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Maritime safety and security Literature review

**Kymenlaakson ammattikorkeakoulu
University of Applied Sciences
2012**

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MIMIC PROJECT SPONSORS



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Copyright: Kymenlaakson ammattikorkeakoulu
Publisher: Kymenlaakson ammattikorkeakoulu
Printing press: Tammerprint Oy, Tampere 2012

ISBN (PB): 978-952-5963-32-8
ISBN (PDF): 978-952-5963-33-5
ISSN: 1239-9094
ISSN: (e-version) 1797-5972

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1 INTRODUCTION

1.1 Background

The increased numbers of maritime security problems during the last decades have forced international societies to organize closer co-operation and create better plans to response to the problem. At the moment, the greatest security challenge globally is piracy and armed robbery. Therefore, International Maritime Organization (IMO) chose piracy and response orchestrating for the theme of the World Maritime Day in 2011. Also United Nations Secretary-General Ban Ki-moon has been highlighted that “the escalating problem of piracy off the coast of Somalia requires urgent and coordinated response”.

Maritime security threats are not a serious problem in the Baltic Sea nowadays. Still, some smaller events and also the global nature of maritime have shown that security threats are worth recognition and discussion in the Baltic Sea region. European Security Research and Innovation Forum, ESRIF has assessed scenarios in the future, in 2030. These scenarios embraced a range of risks, from natural to man-made incidents. ESRIF has stated that capabilities and capacities have to be mobilized to deliver equipment and services to deal with these risks. (ESRIF, 2009.) Finnish security committee has highlighted the need to shift the focus of preparedness proactively to active participation and the identification of threats and disorders as early as possible and to convey the situational picture quickly. (Valtioneuvooston kanslia, 2010.)

Maritime safety is widely studied and for example maritime safety risks are rather well known and analyzed. In contrast, maritime security issues are not studied as much, and security threats in the maritime industry are not defined and analyzed systematically, with the exception of threats caused by terrorists and piracy. Globally, concentration on these more serious security threats is understandable, but for example systematic identification and analyzing of all identified threats and risks is relevant in Europe, more particularly in the Baltic Sea region. These are for example the aims of the Finnish Baltic Sea Security Research Network whose members are Finnish authorities responsible for maritime security. These are also the aims in the MIMIC project that are presented in more detail in the next sub-chapter.

1.2 MIMIC project

This report is a part of work package 3 (WP 3) of the project “Minimizing risks of maritime oil transport by holistic safety strategies” (MIMIC). The aim of the

whole project is to develop a probabilistic model that integrates the models related to traffic, accident probabilities, ecosystem impacts and the response possibilities of the society to decrease the likelihood and the consequences of the hazards. Another aim of the project is to use this model to create effective measures and recommendations for holistic maritime safety strategies. Recommendations are based on the analyses using the integrated model concerning how the risk management system should be modified so that the probability for an accident is minimized by the given public and private resources.

The partners of the project are Kotka Maritime Research Centre, Centre for Maritime Studies at the University of Turku, Kymenlaakso University of Applied Sciences, Aalto University, University of Helsinki, Tallinn University of Technology, University of Tartu, Swedish Meteorological and Hydrological Institute and Finnish Environment Institute. The MIMIC project's cost estimate is approximately 2 Million Euros, and its duration from May 2011 to the end of 2013. The project is funded by the European Union and it has been approved to be a flag ship project of the EU. The financing comes from the European Regional Development Fund, The Central Baltic INTERREG IV A Programme 2007-2013; Centre for Economic Development, Transport and the Environment of Southwest Finland (VARELY); the City of Kotka; Kotka-Hamina Regional Development Company (Cursor Oy); Kymenlaakso University of Applied Sciences; Finnish Environment Institute; University of Tartu; Tallinn University of Technology and Swedish Meteorological and Hydrological Institute.

Work package 3 focuses on security threats of oil transports in the Baltic Sea. The main objective of the study is to determine security related threats in the area and assess them in terms of safety and security. One reason to select oil transportations as a target transportation mode for this study has simply been the availability of written documentations and reports concerning the safety related risks of the oil transportations, thus giving some benefit for the analyzing work. The analyzing method of security threats will be chosen during the project. Finally, based on the gathered and analyzed information, proposals for development of countermeasures against identified risks will be defined.

1.3 The purpose and objectives of the report

The report aims to present the latest relevant research results and studies related to the maritime safety and security issues, which form the basis and theoretical background for the whole research. In this report, both maritime safety and security issues will be discussed, but the primary focus is on maritime security issues.

The purpose of the report is to study current maritime security issues. The research question of this literature study can be defined as follows:

- How comprehensive safety concept of maritime transport can be defined?

The aim of the MIMIC project is to assess security threats, and a preliminary concept of comprehensive security approach will be defined and presented at the end of this report. This definition is based on the contents of the chapters 2-5.

The main focus of the project is on threat identification and risk assessment which are the essential parts of risk management practices. Theoretical background of this literature review and the study that will be carried out in WP 3 is described in more detail in chapter 2.

1.4 The limitations and essential terms

As mentioned earlier, WP 3 of the MIMIC project focuses on mainly oil transport related safety and security issues in the Baltic Sea. It could be difficult to limit the study only to oil transport because the security threats are not only linked to oil transport and many security experts may be unable to distinguish the threats of other shipping types, such as containers, and ro-ro. However, during the project, we will see how the selected perspective is possible to keep.

Although we will identify and record maritime security threats in the Baltic Sea, this report is not solely focused on the Baltic Sea area. The perspective is wider and more general. The special principles of the Baltic region and threats relevant in the Baltic Sea and identified from the literature will be presented in the next report.

Although often maritime safety and security issues are dealt with separately, they are often difficult to distinguish between each other. Because of it we have chosen to use a comprehensive approach of safety and security in analyzing the identified threats. That is why we have included in this report also maritime safety matters. It is important to understand basic principles and structures of maritime safety. Still, because the focus is more on maritime security and because maritime safety is so widely studied and reported, the concept is only shortly introduced.

The essential terms in the report are Maritime Safety and Maritime Security. These terms are defined follows (del Pozo, Dymock, Feldt, Hebrard & Monteforte, 2010, 45-46):

Maritime Safety: *The combination of preventive measures intended to protect the maritime domain against, and limit the effect of accidental or natural danger, harms, damage to environment, risk or loss.*

Maritime Security: *The combination of preventive and responsive measures to protect the maritime domain against threats and intentional unlawful acts.*

The other related terms (hazard, threat, risk, risk assessment and risk analysis) will be presented later in