external risks from the port of Klaipėda are presented in **Table 4**. The internal risks comprise risks associated with internal processes, human errors and IT malfunctions. External risks that are not influenced by the firm itself consists of possible accidents and car crashes, natural disasters, theft or intrusion into vehicles.

“Internal and external risks are carefully considered. Examples include risks associated with human errors, processes, accidents and theft” (#POK1).

**Table 4:** *Extracted example for risks at the port of Klaipėda (own illustration)*

Internal risks	External risks
Human errors—misconduct; incorrect distribution of functions; staff turnover.	Accidents and car crashes—possible fatalities, injuries, damage and loss of cargo.
Processes—possible incidents in loading works—cargo fastening, lifting, falling, dispersion of the substances.	Theft. Intrusion into vehicles.
Documentation and forwarding errors	Natural disasters
IT software or system malfunction causing disruption or the loss of information such as the info on cargo.	Economic-financial problems - bankruptcy, customer and carrier reliability
Carriers do not comply with the rules on the ferry	Competition, competitive battle with other firms
Dangerous goods in cargo handling	Political turmoil/war at loading ports
Compliance with the regulatory legislation	Ship failures

#### 5.1.4 Port of Tallinn

Similar risks were mentioned by the interviewed stakeholders at the port of Tallinn. This comprises natural disasters, IT-risks, and terrorism. **Table 5** shows extracted examples for internal and external risks.

**Table 5:** *Extracted example for risks at the port of Tallinn (own illustration)*

Internal risks	External risks
Human errors	Terrorism
IT failures	Natural disasters
Technical failures	Climatic risk
Energy supply disruptions	Business risks

## 5.2 Risk Management Requirements

This subsection elaborates on the different local, regional and international requirements mentioned by the interviewed stakeholders with the regards to the activities related to risk management.

### 5.2.1 Port of Hamburg

Certifications and requirements from standards and local regulations constitute an important base for many stakeholders in the implementation of their risk management procedures. Several stakeholders are certified by the ISO 9001. Some regulations require stakeholders to conduct a risk management process in facility safety. There are also some requirements from certain laws such as the Disaster Control Law<sup>1</sup>, The Law for the Protection of Public Order and Security<sup>2</sup> and Federal Emission Protection law<sup>3</sup>. Many stakeholders stressed the importance of regulations and legal requirements in conducting the risk management process. These regulations are continuously updated, such as the regulations from the authority of interior and sport.

The terminal operator has to fulfil the port security requirements specified by the ISPS Code which are controlled by the Designated Authority. Shipping firms have to perform risk assessments required from the International Maritime Organization (IMO) and have to adhere to the ISPS-code. Furthermore, the authorities in Hamburg have to prepare an EU report at least every three years.

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<sup>1</sup> Hamburgisches Katastrophenschutzgesetz (HmbKatSG - 16. Januar 1978)

<sup>2</sup> Gesetz zum Schutz der öffentlichen Sicherheit und Ordnung (SOG - 14. March 1966)

<sup>3</sup> Bundesimmissionsschutzgesetz (BImSchG - 15. March 1974)

“Port security is an area where we need to be properly certified. There is an annual audit by a designed authority to check whether our regulations are sufficient for the requirements of port security.” (#POH3)

The law for the protection of public order and security (Gesetz zum Schutz der öffentlichen Sicherheit und Ordnung - SOG) is an important law that comprises security regulations, security measures and general requirements. This law is especially used by the police, waterways police and the port authority in order to define the procedure and responsibilities.

“It is important to know that you can also do a lot about SOG. For example, the police are allowed to tell the waterways police on their own authority during the initial assessment that we are now regulating this in a certain way” (#POF14).

Any stakeholder who handles or controls dangerous goods should follow strict requirements mentioned in different regulations such as: Dangerous Goods Transport Regulations (RID); European Convention on the International Carriage of Dangerous Goods by Road (ADR); International Maritime Code for Dangerous Goods (IMDG Code).

“The risk management process of our firm was certified in 2008 by the customs as an authorization and economic partner” (#POF2).

“We have the requirement of the International Maritime Organization (IMO) for the implementation of the International Safety Management (ISM) code. All additional certification that are related to shipping are provided on a voluntary basis” (#POF4).

### **5.2.2 Ports of Finland**

Regarding the external requirements related to risk management that the organizations face, the nine Finnish port firms provide information on legislative requirements and voluntary requirements. With regard to legislative requirements, the interview evaluation considers the authorities that are setting the requirements, the requirements' contents and their quality. Furthermore, possible resulting consequences of the requirements are mentioned as well as voluntary requirements that the ports face.

In general, the legislative requirements in Finnish port firms are set primarily by the Finnish Transport Safety Agency (Trafí), the Regional State Administrative Agency (AVI), the Finnish Safety and Chemicals Agency (Tukes), the Centre for Economic Development, Transport and the Environment (ELY), the Occupational Health and Safety Administration (Työterveyspiiri), Finnish Transport Agency (Liikennevirasto), further emergency services as well as local environmental agencies.

The requirements set by these instances include, for example, requirements for handling and transporting hazardous goods, environmental guidelines as for example oil spill laws, guidelines considering the private railroads in the harbour area and the hinterland connections or requirements relating to the ISPS Code. In addition, specifications for port personnel such as the need for various certificates, trainings and licenses or the consideration of occupational health and safety (OHS) law are also partly mentioned.

Furthermore, in some cities, city's own guidelines and audits with instructions regarding the general risk management of different risks are set by the municipal organization and valid for the ports. Another peculiarity is represented by a port related to a private actor. In this case, the requirements are defined by the firm to which the port belongs. In general, the legislative requirements relate to safety and risk management systems with the aim of creating risk handling as efficient as possible. Consequences of the increasing legislative requirements include, for example, an increased need for personnel, as well as an increase in procurement services and the need for systematic development work.

“City's own guidelines have instructions/obligations concerning risks and their managing and internal monitoring” (#POF1).

“Finnish Safety and Chemicals Agency (Tukes) has comprehensive requirements and instructions concerning i.a. the transport & handling of dangerous goods and handling of ship's biological waste” (#POF1).

“Increased requirements have led to hiring of additional personnel, more procurement services and systematic development work: Additional standardization in port's practices, additional training” (#POF2).

Considering the voluntary requirements, the interviews show that in general several ISO standards take an important role for management of the Finnish ports. Especially, the standards for risk management (ISO 31000), quality management (ISO 9001) and environmental management (ISO 14001) are set as voluntary requirements by the ports as well as the Occupational Health and Safety Assessment Series (OHSAS 18001). Even if some ports are not certificated, they use the ISO standards as an orientation for they own different management approaches and systems. Besides this, some ports are involved in several programmes (e.g. water quality monitoring programme) as well as into projects with several voluntary organizations.

“Albeit no certified, port operates according to the principles of ISO 31000 (Risk management system)” (#POF4).

“[Concerning] Voluntary requirements the port doesn't have any ISO certificates, [but] takes part in a water quality monitoring programme” (#POF7).

“Port is not interested in obtaining ISO 14001 (environment) or OHSAS 18001 certificates, as they already follow their guidelines and principles and due to the small organization size, it would take too much human resources and would cost” (#POF8).

### 5.2.3 Port of Klaipėda

For the port of Klaipėda, the requirements cover different regulations such as labour safety requirements, internal rules governing firm’s work or national laws. This includes as well environment protection and operational safety requirements. A stakeholder indicated that his firm is planning to assess its internal risks according to the ISO 31000 standard and its associated framework as well as the risk management process.

“We have the requirements with regards to labour safety; internal rules governing firm’s work as well as the national law” (#POK1).

“ Management of certain types of risks is regulated by the law of the Republic of Lithuania and the normative legal acts of the international institutions: Physical Safety Requirements, ISPS Code Requirements, Information Security Requirements, Data Protection requirements and so on” (#POK4).

An interview partner mentioned specific rules governing safe shipping administration as well as fire protection rules. Different authorities such as the port and environment authorities initiate these requirements. Another stakeholder mentioned that they are obliged to follow ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2017.

“We follow the following requirements: Directions and requirements of Port authority; rules and requirements of labour inspection; Fire protection rules. Labour safety requirements; environmental requirements; rules governing safe shipping administration” (POK#3).

### 5.2.4 Port of Tallinn

Different national requirements and EU laws as well as standards are followed by different stakeholders at the port of Tallinn. Several stakeholders are required to have a risk management process because of national requirements such as the Estonian Chemical Act and ISO 31000. A stakeholder mentioned its corporate commitment towards implementing a Health, Safety and Environment for the environmental protection and safety at work.

“Our harbours are important objects in the state and have special needs and security requirements” (POT#5).

“We are obliged to perform risk management because of Estonian Chemical Act, ISO 3100. Also if we want to increase our handling capacities, local government and Environmental



Board ask for risk analysis of planned capacities as an appendix of Environmental Impact Assessment” (POT#1).

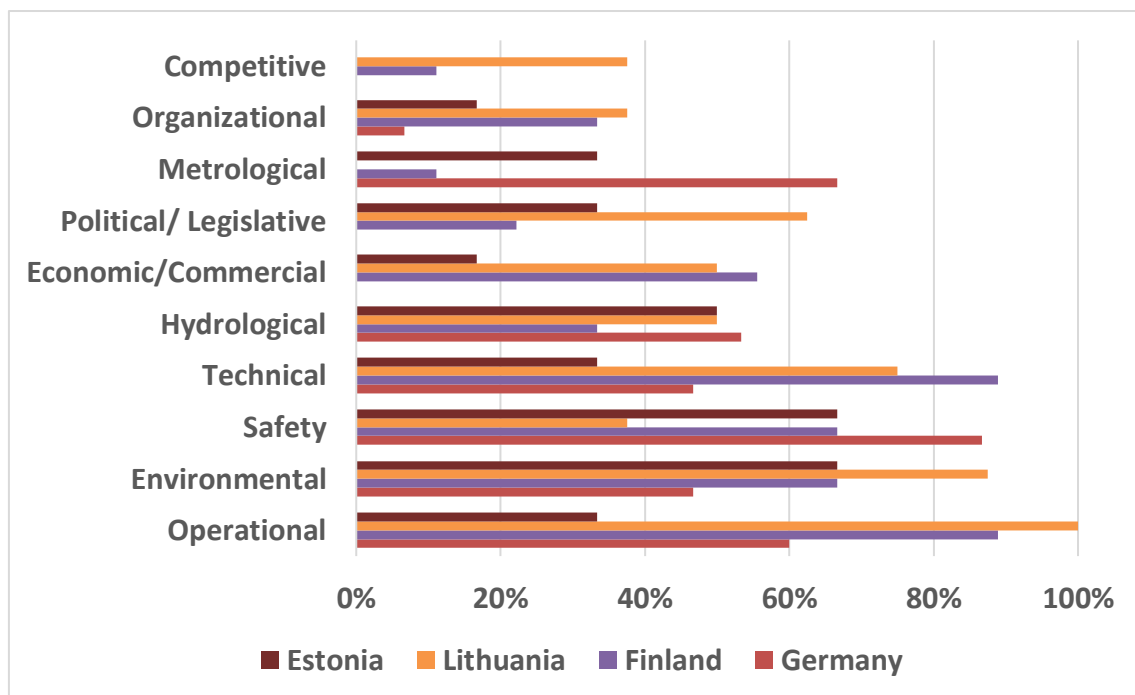
A stakeholder articulated the important consideration of political risks for economic purposes as well as the role of external consultants in providing a set of customized requirements for the risk management process.

### 5.3 Cross-port Comparison

In this subsection, the covered risks and the requirements for risk management in the interviewed seaports are compared and evaluated.

#### 5.3.1 Scope and Type of Covered Risks in the interviewed seaports

A bar chart of grouped columns (see **Figure 7**) is used to visually support the analysis of the different risk categories considered and evaluated by the port firms.



**Figure 7:** Comparison of scope and type of covered risks as percentage of interviewee opinions by country (own illustration)

It should be taken into account that the number of participating port firms differs from city to city. As mentioned earlier in this report, the study in this paper involves 15 Hamburg port firms (Germany), nine port firms (Finland), six port firms from Tallinn (Estonia) and eight port firms from Klaipėda (Lithuania). Therefore, the frequency analysis per unit (interviewed stakeholder) is applied here in order to adequately analyse and extract the core risks mentioned by the

interview partners in the four countries. Therefore, the evaluations always have to be seen in relation to the different number of participating firms in each country. . More detailed information regarding the different risk categories in the different port firms can be found in the previous sub-chapters.

It can be seen that safety, operational risks as well as technical risks are of great relevance for the Port of Hamburg. In addition, environmental, metrological and hydrological risks play a special role for the port firms based in the Port of Hamburg. One possible reason for the strong focus on both operational and hydrological risks could be represented by the fact that the Port of Hamburg is fundamentally exposed to flood risks due to its location. In addition, the Port of Hamburg is Germany's largest seaport and the world's 17th largest container port. Accordingly, the firms in the port are generally exposed to a large number of different operational and risks, especially concerning the handling of dangerous goods.

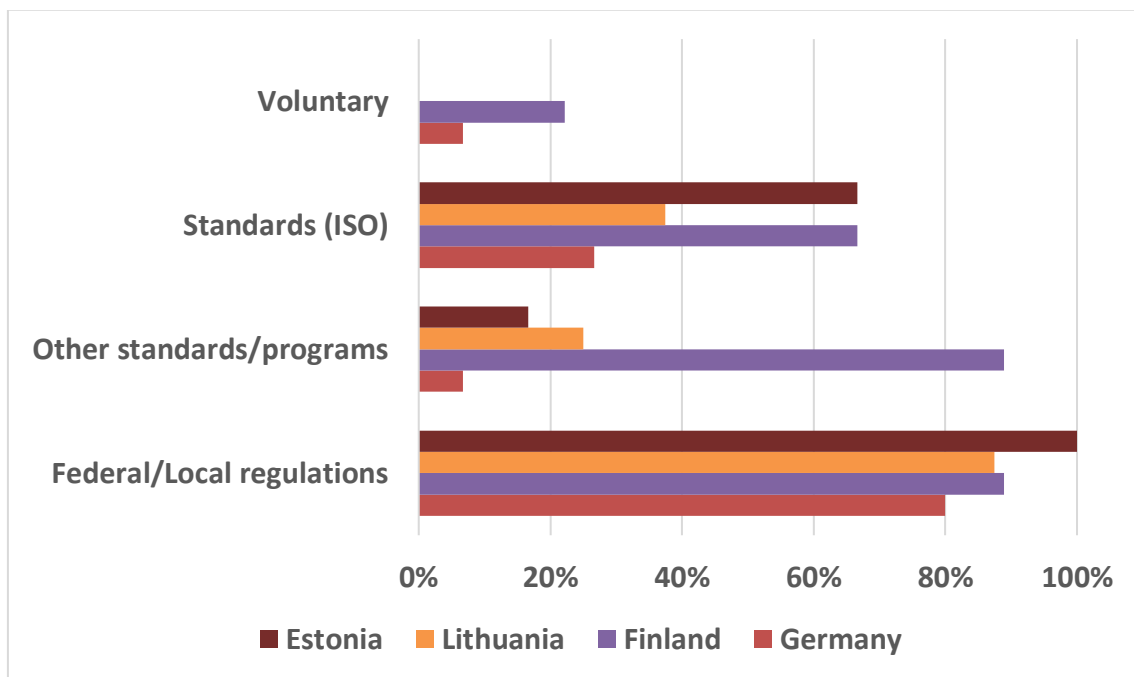
The interviewed stakeholders in the Finnish ports primarily mentioned risks in the categories operational, safety, technical, environmental, and economic/commercial risks. It can be seen, that the range of risk categories considered by Finnish port firms is very broad and that risks from many different categories are taken into account in their risk management.

The risk categories taken up and considered by the port firms in Klaipėda as part of their risk management are also very different. The analysis also focuses on operational risks but also on technical and environmental risks. In addition, the consideration of political/legislative risks is more pronounced than that of other port firms.

The figure also shows that the port firms in Tallinn focus primarily on the categories' safety, hydrological and environmental in their risk assessment. As in the case of Hamburg, the main motives for this focus could be the location of the port and the importance of the port for Tallinn's economic situation.

### 5.3.2 Requirements and Regulations

A bar chart of grouped columns (see **Figure 8**) is used to visually support the comparison of the different requirements set by different instances or standards and to be followed by the port firms. More detailed information concerning the requirements of the different port firms can be found in the previous sub-chapters.



**Figure 8:** Comparison of requirements as percentage of interviewee opinions by country (own illustration)

The figure clearly shows, that the port firms in the various cities mainly follow federal/local regulations. Particularly the firms in Turku stand out in this regard. In addition to the federal/local regulations, the firms have pursued further standards and programmes with sets of rules within the firms in order to enable the most comprehensive risk management possible.

For instance, the ISPS Code from the IMO. In comparison to the port firms in the other cities, especially the firms in the Finnish port of Turku, also place an emphasis on the pursuit of such further standards in this point of view. In addition to the other standards and programmes, some firms also take ISO guidelines into account in their risk management. This ensures that risks and associated situations are dealt with in an internationally recognized, certified manner. In addition to the three options mentioned above, federal/local regulations, ISO standards or other standards/programmes such as ISPS, some firms also pursue voluntary requirements (e.g. participation in various programmes or studies).

The aforementioned local, federal and international requirements influence the risk management process. The different methods and approaches for each phase of the process are elaborated in the next sub-section.

## 6 RISK MANAGEMENT PROCESS IN THE STUDIED SEAPORTS

Based on the conducted interviews, there is no defined process for risk management that is followed by firms at the seaports which opens up the possibility to define a standard process for risk management. The process of risk management in the course of this report is based on ISO 31000: Risk management—principles and guidelines.

The risk assessment phase—according to the standard—comprises the identification, analysis and evaluation of risks. The risk phase relies on the results of the risk assessment phase. Risk monitoring follows to check and improve the implemented measures and overall process. The phases of this process was elaborated in sub-section 3.2.

### 6.1 General Aspects

This subsection deals with the general aspects related to the risk management process in the studies seaports. The overall process, definitions, roles and responsibilities for risk management are elaborated.

#### 6.1.1 Port of Hamburg

There are no defined risk management processes that are followed by all stakeholders at the port of Hamburg. Each firm defines its own internal processes based on the risks that are associated with their daily operational activities. Most of the firms—belonging to the same category (e.g. terminal operators)—follow the aforementioned defined legislation, and therefore, have strict requirements to follow.

The risk management process of several interviewed stakeholders serves to identify and assess risks. The structure of such process differs from each firm. One of the interviewed stakeholders mentioned the interaction between Controlling, Internal Audit and the Executive Board as an important aspect within the firm risk management system.

Different definitions of risk management were extracted from the interviews. One of the interviewee defined risk management as a process that focuses on describing, analysis, assessing of a situation with the corresponding derived measures. Another interviewee differentiates between emergency and risk management based on the impact on external areas. Risk management is related to incidents that affect neighbourhoods and external environment whereas emergency management is the handling of emergencies such as natural disasters.

*"Our operational risk management is based in the nautical headquarters. That has five navigators who are all authorized to make decisions. Contrary to other central stations, e.g. at the federation. There is a watch leader and only that is authorized to decide. The others are working for him. We have five people who are all authorized to make decisions for themselves*

*and constantly carry out a risk assessment for all decisions they make. But also always situation-bound. We also have instructions for each situation and scenario” (#POH14).*

### 6.1.2 Ports of Finland

The interviewed Finnish port firms have a broad definition of the term risk management. In general, based on the statements of several interviewees, it is obvious, that the topic of risk management is becoming increasingly important and that efforts are being made to continuously improve risk management processes. Particularly after the events of 11 September 2001, security precautions were tightened in a large number of Finnish ports. Firms are increasingly recognizing that different risks can influence each other and domino effects can be caused.

In addition, the various actors involved in the processes have a considerable influence on the design of risk management. The processes within the scope of risk handling are to be systematised and thus safety and quality aspects are to be integrated sustainably into the firm processes. The processes are often subdivided into sub-processes, so that their handling and execution can be carried out more clearly and efficiently. The aim is to create a holistic and systematic approach to risk management. In addition, principles such as lean management (reduction or elimination of waste and slack) and kaizen (constant improvement) are applied in the firms surveyed in Finnish ports.

*„Constant improvement in the field of risk management“ (#POF2).*

*„Risk management is continuously becoming more important“ (#POF2).*

*“Risk management is part of everyday life” (#POF3).*

*“Risk management is an essential part of operations” (#POF6).*

*“Important in risk management is who is in charge of that and which procedures are the most effective” (#POF7).*

The Finnish firms interviewed differ greatly in terms of responsibilities within the risk management process. While in some firms the responsibilities of the process are assigned to specific individuals and their representatives, others have groups who are involved in the risk management process. Other organizations subdivide the entire risk management process into individual sub-processes and define responsible process owners who take over further coordination. Examples of process subdivisions include control processes, core processes or supporting processes.

*“All personnel involved report to the managing director and are not alone responsible ultimately, but the whole organization takes part in risk management” (#POF1).*

*“Each process has its own owner, but it doesn’t mean that the risk management is solely this owner’s responsibility and task” (#POF2).*

*“Every single person part of the port organization is involved in risk management” (#POF3).*

*“[The] risk group consists of couple of individuals, organizing risk mappings for different units/divisions [that are] responsible for the summaries of the key risks going to the management group” (#POF4).*

*“Port manager has the role of an operational controller” (#POF5).*

The following **Table 6** provides an overview of the roles involved in the risk management process as well as some exemplary tasks of their responsibility spectrum.

It can be seen, that for example the Safety & Security Director does have the responsibility to state what has to be monitored and observed in terms of the risk management process and related activities. Whereas, on the other hand, also the Marketing Director can be involved in the risk management process in some of the organisations.

The Marketing Director is in charge of communication and marketing since managing director’s responsibilities also include marketing and technical matters and therefore administrative risk management represents also a relevant part within the risk management process.

Besides the different roles listed above, also general groups are involved into the risk management process. An overview of several exemplary roles can be found in the table below (see **Table 7**).

**Table 6:** *Involved Groups (own illustration)*

Involved Groups	Tasks
Management Group	Responsibility for port organisation and management of risk management process
Port Staff	Everyone is involved in the risk management process and responsible to take care; “risk management is everyone’s concern”
Risk Panel	Organisation of risk mapping for different units/divisions and summarisation of key risks

**Table 7:** *Involved single responsibility roles (own illustration)*

<b>Role</b>	<b>Tasks</b>
Safety & Security Director	Determination, what has to be monitored/observed
Development Director	Responsibility for ISO systems, the systems' maintenance, environmental matters
Financial Administration Director/ Chief Financial Officer	Supervision of risk management process under financial and economic aspects
Maintenance Manager	Responsibility for OHS aspects
Managing Director	Overview of risk processes (receives reports from personnel involved into risk process); Responsibility for administrative risk management (in terms of marketing matters)
Port Security Officer	Process Owner; Responsibility for production, safety & security and data administration
Technical Manager/Director	Process Owner; Responsibility for railroad
Readiness/Preparedness Manager	Process Owner; Also responsibility for occupational health and safety aspects
Development Engineer/Manager	Process Owner; Responsibility for railroad traffic; Supervision of crane operators
OHS Manager	Responsibility for occupational health and safety
Quality Manager	Responsibility for quality aspects
Environmental Manager	Responsibility for environmental aspects
CEO	General overview of risk management process; in cases: last instance considering taking decisions
Harbour Manager/Master	Role of operational controller
Railroad Maintenance Manager	Responsibility for railroad and hinterland connection
Marketing Director	Responsibility for communication and marketing; Administrative Risk Management (considering marketing)
Commercial Director	Responsibility for risk management in commercial operations
Director of Traffic Operations	Responsibility for traffic-related and environmental risk management

### 6.1.3 Port of Klaipėda

The definition of risk management based on the stakeholders interviewed in the port of Klaipėda comprises aspects related to risk factors as well as the implementation of preventive and reactive measures to mitigate the identified risks. Several stakeholders have limited scope in their definition since they only focus on the measures and the risk handling process.

*“Risk management is the systematic identification of risk factors and preventive activities with the implementation of measures to limit the effect of different risks” (#POK1).*

*“Risk management is a range of measures that reduce the possible damage with regards to an extreme situation” (#POK2).*

The involvement of internal partners in the risk management process in the port of Klaipėda include specialists and/or expert employees such as head of department who has long experience in the different operations and associated risks in an organisation, or a specialist in labour safety.

### 6.1.4 Port of Tallinn

Similarly, the aspects prevention and mitigation were frequently mentioned by the interviewees at the port of Tallinn. An interviewed stakeholder elaborated the importance of risk analysis with its associated methods which help in deriving a risk class for the handling phase.

*“Risk management is doing everything economically possible to prevent and mitigate possible risks” (#POT1).*

*“Risk management is dealing with prevention and mitigating possible risks raising from our activities” (#POT2).*

A terminal operator mentioned the documentation of risk events in a risk register by the operational staff. Another interview indicated the importance of data collection and experts' opinions to carry out an optimal risk management process.

## 6.2 Risk identification

This subsection deals with the identification phase of the risk assessment process. The continuous identification of possible hazard sources along with their risks is essential to develop the required measures that can prevent their likelihood and consequence.



### 6.2.1 Port of Hamburg

Individual identification and checklists are normally used to identify the possible risks that might occur based on certain criteria such as the extent of damage. Individual identification is used for heavy lift cargo or project cargo since every piece is different from the previous one. Remote detecting devices can be used to detect dangerous goods. The Hazard diamond is normally used to identify the risk associated with hazardous materials and dangerous goods.

**Table 8:** *Storage classes of materials (Own illustration based on Schütz 2006)*

Storage classes	Description
3A	Ignitable flammable materials
3B	Flammable liquids
6.1A	Flammable toxic substances
6.1B	Not combustible toxic substances
8A	Flammable corrosive substances
8B	Non-combustible corrosive substances
10	Flammable liquids (if not 3A or 3B)
11	Combustible solids
12	Non-flammable liquids
13	Non-combustible solids

For the identification of dangerous goods, a standard list of material categories from the Association of Chemical Industry (VCI) that indicates the flammability and toxicity of a certain material in a specific category is used by one of the interviewed firms to identify the category of dangerous goods in a container as shown in **Table 8**.

For the identification of leakages, several inspection rounds within and outside the operating hours are planned. Samples must be taken und analysed before pumping a liquid from the storage sump into the rainwater sewer if the leakages could not be identified visually or olfactorily. The installation of a gas detection system is necessary in case of the storage of flammable, toxic or corrosive gases as well as hazardous liquids with high vapour pressures.

"We have a risk management process in which we actually categorise the existing risks and say that these are the top 5" (#POH13).

“Checklists are often used. Most of the time in co-operation with the security specialist.  
Exactly that one votes: Watch out, that and that is the problem” (#POH7).

For fire brigades and rescue services, in case of fire and explosions, the reactive process normally start from the initiating point such as the captain on a ship where he communicates with the nautical headquarter. Special radio devices are used for the communication process. The fire brigades then arrive to the situation to assess the identified risk.

“That's exactly where we have our so-called alarm types. These are broken down by how big the extent of damage is and what is there and whether persons are involved” (#POH12).

### **6.2.2 Ports of Finland**

The approach of how different risks are identified and handled also differs greatly between the Finnish port firms. Within the scope of the interview study it became apparent that a frequently used method is SWOT analysis, which serves the identification of strengths, weaknesses, opportunities and threats of organisations.

“SWOT analysis, each year is defined, what are the key areas of analysis. This practice comes from ISO 9001 and 14001” (#POF1).

“SWOT analysis [is] widely used, especially when making economical decisions” (#POF9).

Another common method is the creation and use of checklists, most of which are in a Microsoft Excel format. The checklists are mainly used for standard processes relating to shipping traffic and the handling of ships.

“Checklists for vessels. Standard procedures when a vessel arrives at the port. Over 50 instructions for the port personnel” (#POF5).

“Checklist not used widely, but in certain areas” (#POF9).

In addition to checklists, risk identification is also carried out via brainstorming. Various working groups in different areas conduct brainstorming in order to exchange information, update data and derive new approaches for identifying and dealing with risks. In addition, some subcontractors of Finnish port firms are involved in the brainstorming processes. However, subcontractors are also included in the risk identification of some firms through the allocation of so-called subcontractor indexes:

“Subcontractor indexes: Used to track for example, construction firms’ performance. If a firm can fulfil a goal concerning OHS or environmental instructions (no occupational accidents for example), firm’s workers are awarded with a financial bonus (for example 50,000€, if

everything goes according to the plan. If a firm fails to obey rules—a construction worker is caught without a helmet in a helmet-required area—a fine of 3,000€ will ensue” (#POF6)

“On a strategic level, [there is] brainstorming with subcontractors as well” (#POF7).

“Brainstorming is most widely used. Grants the best results” (#POF4).

“Brainstorming [is] widest coverage possible by discussion with different groups. [The] management and workers can identify most of the risks, but not all. Especially used for basic risk analysis.” (#POF6).

“Brainstorming [used for] updating the risk categorisation, impacts and probabilities recently” (#POF9)

Other firms use risk matrices to classify emerging risks:

“Risk matrix [as a] quantified scale, the product of risk’s severity and risk’s probability. Red, orange, yellow or green status determines the follow-up procedures. Also UN’s Sustainable Development Goals (SDGs) have given influence to the decision-making when thinking of the business environment. Considerations also for the firms, which operate in the port area” (#POF3).

“Action error analysis: FOUND software includes a risk matrix” (#POF5).

Furthermore, regular agreements and feedback between the parties involved should not be neglected in order to develop and integrate sustainable risk management. For this reason, many of the Finnish firms surveyed conduct continuous audits. The audits are either internal or external. Internal audits are used, for example, to check the effectiveness of processes. External audits, on the other hand, can be conducted with external consultants. In addition, some firms conduct interviews and safety walks with external consultants within the firms in order to obtain further information and to continue working with them.

“Internal audits: For example, checking the effectiveness of processes” (#POF1).

“External consultants conducted interviews and safety walks in the port area. Used score cards based on quantitative and qualitative measures” (#POF1).

“External audits: Risk consulting from a specialised firm” (#POF7).

Regular meetings (e.g. weekly or monthly) serve to discuss the concerns of different parties. These meetings can take place at management level or at departmental/location level to ensure that the relevant parties are appropriately involved in discussions and decision-making process.

"Matters are discussed in weekly and monthly meetings. Monthly meeting is for the HSEQ management group encompassing managers from all of the parent firm's ports (in total 7 ports)" (#POF5).

Safety walks serve to identify risks in processes and minimise their occurrence. Due to the fact that it can happen that the workers are not fully aware of the risks they are exposed to on a daily basis, the safety walks are also intended to increase the risk awareness of the employees.

"Safety walks: Importance of reporting the risks encountered in executive work is acknowledged. However, blue-collar workers might occasionally become blind to their own risk-prone behaviour and an external observer (port staff member) could be able to spot such behaviour" (#POF6).

"Twice a year, an internal working group assess the port for risks. Safety walk-natured. Produces reports, which are gone through in large meetings" (#POF8).

### **6.2.3 Port of Klaipėda**

Brainstorming and experienced staff meeting are used to identify possible threats and their associated risks in the port of Klaipėda. One stakeholder mentioned the usage of SWOT analysis for the risk identification process.

One of the interviewed stakeholder revealed that risk management is an inseparable part of the daily activities. According to the interviewee, the risks are identified in the activities' planning process. PESTEL analysis is initially carried out to identify external factors, porter's value chain to identify the internal factors and SWOT to analyse the situation of the firm with its competitive environment.

"For the identification phase, brainstorming and staff meetings are used to analyse the possible threats and consequences in order to create suitable measures and models" (#POK1).

Emerging risks are managed based on two steps: firstly, the identification process is carried out in the department; afterwards, special measures and resources are identified and assigned respectively in order to minimise the levels of risk to a tolerable acceptable level. Authorities and external resources are utilised if the internal resources are not sufficient.

### **6.2.4 Port of Tallinn**

Several stakeholders at the port of Tallinn work closely with consulting firms that aid them in using methods for identifying risks that could occur at seaports. Such methods include brainstorming and SWOT analysis.

“Brainstorming is the main method for the identification of risks. SWOT is also used for risk identification of issues that are internal and external to the organisation” (#POT6).

Legislation also serves a basis for the risk identification for several stakeholders. The role of consulting firms also appears critical for the risk identification methods that are not covered by legislation.

### 6.3 Risk analysis and evaluation

This subsection deals with the analysis and evaluation phases of the risk assessment process. Using different analysis and evaluation methods, each risk can be categorised into a certain critical level based on its probability of occurrence and severity.

#### 6.3.1 Port of Hamburg

According to the interview partners, there are no unified methods for risk analysis and evaluation that are followed by stakeholders at the port of Hamburg. One of the interviewed stakeholders mentioned the usage of the FMEA to analyse and evaluate the identified risks.

“We do not really have a classical risk assessment in any area. So the only corner where we have just introduced is a safety report on the handling of dangerous goods. On the contrary, we have now taken FMEA through with us, which provides us with an appropriate assessment for the individual risks” (#POH3).

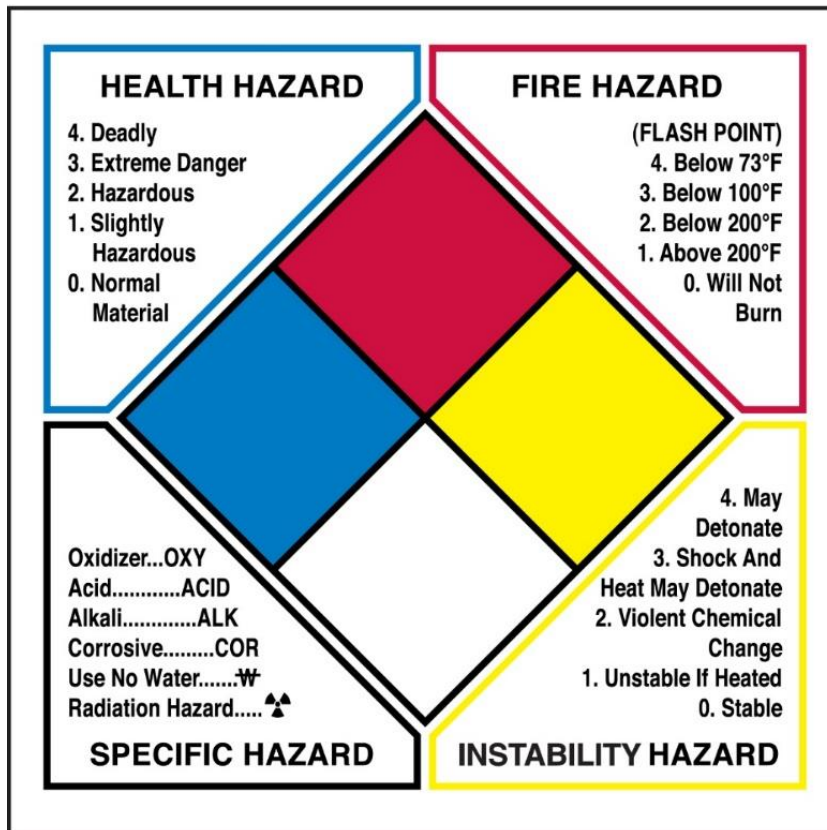
The hazard-based risk assessment is conducted by some of the stakeholders based on teamwork while having the basic requirements in hand in the form of checklists. Exchange of information with external partners during the analysis phase is also crucial to identify the possible consequences. Gas measurement devices are used with predefined associated indicators to assess the impact on health or the environment.

“We usually carry out the hazard assessment in team. We discuss the current issues along with the provision of the basic requirements and all required points. This is normally carried out between two or three teams so that we have an adequate finalised hazard assessment at the end.” (#POH1)

Synergy effects are used with the experience of sailors on board together with experts’ valuation in the form of teamwork. With regards to project cargo or heavy lift cargo, specific risk assessment process is carried out for the individual elements.

The fire brigade and rescue service use the hazard diamond (see **Figure 9**) to identify and analyse the different risks associated with hazards. The hazard diamond or the so-called fire diamond is

defined in the NFPA 704 which is the Standard System for the Identification of the Hazards of Materials for Emergency Response. The four divisions of the diamond are color-coded to represent flammability (red), health hazard (blue), chemical reactivity (yellow) and special hazards (white).



**Figure 9:** Hazard diamond (NFPA 2011)

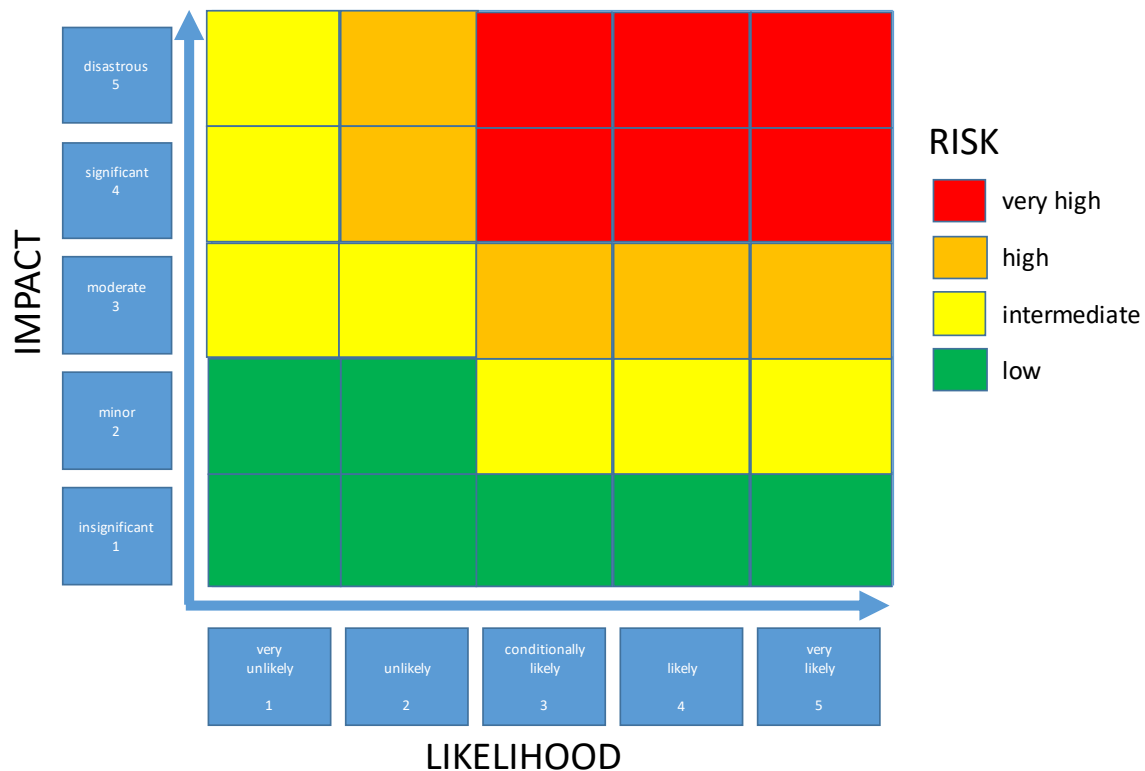
The assessment of risks for another stakeholder is based on an occupational safety system that is continuously monitored and updated based on the actual chemical regulations and labour protection law. The database of occupational safety system in form of a software is updated with each incident along with its corresponding hazard assessment.

Another stakeholder also uses an online hazard assessment developed by employer's liability and insurance association (Berufsgenossenschaft) indicating the frequent use of checklists that are extracted from regulations and requirements.

Measuring technology is essential to predict different scenarios. These measuring devices can be used, especially to predict the occurrence of natural disasters such as flood.

“We have wind gauges with which we can check the wind, for example, if we have blasts that go beyond eight, then we can already take initial measures” (#POH6).

The Federal Office of Civil Protection and Disaster Assistance (BBK) developed a risk matrix for the risk analysis of civil protection based on different kinds of hazards (see **Figure 10**). The matrix corresponds to the international standard ISO 31000. The risk matrix comprises a five-stage classification that is represented by associated analysis steps for the determination of likelihood and impact.



**Figure 10:** Risk matrix developed by BBK (BBK 2010)

Fire brigades also classify the identified incidents according to specific alarm types. These alarms are further classified based on the extent of damage (e. g. number of people affected by the incident). Specific alarm keywords are used to identify the degree of damage (e.g. THY (Technische Hilfeleistung Menschenleben in Gefahr) if a person is in danger where TH demands the need of technical assistance and Y is linked to human risk). Based on the analysis and evaluation of the current incident, specific measures are taken based on the degree of fire. Each alarm level is associated with certain number of resources.

“In case of explosions, we always make a default measurement for radiation (for all events), carry out a radioactive inspection and advice the chief of operations on site” (#POH1).

“Gut feeling is important, and we also have a mobile measurement technology we enable us to assess very common combustion gases. A remote sensing system let us detect distant clouds of hazardous substances” (#POH1).

Several stakeholders also expressed their satisfaction with the current hazard-based risk assessment process especially for dangerous goods. Additionally, there is also a specific risk assessment procedure that is conducted for large ships that requires a special permit to enter the Port of Hamburg.

“The process is perfectly adequate for the pure operative process. There is still room for improvement” (#POH3).

“We also carry out risk assessments together with HPA For the very large ships, i.e. unusually large ships, that require a special permit to enter the Port of Hamburg. Under what conditions can I still bring this large ship safely to Hamburg? E.g. weather, not too much wind etc.” (#POF15).

### 6.3.2 Ports of Finland

Finnish firms use various systems to identify and manage risks. *Microsoft Excel* and the *Port Data System (PDS)* are very frequently used applications. For example, Microsoft Excel is mainly used to collect data for subsequent analysis as well as to create risk matrices. PDS supports risk management. This software covers many risk sources and allows a large number of employees' access. PDS is often used for reporting, monitoring and analysis of security and safety deviations and/or anomalies. According to the damage occurrence, which is recognised by the system, follow-up procedures are considered and introduced. Right now, many of the Finnish firms surveyed already work with PDS, but not all.

“Port Data System (PDS) helps in risk management—can be used to monitor the realisation of set goals for example in environmental measures. Can also be fed with information about safety & security anomalies/deviations and accidents” (#POF3).

“Port Data System (PDS) in use for reporting, monitoring and analysing safety & security anomalies/deviations” (#POF6).

“All operators in the port area have access to PDS, where they are obliged to report safety & security anomalies/deviations” (POF8).

*SAP ERP* is also used, e.g., for procurement processes. Furthermore, *NCR*, *FOUND*, *HAZOP*, *One Finnish* and *Pro24* are mentioned as used programmes. Most of these programmes are web-based applications and are used for action error analysis or reporting of near misses and safety and security deviations. *WD.Net* and *Portnet* are also partly used for financial management. Not every firm uses each of these programmes. The use of the programmes depends on various factors such as the size and focus of the firm as well as the experience and affinity of the employees in dealing with the programmes and IT aspects. In general, great efforts are made to identify risks and to evaluate the effects and likelihoods of risks occurring. This usually happens



in teamwork. Occasionally, the teams are accompanied by external consultants who help to shape the risk management process.

“SAP ERP is used for procurement purposes as that is the system of the municipal organisation” (#POF1).

“Action error analysis uses a software called FOUND. HAZOP shares some functionalities of the application. SAP ERP will be introduced partially (...). NCR software for reporting near misses and safety & security anomalies/deviations” (#POF5).

### 6.3.3 Port of Klaipėda

Most of the interview partners mentioned the usage of the FMEA for the analysis and evaluation of risks. The risk score of FMEA (RPN: Risk Priority Number) is based on the multiplication of three values: likelihood (o), consequence (s) and the probability of the failure being undetected (d). **Table 9** shows an example of an FMEA table. The FMEA aims at identifying measures to counteract or minimise the risks arising from the identified failure modes. Thus, it can also be used as well for the risk-handling phase.

Also several stakeholders mentioned the usage of risk matrix in internal meetings to calculate the probability of occurrence and severity of consequences. The assessment according one interviewed firm is planned to be based on ISO 31000.

“It is essential to assess the risks based on the probability of occurrence and the impact of consequences. We are planning to assess our internal risks based on the ISO 31000 guideline” (#POK4).

**Table 9:** *Failure Mode and Effect Analysis table (own illustration)*

Failure mode	Consequences	S	D	O	RPN
Undeclared dangerous goods	Explosions; leakages of dangerous materials	10	5	3	150
Causes	Process controls	Recommended actions			RPN (new)
Failure during inspection	Full control of labels	Intelligent system to identify ambiguous containers			60

### 6.3.4 Port of Tallinn

The usage of risk matrix for the risk analysis was mentioned by several interviewed stakeholders in order to define an appropriate strategy based on the obtained value. An example of such

matrix is shown in **Figure 10**, where the colour code aids in the evaluation phase according to the predicted consequences and the associated probability of occurrence. Several interviewed stakeholders mentioned the dependency on external hired consultancies such as environmental consultancy firms.

One of the interviewed stakeholders mentioned the usage of cumulative risk analysis (CRA) to consider the risks occurring from the exposure to different types of chemicals. This analysis considers the cumulative levels and effects of past and current environment pollutions.

“We don’t do risk analysis ourselves, it is done by environmental consultancy firms” (#POT2).

“Different methods are used for the risk analysis process. Mostly, risk matrixes are used in order to define appropriate handling strategies” (#POT3).

Another interviewed partner mentioned the usage of the HAZARD and Operability Study (HAZOP) based on the assessment needs. HAZOP can be used as a systematic procedure to analyse the consequences involved with different hazardous sources.

## 6.4 Risk treatment

The risk treatment phase is based on the analysis and evaluation of risks during the assessment process. Based on the type of risk, appropriate measures are defined in advance in order to reduce the severity of consequences.

### 6.4.1 Port of Hamburg

The handling of risk that occur in seaports can take place reactively or proactively. Normally the ultimate purpose of risk management is to prevent the occurrence of risk in advance, or at least minimise the severity of consequences by preparing a list of adequate measures.

Several methods were mentioned to define and document the required measures including teamwork, workshops and 8D report. Different measures are implemented based on the risk type. Examples include flood polders in the case of flood, emergency management with evacuation plans and safety equipment. For examples of measures for several type of risks, see **Table 10**.

“We also have such an emergency team, which employees or operational staff can still call when they realise they may not be in control of the situation. With that they can support each other” (#POH6).

“I want the employees to come up with an idea of how to deal with the identified risk. The 8D-report follows afterwards....” (#POH1).

“When colleagues are ill, we have a developed system that can quickly switch to another shift system” (#POH1).

**Table 10:** *Examples for measures for different risk sources (own illustration)*

<b>Risk source</b>	<b>Associated measure</b>	<b>Risk source</b>	<b>Associated measure</b>
All risk sources	8D Report	General	Staff training
Containers with dangerous goods as well as IT or software failure	Inspection/maintenance	Event of a fire	Fire protection plan
High water/flood	Alarm levels as well as evacuation signs and plans Warning concept (e.g. gradual approach)	Health and safety	Safety equipment
Fire as well as explosion of gas and chemicals	Emergency/Evacuation plans	IT failure and energy supply disruptions	Backups
Flood	Flood polders		

The communication process during the handling phase plays an important role. The fire brigades and rescue services normally use radio devices. Different escalations levels are then defined based on the rescue coordination centre and the alarm plans.

“We have a so-called emergency call on the radio devices. This is a small button which should be pressed for three seconds in order to trigger an emergency call on the site. The person who pressed the button has immediately the time to speak in order to explain the situation” (#POH3).

“Fire in the cargo area can only be caused by dangerous work, flying sparks. Therefore, corresponding preventive measures are prepared, such as the availability of a fire C-hose. There's a fire extinguisher on site, there's a fire blanket on site, and so on. The hoses lie on deck from above, so that you can then enter from above when there is a fire in the hatch”(#POH4).

The upper port authority uses simulation solutions in order to proactively prepare for certain measures for large ships that have new dimensions and properties to evaluate the applicability of entry for such ships to the port of Hamburg. Ship models are therefore developed using simulation solutions for this purpose.

Emergency power supply is used in case of general power failure. Emergency generators with considerable power ensure the supply of power. Terminal operators have a very large

distributed energy supply area on their premises. Ring structures ensure the supply of energy in case of a malfunction.

With regards to dangerous goods, the fire brigade and rescue service use the hazard diamond to identify the measures required to mitigate the risks. The waterways police are also responsible for the environmental violations. The police, on the other hand, provide their support by implementing the blocking measures for any affected areas. Escalation levels are also present for several type of risks, such as flood.

“We have a gradual approach. Depending on the warning level, action is taken. The worst case is the section evacuation” (#POH1).

“The fire brigade has an option with the HAZARD diamond. They use a catalogue comprising many substances which are sorted then into measure packages. For example, can I extinguish with water or not” (#POH16).

#### **6.4.2 Ports of Finland**

The interviews clearly show that the focus of the Finnish port firms is on risk prevention as a strategy.

“Prevention for the risks which score highest in the risk matrix (probability times severity), [is] the preferred strategy” (#POF6).

“Top priority is the prevention of the occurrence of the risk or at least lowering the probability of the occurrence” (#POF9).

Mitigation is also used as a strategy in some firms. A mitigation strategy is intended to limit the impact of risk effects and to adjust and modify the relevant operations and processes accordingly in order to reduce the likelihood of risks occurring. With regard to technical or financial risks, it is difficult for firms to completely avoid their occurrence:

“If prevention is impossible, then mitigation is applied. Might be technically or financially impossible.” (#POF5)

“Mitigation as a strategy is also used” (#POF1).

“Mitigation has the same principles as prevention (striving towards making operations safer” (#POF2).

“If prevention is not possible, then mitigation” (#POF4).

“Second priority is mitigation. Both aspects, reducing the probability of occurrence and severity used, but an emphasis on reducing the probability of occurrence” (#POF9).

The third strategy often cited by some of the interview participants is the strategy of acceptance. However, the acceptance strategy has a lower weighting for the firms, as it is not expedient to accept risks instead of working towards minimising their probability of occurrence.

“Strategy of acceptance also applied” (#POF3).

“Some risks just have to be accepted” (#POF4).

“Acceptance as a strategy has a considerably lower emphasis [...]” (#POF9).

Nevertheless, in some areas the acceptance strategy is more permitted than in others. For example, the areas of responsibility and responsibility in transport planning are sometimes not clearly enough defined: “Acceptance appears frequently in traffic planning: where is the boarder drawn? According to the law, the port is not obliged to install railroad safety equipment including booms and alarm equipment, but does it voluntarily as part of risk management process in the highly-trafficked intersections. For some lightly-trafficked intersections, port may choose not to install the equipment and accept the risk due to its low impact and probability.” (#POF4)

Within the Finnish port firms, risks and the associated obligations and processes are often transferred through insurance policies. The following example illustrates the motivation of firms to take out appropriate insurance policies and thus, for example, to reduce high cost risks or to divest some of them and not to have to bear them themselves: “Transfer in form of insurances. Piers are nowadays insured due to a previous accident, when a vessel crashed into a pier. The damage was estimated to be worth 6 million EUR. Vessel’s operations were considered to be activity regulated by the maritime law, leading to a conclusion, where the shipping firm had to compensate only 600,000 EUR instead of the whole 6 million EUR. Port insured the piers after transferring the risk.” (#POF6)

“Risk transfer: the port is comprehensively insured” (#POF1).

“Risk transfer also in use in form of insurances. Audits once a year” (#POF5).

“Transfer in the form of insurances. Facilities [are] widely insured” (#POF7).

However, not all firms use transfer as part of their insurance policies as a strategy: “Transfer as a strategy is applied very rarely” (#POF9).

In addition to the principles mentioned above, the “principle of continuous improvement” (kaizen) was stated. Based on this principle, employees should be made aware of the issues of waste and continuous improvement: “Constant improvement, kaizen. Staff is currently participating in a lean training, with a focus on the reduction of waste and slack (muda).” (#POF1)

In addition, procedures such as assessment of suppliers and subcontractors are used as a strategy to contain potential risks that may arise in the context of supplier and contractual relationships as early as possible: "New procedures include the assessment of suppliers and subcontractors. Assessment by the port or a self-assessment by the supplier/subcontractors (10-12 questions). Subcontractors must, for example, listed in a Reliable partner service." (#POF3)

One of the interviewees also cited recovery as an applied strategy. This measures how quickly recovery takes place and what effects it does have: "[...] recovery to be added as a strategy among the four existing ones. [...] It varies how long it takes to recover from a risk actualisation—one day's event may require two months of recovery procedures to return back to normal." (#POF9)

In general, it can be stated that the process steps to be initiated depend on the type of risk. Depending on the type of risk, different instances have to be informed which react accordingly. The procedure of handling processes and risks can vary greatly from port to port and the respective actors involved. This is since each port can differ in different aspects such as size, (infra-) structure, functionality but also with regard to the goods to be handled. In addition, a further differentiation is made to what extent the steps to be followed are defined in advance. For example, one of the Finnish firms/ports has an integrated management system in which the arrangements are defined and recorded. With the help of an emergency procedure chart and crisis plan, the necessary measures are specified and initiated. Other firms/ports follow the steps defined by the quality management standard (ISO 9001).

The firms use different approaches and media to handle the processes after critical incidents. Some firms use their own systems, facilities, equipment and services

"Instructions are in the Integrated Management System. If an alarm is raised, procedures are followed according to the emergency procedure chart and crisis plan" (#POF2).

"Reporting to emergency services, if an accident has occurred" (#POF4).

"Emergency procedure chart will inform of which parties need to be alarmed and how to proceed, when the risk actualises" (#POF4).

"Port has its own fire department, but also emergency services will be alarmed. Port has also fire cannons at the piers and other emergency equipment such as oil booms" (#POF5).

"In case of a severe risk, the responsibility of the emergency operation shifts to the emergency services. Port assists according to the needs of the emergency services, for example, by blocking the incoming traffic to the port" (#POF6).

"Port personnel slipping, or tripping is the most probable risk. Risks are first detected/identified, then assessed: The magnitude/severity of the risks; frequency of occurrence; the effect, what it leads to. After this, the risk at hand is mitigated or eliminated, if

possible. In case of minor oil leakages, the port has equipment to combat against leakages. In all cases, the emergency services are still alarmed. Port's own equipment includes oil booms, impregnate matter" (#POF7).

"Port has its own boat at disposal to lay oil booms and, also a car with a winch to lay the booms, if the boat is not available. Also, an oil spill prevention trailer with equipment i.e. drain mats, impregnates, bulkheads etc." (#POF8).

Other firms follow the instructions of the uniformly defined quality management system (ISO 9001): "The process comes from the quality system (ISO 9001). Complete procedures based on who detects: Who does what? What does the closest supervisor do? Ultimately going to the director of the division and after that to the management group. ISO 9001 defines the whole process in the end. Concerning other accidents i.e. fire, the responsibility of the operation shifts swiftly to the rescue department after the alarm is given. Port assists in giving directions and auxiliary tasks. In milder accidents/incidents the port uses its power as the landlord i.e. controlling the entrance to the port area (for example breathalyser test for truck drivers). Co-operation with the customs due to the location and police" (#POF9).

Several firms mentioned the harbour guards and harbour manager as particularly important functions in risk situations. They are alerted and take further necessary steps:

"The most important personnel in reacting to risks are the harbour guards. Harbour guards have received oil spill prevention training and raise an alarm according to the procedures. They can start operating and manage the situation until the emergency services arrive. Port personnel can offer local directions to the emergency services upon arrival" (#POF2).

"Harbour manager will raise the alarm and is in charge of the operation, when an accident occurs. If harbour manager is absent for example during a night shift, harbour master will step in for her/him. Harbour manager/harbour master will alarm the parent firm as well" (#POF5).

"Highly dependent on the risk in question. Harbour guards are usually first to observe the risks and accident situations, initiate alarm and start the operation. [...]" (#POF8).

In principle, a focus is also placed on training and drills of employees and parties involved. The aim is to familiarise the staff with the exceptional situations and to integrate and consolidate the necessary sequences of action. As a result, the handling of risks should run more smoothly in an emergency and dangers should be eliminated quickly.

"Alarming and emergency situation instructions and multiple drills/exercises with the emergency services, so that the process flow [is] unhindered" (#POF6).

"[...] Harbour guards are trained to oil spill prevention and they will start the operation until the emergency services make it to the scene. [...]" (#POF8).

**Table 11:** Risk treatment in the different ports of Finland (own illustration)

Firm	Approach	Action	Evaluation
#POF1	Emphasis on proactivity	Various exercises/drills; Trainings; Seminars; Projects (like HAZARD); Recognition of most notable and dangerous risks	- "Situation was assessed to be good currently, but there is always room for improvement." (#POF1)
#POF2	Execution of exercises /drills	Exercises/drills; Communication; Information flow; Overview of the situation;	- Level of effectiveness is accepted by the port personnel - "Importance of communication and the flow of information was stressed."(#POF2) - "All participants/parties involved should have a clear situation picture."(#POF2)
#POF3	Proactive/ Reactive	n/a	- "Emphasis on proactive action." (#POF3)
#POF4	Proactive	Proactively trying to avoid getting into a reactive situation; Find reasonable level of risk management, so that the port operations are not hindered to paralysis, but risk management is still sufficient	n/a
#POF5	Holistic risk management process	Parent firm does have an outstanding HSE (health, safety & environment) organisation;	- Risk management process is very effective
#POF6	Proactive/ Reactive	Proactive: Identification of risks; Reactive: Reaction to deviations reported via PDS; After failure: situation is gone through with different stakeholders regarding improvement and learning aspects	- "[...] is hard to evaluate the effectiveness, until a risk, which hadn't been identified before, actualises." (#POF6) - [...] the organisation has gone through around 5 years without one OHS accident." (#POF6)
#POF7	Proactive focus	Prevention, where possible; Plans are seen as catastrophe tools	- "Overall effectiveness is on a good level, although there is always room for improvement."(#POF7) - "Cost-effective risk management sets constraints on what is feasible to execute." (#POF7)
#POF8	Proactive emphasis	Weekly operational meetings the past 5 years; Training given to port operators concerning the handling of dangerous goods and also drills/exercises using oil spill prevention equipment	- "Effectiveness has been constantly improving, nowadays is quite effective." (#POF8)
#POF9	Emphasis on pro-activity; Also reactive perspective	Frequent exercises/drills; Contingency planning; When risk actualises, reactive perspective is adopted → responsibility of operation shifts to the authorities according to the law	- n/a

**Table 11** gives an overview of the treatment approaches of the various Finnish seaport firms. It is obvious, that firms focus on a proactive approach to risk avoidance. A proactive approach is



based on careful advanced planning and a target-oriented action process, so that any events that occur can be handled accordingly and based on a structured approach. The table also represents the evaluation of the different approaches and actions defined and followed by the Finnish firms, so that a holistic overview as well as a better understanding of the context are created.

### 6.4.3 Port of Klaipėda

For the port of Klaipėda, **Table 12** presents an example the proactive and reactive approaches followed by several stakeholders. IT, as an example, enables the rapid identification of the type of cargo and possible corresponding actions. According to the interviewed stakeholders, the current situation of IT infrastructure efficiently support the definition of measures for the risk treatment phase.

**Table 12:** *Examples of reactive and proactive approaches—Port of Klaipėda (own illustration)*

Reactive	Average evaluation of effectiveness
Plan for eliminating the consequences of the accident	Average
Plan for eliminating the consequences of improperly loaded cargo or improper cargo	Good
Reaction to the identified dangerous goods	Good
Proactive	Average evaluation of effectiveness
Plan for eliminating possible fires and protection against fire	Good
Labour safety requirements, rules, requirements applicable to special clothing	Excellent
IT measures	Excellent

### 6.4.4 Port of Tallinn

The interviewed stakeholders at the port of Tallinn mentioned the procedure followed to identify suitable measures to mitigate the identified risks. This process relies on the communication with the rescue board along with different escalation levels based on the severity of the consequences. **Table 13** presents an example the proactive and reactive approaches followed by several stakeholders.

"Based on the identified risk, actions are taken to mitigate the risks where the rescue board is informed. The risk and the identified measures are stored in a register along with the causes as well as consequences" (#POT1).

"As a reactive process, the rescue board is informed in order to identify the suitable measures to mitigate the identified risk" (#POT2).

"There are response as well as security plans for each type of incidents that are accordingly identified" (#POT5)

**Table 13:** *Examples of reactive and proactive approaches—Port of Tallinn (own illustration)*

Reactive	Average evaluation of effectiveness
Reaction to risks in co-operation with rescue board	Excellent
Use of suitable methods and techniques to reduce the impact of risks	Very good
Preparedness to pollution control	Very good
Exercises and training	Excellent
Creation of response plans	Excellent

## 6.5 Risk Monitoring, Effectiveness Check and Improvement

It is very essential to continuously update and monitor the implemented measures for risk mitigation and prevention. The measures should be checked for effectiveness in order to continuously improve the risk management process, especially during the risk treatment phase. This subsection focuses on monitoring, effectiveness check and improvement of the risk management process as well as the implemented measures during the risk treatment phase.

### 6.5.1 Port of Hamburg

The effectiveness of the implemented measure as well as the risk management process is essential to ensure an effective handling to risks that could occur at seaports. Continuous monitoring and check of the implemented measures are carried out regularly. An evaluation of these process varies among the interviewees. This process is carried out sub-optimally with trainings that are continuously updated and improved. The continuous check and monitoring from authorities require the organisations to keep their documented procedures up-to-date.

“With regards to safety management, we also have to create the so-called safety report where we document all our measures. The report, I think, must be updated every three or four years. Additionally, we are constantly reviewing our entire processes” (#POH3).

“The environmental authority in the field of emissions legislation creates and reviews the contingency plans for external entities (an EU report has to be created every three years)” (#POH5).

“When it comes to accidents due to wrong manoeuvres, either by port pilots or captains without pilots, then we take them into consideration. We have also the opportunity to make radar recordings via our nautical headquarters in order to evaluate the implemented measures and start a mutual discussion” (#POH14).

A regular inspection on authorities and port operators is carried out every three to five years by the so-called EU inspections. This in order to assess the degree of conformance to the agreed standards and regulations.

“And of course we also have a super version by the EU. This means that we have the so-called EU inspections in Hamburg every three to five years. Both us as authorities as well as the port firms” (#POH16).

## 6.5.2 Ports of Finland

**Table 14** represents different issues regarding room for improvement mentioned by the firms. The issues are categorised into improvements regarding activities as well as improvements regarding methods/processes.

**Table 14:** *Issues and room for improvement—Ports of Finland (own illustration)*

Firm	Improvement Regarding Activities	Improvement Regarding Methods/Processes
#POF1	- “Clarification and simplification of guidelines and instructions” (#POF1).	- “Risk assessment should be part of the everyday work. Approach should be made simpler, more pragmatic, ‘no rocket science’” (#POF1).
#POF2	- “More clarification and detailed instructions to the requirement coming from the authorities. [...] concerned especially safety & security legislation about different plans i.e. contingency plans” (#POF2).	- “Authorities are not aware of the reality in ports” (#POF2).
#POF3	- “Enhanced documentation, entity management. A lot of things are done, but it is hard to track what exactly has been done. Implementation of the planned things. Process to improve entity management, is underway→added structure. Motivation to participate in risk management on an individual level” (#POF3).	- “Improvement of the existing tools” (#POF3). - “Assessment of the activities executed, when doing risk prevention” (#POF3). - “Light checklist for different activities” (#POF3).

#POF4	<ul style="list-style-type: none"> <li>- "Change in the working culture, in attitudes." (#POF4)</li> <li>- "From 'Risk management is useless, laboursome and done only because we have to.' → To: 'Risk management is in fact useful and we can create new useful concepts, risk management is a natural, embedded part of the work'" (#POF4)</li> </ul>	<ul style="list-style-type: none"> <li>- "Deeper and better exploitation of data [...]" (#POF4)</li> <li>- Ideally, the whole port area would have only one single safety &amp; security deviation reporting system" (#POF4).</li> </ul>
#POF5	<ul style="list-style-type: none"> <li>- "Individual's attitude to consider risk management more. Know-How doesn't only consist of professional skill and expertise, but also of attitude and professional pride" (#POF5) .</li> </ul>	<ul style="list-style-type: none"> <li>- "[...] the role of individual worker in risk management" (#POF5).</li> </ul>
#POF6	<ul style="list-style-type: none"> <li>- Environmental risks would need a larger focus" (#POF6).</li> <li>- "Environmental risks are also often caused by the operators' neglecting the regulations" (#POF6).</li> <li>- "Finnish permit system in general, which imposes obligations to the port keeper to follow and monitor the operators" (#POF6).</li> <li>- "[...]the same safety &amp; security culture and attitude (obeying the rules) for all the personnel operating in the port area" (#POF6).</li> </ul>	<ul style="list-style-type: none"> <li>- "Not currently—if an improvement suggestion arises and it will be accepted, and it will be financially or technically executable, it will be implemented" (#POF6).</li> </ul>
#POF7	<ul style="list-style-type: none"> <li>- "Deepening the risk management skills and know-how of the port personnel. Both, in terms of attitude and skillset. Training, so that the staff could understand and recognise risks better in their occupational environment." (#POF7) .</li> </ul>	<ul style="list-style-type: none"> <li>- "Better data collection from risk-prone activities. Better understanding and more thorough analysis, so future assessment of activities is easier" (#POF7).</li> </ul>
#POF8	<ul style="list-style-type: none"> <li>- "More effort into training of personnel working in the port area. More training sessions and introductions/orientations" (#POF8).</li> <li>- "A dashboard for better analysing and summing up the risks" (#POF8).</li> </ul>	<ul style="list-style-type: none"> <li>- "A dashboard helping the summarising of the risk assessment's results." (#POF8).</li> </ul>
#POF9	<ul style="list-style-type: none"> <li>- "Exercises/drills are frequent, but the hotwash is often insufficient and still a fledgling, new procedure" (#POF9).</li> <li>- "Hotwash does happen, but it is done on the fire/rescue department's terms→ does not always include assessing the impact of the operations models on risk and domino effect mitigation" (#POF9).</li> <li>- "The enterprise culture of new firms starting to operate in the port area not always in line with others. New firms' subcontractors' enterprise culture concerning safety &amp; security procedures needs also to be in line" (#POF9).</li> </ul>	<ul style="list-style-type: none"> <li>- "An increased use of simulation models and applications, especially what-if simulations. Or a wholly new tool to aid in simulating what-if scenarios" (#POF9).</li> </ul>

### 6.5.3 Port of Tallinn

The risk analysis and management plans based on several stakeholders are effective and are continuously monitored based on regular meeting, exercises and training.

"As a room for improvement in the activities related to risk management, more experts should be involved from different levels inside and outside the organisation" (POT#3).

National legislation serve as well as a basis to monitor the internal processes and approaches implemented. Usage of proper methods and techniques to mitigate the risks was rated by

several interviewed firms as “somehow effective”. Emergency management and the risk specific response plans with the rescue services were rated as “very effective”.

#### **6.5.4 Port of Klaipėda**

The stakeholders in the port of Klaipėda mentioned several suggestions to improve the status of their risk management process. These include the formulation of a plan for action in unexpected situations as well as the provision of trainings with regards to the handling of dangerous goods. A continuous monitoring of all risks is necessary, according to the interviewed stakeholders, especially in the current technological changes.

“Risk management is a very dynamic process, especially in the modern world, where technologies, geo-political situation change really quickly. Therefore, a continuous improvement process of risk management is required in all areas” (POK#4).

“It is necessary to update risk management aspects under changing market segments. In particular, the risks that are directly linked to firm's services and the ones that can be minimised by corrective actions” (POK#7).

### **6.6 Cross-port Comparison of risk assessment and handling methods**

In this subsection, the methods for risk assessment and handling mentioned by the interviewed stakeholders are compared and evaluated.

#### **6.6.1 Methods for Risk Assessment**

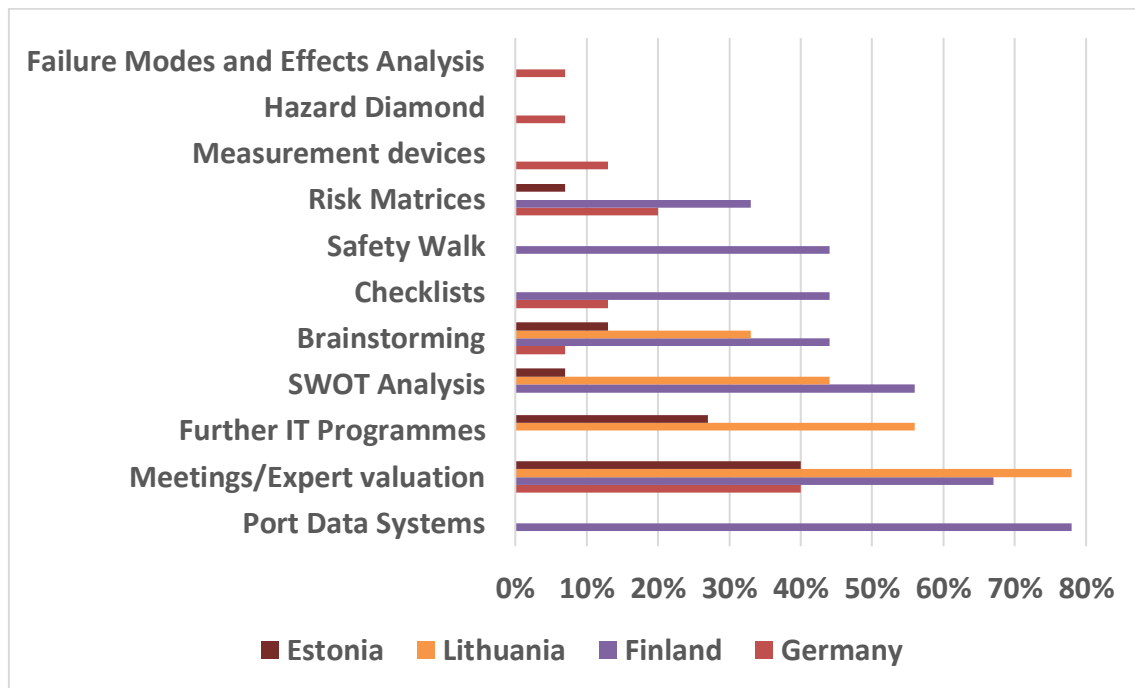
Within this subsection, the methods for the risk assessment process including identification, analysis and evaluation are compared and evaluated based on the interviews analysed in each seaport.

A bar chart of grouped columns (see **Figure 11**) is used to visually support the comparison of the different methods used by the port firms in the Hamburg, Finland, Klaipėda and Tallinn. More detailed information concerning the methods used by the different port firms can be found in the previous sub-chapters.

When comparing the methods used by the port firms, it is obvious, that a lot of different methods were mentioned. A total of 10 different methods are used, some of which may overlap or be very similar in application.

The firms in the Port of Hamburg mainly use checklists, meetings and expert valuations, measuring technologies and accident statistics to handle risk management. Checklists and brainstorming are also increasingly being used by Finnish firms as a methodological tool in the

risk management process. Basically, it can be clearly seen that the Finnish port firms have a very extensive application of methods. Especially meetings/expert valuations/requirements, Port Data System (PDS) and further IT programmes are increasingly being used. In addition, SWOT analysis is used above all in order to be able to handle potential risks accordingly.



**Figure 11:** Comparison of the risk assessment methods as percentage of interviewee opinions by country (own illustration)

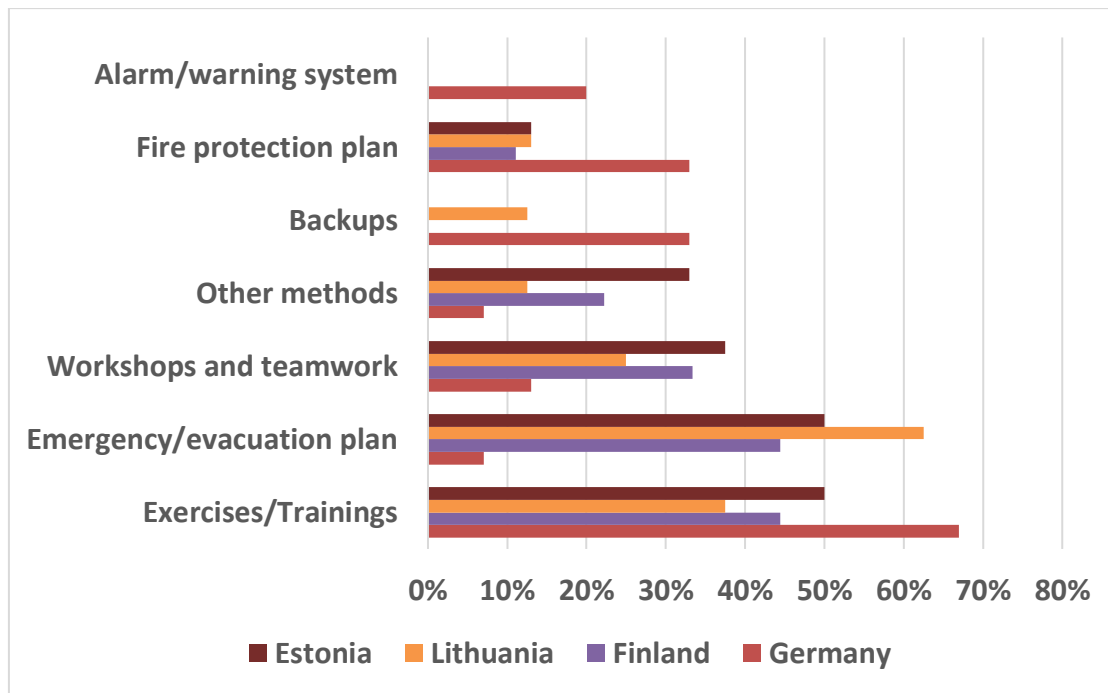
The firms in Klaipėda focus primarily on meeting and expert valuations, SWOT analysis and brainstorming for risk assessment. Tallinn, on the other hand, also places as well a strong focus on meetings and expert valuations, the use of further IT programmes as well as general brainstorming on risk management. In general, it can be seen, that one of the most frequently used methods of firms is to convene and hold meetings, to consult experts (e.g. consultants) or to follow requirements. By a broad field of application of different methods, the firms should be able to prepare themselves well for different risk situations and to consider the risks well in the enterprise everyday life.

### 6.6.2 Methods for Risk Handling

Within this subsection, the methods for the risk handling phase are compared and analysed based on the interviews analysed in each seaport.

An additional bar chart, as shown in **Figure 12**, is created to show the different methods and measures that are frequently mentioned by the interviewed stakeholders. From a proactive perspective, the focus is on organising exercises and trainings to increase the degree of

preparedness. Emergency and evacuation plans for cases such as natural disasters are important for all seaports and serve as an important preparation for the reactive risk management process. To protect the surrounding areas, the interviewed seaports stressed the importance of developing fire protection plans. Workshops and teamwork are addressed in all seaports. They are organised to defined proactive measures and improve the currently implemented emergency and evacuation plans.



**Figure 12:** Comparison of methods and measures for the treatment phase as percentage of interviewee opinions by country (own illustration)

Backups, frequently mentioned in the port of Hamburg, are normally used for IT-related risks to avoid the loss of data in the case of a cyberattack or hacking. Other methods include specific approaches such as risk registers implemented in Excel sheets that are used in the ports of Tallinn and Klaipėda to document the implemented measures. As an approach for risk handling, the 8D report was mentioned by one of the interviewed stakeholders at the port of Hamburg to define and implement specific measures based on defined and clear steps.

## **7 CO-OPERATION AND COMMUNICATION WITHIN SEAPORTS**

Co-operation among stakeholders at seaports is very important in order to utilise the knowledge of each partner in the identification, analysis, evaluation and handling of risks. The network of stakeholders at each seaport is quite different and complicated. For example, the network at the port of Hamburg comprises 1200 stakeholders who communicate with each other in different clusters based on the type of incident/risk. This section deals with several co-operation aspects as well as communication means with regards to the activities related to risk management based on the conducted interviews.

### **7.1 Co-operation Aspects**

This subsection deals with the co-operation's aspects mentioned by the interview partners. Examples include coordination and leadership, consultation and exercises to deal with the consequences of certain types of risk.

#### **7.1.1 Port of Hamburg**

Based on the conducted interviews, there is strong co-operation among partners in the seaport of Hamburg. This co-operation is clearly noticed with stakeholders inside and outside the port.

Example include the extraction of information from other departments to get informed about the radiation protection regulation. Additionally, the strong co-operation between the fire brigades and rescue services with external partners working in occupational safety and related authorities such as: Hamburg Port Authority, agency for roads, bridges and water as well as district offices.

Strong co-operation with partners outside the port, such as the state authority for urban development and environment with aspects related to sustainability and environmental risks. Some stakeholders as well work with service providers and competitors in the port in case of emergency. A strong co-operation with the fire brigade and rescue service of Hamburg is mentioned by partners, especially in general assistance and handling of accidents and dangerous goods as well as ship firefighting. Several stakeholders mentioned low degree of co-operation with some partners such as customs.

“We are already very transparent with our partners. I think being more transparent is almost impossible” (#POH13).

“We have interestingly, through this co-operation structure in the port, very stable and very long co-operation with the port employees” (#POH11).



The operational control is normally taken by the fire brigade to coordinate the aspects and measures to mitigate fire and explosions that occur in the seaport. According to specific alarm levels, resources are utilised and coordination with other actors such as the waterways police is carried out. The coordination with various stakeholders is necessary to consider different aspects and consequences of hazard sources and their associated risks.

The nautical headquarters together with the upper port authority in Hamburg are the responsible entities in receiving incidents and accidents. Captains or pilots are required by law to report accidents. The coordination is then carried out by the nautical headquarter and the upper port authority in order to define a specific escalation level (e.g. informing the police, waterways police or fire brigades and rescue services).

In case of risks that have implications on the environment, a direct communication is initiated with the authority for energy and environment. A reactive process is then carried out in form of booms or pumps to mitigate the risks (e.g. oil spills). The terminal operators also follow certain escalation levels based on the incident or accident under investigation.

“In case of environmental pollution as well as in every incident that has to do with dangers along with accidents involving 5 persons, we have to inform the authority. Before that, it is the task of the person in charge to investigate and evaluate extent of the accident to decide if the help of police is necessary” (#POH13).

Several contracts are used among the stakeholders at seaports based on agreed conditions. Such contracts are signed, for example, with technical experts since they have the required resources. Another example includes IT firms that carry out contractual agreements with the major players at the seaport to provide support with the several developed interfaces, such as the exchange of data related to dangerous goods.

“We have co-operation agreements with the German Armed Forces (Bundeswehr), because if we have our forces on the dike, they are exhausted after one or two days, and then the Bundeswehr comes with units” (#POH10).

### **7.1.2 Ports of Finland**

Additionally, to internal partners, external partners are also involved in the risk management process. Often, regular meetings take place in order to inform each other about the current status of the daily work and operational level. Furthermore, seminars or specialised meetings were mentioned by the firms due to improve the status of information and the general level of co-operation between the different parties.

The external partners of the Finnish study participants can be divided into three groups: "Authorities/Agencies", "Port Operators" and "Customers/Firms". These groups can be further elaborated as follows:

- “Authorities/Agencies” includes, for example, the Regional State Administrative Agency (AVI); Centre for Economic Development, Transport and Environment (ELY); The Finnish Boarder Guard; Finnish Transport Agency (Liikennevirasto)<sup>4</sup>; Finnish Transport Safety Agency (Trafi)<sup>5</sup>; Occupational Health and Safety Administration (Työterveyspiiri) oversees OHS; Finnish Defence Forces, Boarder Guard/Coast Guard; Emergency services (e.g.; police, fire department, etc.) or the National Emergency Supply Agency.
- “Port Operators” comprise e.g. service providers and the port operators themselves.
- “Customers/Firms” includes firms working in the port environment such as carriers, oil refineries travel agencies, bus, taxi, train operators as well as insurance firms, external consultants or subcontractors.

“When new developments including risk management are discussed, the port gathers together groups from these partners and go through the procedures collectively” (#POF1).

“Meetings with authorities and customers minimum once per quarter. How to make things better. Co-operation with every possible authority from Regional State Administrative Agency (AVI) and Centre for Economic Development, Transport and the Environment (ELY) to Finnish Safety and Chemicals Agency (Tukes), Finnish Transport Safety Agency (Trafi) and the emergency services” (#POF3).

“Once a month a meeting is held with the port, pilots, agents and tug boat operators. [Content of the meeting is] which mistakes have been done and what can be learnt, how does the development of the traffic volume seem to be and how to prepare for it.” (#POF3).

“Port [...] surprisingly does not co-operate much with the neighbouring port in the immediate vicinity. [...] Authorities, especially Tukes. [...] Shipping firms and others. Comprehensive co-operation with the oil refinery. [...]” (#POF5).

“[...] Comprehensive co-operation with the insurance firms. External consultants in environmental matters. Subcontractors such as security firm. Others include IT system suppliers and IT maintenance suppliers. [...]” (#POF7).

“Weekly operational meetings. All operational groups in the port meet for half an hour. Going through next week’s incoming vessel traffic and, also OHS matters, what have happened during the week. Representatives for pilots, customs, stevedores, Finnish State Railways,

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<sup>4</sup> As from January 1, 2019, this agency is called Finnish Transport Infrastructure Agency

<sup>5</sup> As from January 1, 2019, this agency is called Finnish Transport and Communications Agency (Traficom)

Finnish Transport Safety Agency (Trafi), brokers, tugboat operators, crane operators, harbour guards, maintenance, whoever is involved in risk management and is willing to participate. Discussing near-miss situations. 25 people approximately take part in a meeting” (#POF8).

“Meeting every quarter for port all players working in the port area. Twice a year a common OHS meeting. [...]” (#POF8).

Also, SEVESO-classified facilities and related exercises/drills are mentioned by one of the Finnish port firms:

“Frequent exercises/drills due to SEVESO-classified facilities in the port area. [...] In the port area there are 5 production facilities, most SEVESO-classified: Chemical industry, Saw mill, Pulp mill, Board mill / pasteboard factory. These facilities are included in the safety & security plans and have their own plans. Facilities use e.g. chlorine and ammonia, [therefore the] local rescue department [is] in charge of information flow” (#POF9).

**Table 15:** *Co-operation aspects in the interviewed Finnish ports in 2018 (own illustration)*

Partner	Task/Role/Content of co-operation
Regional State Administrative Agency (AVI)	Discussions about developments and new procedures (#POF1); Grants the environmental permissions (#POF2); Own point near misses (#POF3); Safety & Security anomalies/deviations (especially for benchmark purposes) (#POF3); etc.
Centre for Economic Development, Transport and the Environment (ELY)	Discussions about developments and new procedures (#POF1), Own point near misses (#POF3); Safety & Security anomalies/deviations (especially for benchmark purposes) (#POF3); etc.
Finnish Safety and Chemicals Agency (Tukes)	
Finnish Transport Safety Agency (Trafi) <i>Note: as from January 1, 2019, this agency is called Finnish Transport and Communications Agency (Traficom)</i>	Enforces ISPS (#POF2); Own point near misses (#POF3); Safety & Security anomalies/deviations (especially for benchmark purposes) (#POF3); Supervising authority (#POF4); etc.
Finnish Defence Forces	Drills/Exercises 4-5 times a year (#POF4), etc.
Emergency services (fire department, police, etc.)	Frequent exercises/drills; Extra meetings (#POF9), etc.

Not all Finnish ports participating in the interview study are involved in co-operation with each of the external partners listed above. So, there is no core operator regarding the co-operation aspects between the Finnish port firms involved in this study. The type and scope of co-operation depends on the size and specialisation of the ports and their partners. For a better understanding, **Table 15** gives a short overview of some of the listed parties above their tasks/role and/or the content of co-operation within the risk management structure.

### 7.1.3 Port of Klaipėda

In the port of Klaipėda, internal stakeholders such as general manager or head of department normally work with IT, situation monitoring as well as in the determination of preventive measures. Several stakeholders mentioned the co-operation with fire brigades, the occupational safety inspection and logistics firms. **Table 16** provides an example of the co-operation partners mentioned by one of the interviewed stakeholders along with an evaluation of the co-operation.

**Table 16:** *Example for co-operation partners—Port of Klaipėda (own illustration)*

External partners	Tasks regarding to RM	Evaluation of co-operation (poor, satisfactory, good, excellent)
Other logistics firms—clients and partners	Definition of measures for risk management.	Satisfactory
Occupational Safety Inspection	Verification	Excellent
Port authority	General safety, control and maintenance	Excellent
Fire brigades	Verification and training	Excellent
Educational establishments	Train staff, obtain certificates	Satisfactory
Environment authority	Requirements and control	Good
Labour inspection	Labour safety	Good
Customs	Cargo control	Good

### 7.1.4 Port of Tallinn

In the port of Tallinn, intense co-operation take place among authorities, rescue services and terminal operators. Joint exercises, as an example, take place among terminal operators, rescue service and transshipment firms to enhance the level of responsiveness and increase the efficiency of risk management process. Co-operation as well exists with consulting firms to create and develop special risk management documents in order to explain the different steps

and activities of the risk management process. Ministries and authorities play an important role in conducting risk analysis on a national level as well as on the approval and management of different escalation levels concerning the measures implemented for certain risks or emergencies.

Table 17 provides an example of the co-operation partners mentioned by one of the interviewed stakeholders along with an evaluation of the co-operation.

**Table 17:** *Example for co-operation partners—Port of Tallinn (own illustration)*

<b>External partners</b>	<b>Tasks regarding to RM</b>	<b>Evaluation of co-operation (poor, satisfactory, good, excellent)</b>
Port authorities	Coordination	Good
Technical surveillance Board	Approving risk management plan and analysis	Satisfactory
Rescue board	Approving risk management plans as well as joint exercises	Satisfactory
Consultancy firms	Creating risk management documents	Excellent
Terminal operators	Joint exercises	Good

## 7.2 Communication

Communication among partners plays an important role in mitigating different risks, especially during the reactive risk management process. Different communication means and devices are used to facilitate an efficient implementation of the required measures to mitigate the severity of consequences.

### 7.2.1 Port of Hamburg

Different internal and external communication means and devices are used by authorities in the port of Hamburg. As an example, radio devices are used by the fire and rescue services to internally communicate the measures and plans for the occurred incident. These communications are connected directly with the nautical headquarters.

The nautical headquarters and the upper port authority communicate with other stakeholders using radio devices, telephone or E-mail depending on situation and the sending/receiving entity. Incidents or accidents are reported as well from captains or pilots using the radio devices.

Incidents that could affect the seaport are reported via telephone and E-mails for further support and analysis.

“We have three main communication means/devices. The first GO signal is communication via the radio devices. If something happened directly in the harbour area, then also over the phone. If the damage covers a large area in the landside, then E-mails are used as well” (#POH14).

Certain functions of the terminal operators are responsible for the communication process with another point of contacts such as authorities (e.g. police or fire brigades) based on the examined situation.

“We have certain functions that have responsibility in the communication flow of incidents. They are also considered to be the point of contact for the authorities, such as the fire brigade or the police, depending on the situation” (#POH13).

## **7.2.2 Ports of Finland**

Communication with external partners takes place in various ways such as emails, diaries and/or notice boards.

“Weekly operational meeting. [...] Meeting every quarter for port all players working in the port area. [...] Twice a year a common OHS meeting” (#POF8).

In the context of communication with external partners, various topics and concerns relating to co-operation are addressed. During the meetings, for example, employees can discuss their observations and assessments of their work environment and processes: “Supervision of work during the distribution of work uses 15 min to recap on safety & security and the personnel has a free word to discuss their own observations.” (#POF3)

In addition, current conditions, processes and forecasts, target/actual deviations from agreed plans and processes are discussed as well as the causes of the deviations. Furthermore, the co-operation has a positive effect on the parties involved as knowledge can be exchanged and improvements in the risk management process can be implemented together. It is also important for a uniform risk management that the parties involved react together in order to work as efficiently and appropriately as possible.

The regularities and periods of communication between the partners vary greatly. For example, some parties meet for weekly operational meetings or communicate daily. Other party associations hold meetings on a monthly, quarterly or semi-annual basis. This depends on the thematic content of the meetings and their relevance and timing. Regular training, seminars and

exercises on behavioural sequences and processes in case of danger are also organised. To this end, the various parties involved are invited and the various scenarios run through.

“Organisational attitude has changed from practically focusing risk management and communication tasks to a single responsible (former quality manager) to an approach, where the whole organisation works together in risk management matters” (#POF2).

“Parent firm supports in risk management. It can provide knowledge and facilitators for example” (#POF5).

In general, the feedback from Finnish study participants regarding co-operation and communication with external partners is very positive. The co-operation went largely well and reliable. However, it is also pointed out that due to the fact that the risk management process is very dynamic, co-operation with the various parties can also be very dynamic and volatile. Some of the various co-operation partners have different interests, so that possible conflicts have to be resolved and compromises have to be found. Above all, the fact that the port is a shared workspace should not be underestimated and should always be taken into account during the risk management processes.

“[...] Monthly meetings with stakeholders [considering] what is happening currently, what is new, what is changing. Meetings involve authorities and customs especially” (#POF7) .

“Co-operation and communication are evaluated to work extremely well, especially the operational weekly meeting” (#POF8).

### **7.2.3 Port of Tallinn**

The communication means according to the interviews are based on the following aspects: alarming the rescue service in case of accident; Exchange of data (e.g. accident data) with relevant stakeholders based on customised databases; Communication with technical surveillance board if needed, especially with regards to hazardous substances in electrical and electronic equipment.

### **7.2.4 Port of Klaipėda**

The communication means according to the interviews are based on the following aspects: Alarming the fire brigade and rescue service in case of accident; regular face-to-face meeting to discuss possible sources of threats; Communication among quays operators, customs and public authorities for root cause identification to minimise or prevent the occurrence of risks.

### **7.3 Cross-port Comparison**

In this subsection, the co-operation aspects along with the communication means and devices mentioned by the interviewed stakeholders are compared and evaluated.

#### **7.3.1 Co-operation aspects**

Co-operation with internal and external partners is essential to increase the level of preparedness as well as to enable better coordination and communication at seaports. As indicated previously, there are different aspects for co-operation that are utilised among the stakeholders. Examples include the mitigation of different risks such as explosions of gas and chemicals; co-operation among port authorities, rescue service and terminal operators in terms of coordination and the planning of joint exercises.

The dominant co-operation aspect in the ports of Finland is the regular meetings and seminars that take place among port authorities, operators and firms. These meetings and seminars focus on new procedures, examining previous incidents to suggest improved measures, and the new revised local, EU and international regulations. Similarly in the port of Hamburg, strong co-operation is noticed among authorities, terminal operators and shipping firms. A core aspect is the handling of dangerous goods as well as exercises and consultations provided to discuss and improve the implemented measures for different type of risks, especially operational and environmental risks.

The ports of Klaipėda and Tallinn mentioned the frequent meetings and joint exercises among partners at and outside the seaport. The participation in such exercises and trainings keep the firms up to date with regards to the national, European and international requirements. The joint exercises also aim at increasing the degree of preparedness in the case of emergencies by developing mutual emergency/evacuation plans.

As aforementioned, the overall co-operation in all examined seaports were positively evaluated. However, the dynamic process of risk management and the complex network of stakeholders require the development of a shared cooperative system that can be used to utilise the knowledge of partners with regards to the different activities related to risk management.

#### **7.3.2 Communication means and devices**

The stakeholders at the examined seaports use similar communication means and devices. The radio devices are normally used by the fire brigades and rescue services and other authorities during the reactive risk management process. Based on different escalation levels, E-mails and direct phone calls are utilised to expand the area of coverage, especially for critical health, safety and environmental risks.



In the port of Hamburg, several IT portals are used to update and disseminate the information related to specific type of dangerous goods and the required measures to mitigate their consequences. One of the leading shipping firms has developed its own online solution to identify suspicious items that are not declared as dangerous goods.

In general, the interviewed stakeholders at the seaports organise meetings, exercises and seminars to acquire new skills and knowledge as well to disseminate important information in order to increase the efficiency of the implemented measures and co-operation among partners.

The communication means and devices depend as well on the type and severity of the incident. Clear guidelines should be shared with every core stakeholder to define responsibilities and the required actions for every type of risk. These responsibilities and communication means should be integrated to a cooperative system for risk management. One of the main requirement to enable such a cooperative system is to analyse the network and structure of stakeholders at each seaport. The core stakeholders for the activities related to the different phases of the risk management process can then be identified.

## 8 CONCLUSION AND IMPLICATIONS

This report compared the status of risk management at BSR major seaports through 38 interviews that were conducted in major ports of Finland, Germany, Lithuania and Estonia.

The results revealed that there is no standard or a clearly defined process for risk management. Furthermore, there are no specific catalogues of methods defined by any stakeholder that can be used to identify, analyse and evaluate the different categories of risks. The type and scope of risk categories vary from seaport to the other. The operational, safety and environmental risks are the main categories covered by most of the interviewed stakeholders at the BSR region.

The requirements of risk management as extracted from the comparison and evaluation among seaport are mainly focused on local/federal regulations for specific risk sources. Such regulations are one of the main drivers to continuously improve the risk management process at seaports. However, a clear list and understanding of the regulations followed in other BSR countries would facilitate a joint co-operation in this aspect to help authorities and other core stakeholders in the decision-making process.

The results also indicate that there are no standard and uniform methods used by the stakeholders at the interviewed seaports in the five countries. The analysis showed that the focus is on checklists and brainstorming for risk identification. Meetings and experts' valuation, measuring technologies and SWOT analysis for risk analysis and evaluation. Formulation of emergency and evacuation plans with the associated documented measures for risk handling. Specific customised methods such as Port Data System (in Finland) and Hazard Diamond (in Germany) are used for specific applications and hazard sources.

Co-operation with internal and external partners is essential to increase the level of preparedness as well as to enable better coordination and communication at seaports. Seminars, meetings and trainings that focus on measures, requirements, and new procedures in addition to the handling of dangerous goods are examples of the co-operation aspects shared among BSR core seaports. The communication within the stakeholders in a seaport is essential to coordinate and implement the different measures, especially in the case of emergencies. The interview partners indicated the importance of joint exercises to increase the degree of preparedness in order to have an efficient reactive risk management approach.

In order to improve the current status of risk management in seaports, a clear framework, process and guideline for risk management should be developed. For instance, a toolbox for different applicable methods to identify, analyse and evaluate risks can be utilised to create a set of standard methods that can be used for different sources of risks. Additionally, the co-operation aspects should be further utilised among stakeholders to facilitate an efficient knowledge transfer process. Clear roles and responsibilities should be defined to coordinate the activities related to risk management according to the nature of the examined risk.

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## ANNEX

### Interviews at the Port of Hamburg

No.	Stakeholder group	Organization	Function of expert
1	Authority	Fire Department	Environmental Protection Service
2	Authority	Civil Protection	Head of Department
3	Terminal Operator	Private Firm	Occupational Safety Management
4	Service Provider	Shipping Firm	Dangerous Goods Safety Advisor
5	Authority	Interior	Civil Protection
6	Terminal Operator	Private Firm	Occupational Safety Management
7	Service Provider	Cargo Securing/Lashing	Sales Manager
8	Authority	Hamburg Port Authority	Hazard Prevention
9	Service Provider	Stevedoring and Transshipment	Sales and Operation Management
10	Authority	Fire Department	International Co-operation
11	Service Provider	Port IT-System	Head of IT-Services
12	Authority	Fire Department	Station Leader
13	Terminal Operator	Private Firm	Cross-departmental Function
14	Authority	Port authority	Head of Nautical Headquarters
15	Service Provider	Harbour Pilots	Emergency Management

## Interviews at the Ports of Finland

No.	Stakeholder group	Organization	Function of expert
1	Authority	Port management	Managing Director
2	Authority	Port authority; Port management	Traffic Manager/Port Security Officer; Port Director/Chief Operating Officer & Commercial Director
3	Authority	Port management	Managing Director; Development Manager
4	Authority	Port authority	Traffic Manager; Safety expert
5	Authority	Port authority?!	Harbour Manager
6	Authority	Port management	Chief Executive Officer
7	Authority	Port authority	Harbour Master, Port Security Officer, Data administration manager
8	Authority	Port authority	Harbour Master
9	Authority	Port authority	Director of Traffic Operations, Captain

### Interviews at the Port of Tallinn

No.	Stakeholder group	Organization	Function of expert
1	Service Provider	Private Firm	Member of the Board
2	Service Provider	Private Firm	Head of Department
3	Authority	Civil Protection	Crisis Management
4	Service Provider	Technical Surveillance	Vice President
5	Authority	Port authority	Head of Department
6	Authority	Port authority	Head of Department

### Interviews at the Port of Klaipėda

No.	Stakeholder group	Organization	Function of expert
1	Service Provider	Cargo transportation	Manager
2	Service Provider	Transshipment	Head of Department
3	Terminal Operator	Private Firm	Manager
4	Authority	Port Authority	Coordination
5	Service Provider	Ship Repair	Manager
6	Service Provider	Shipping Firm	Sales Manager
7	Service Provider	Shipbuilding	Occupational Safety Management
8	Terminal Operator	Private Firm	Occupational Safety Management

HAZARD project has 14 full Partners and a total budget of 4.3 million euros. It is executed from spring 2016 till spring 2019, and is part-funded by EU's Baltic Sea Region Interreg programme.

HAZARD aims at mitigating the effects of major accidents and emergencies in major multimodal seaports in the Baltic Sea Region, all handling large volumes of cargo and/or passengers.

Port facilities are often located close to residential areas, thus potentially exposing a large number of people to the consequences of accidents. The HAZARD project deals with these concerns by bringing together Rescue Services, other authorities, logistics operators and established knowledge partners.

HAZARD enables better preparedness, coordination and communication, more efficient actions to reduce damages and loss of life in emergencies, and handling of post-emergency situations by making a number of improvements.

These include harmonization and implementation of safety and security standards and regulations, communication between key actors, the use of risk analysis methods and adoption of new technologies.

See more at: <http://blogit.utu.fi/hazard/>

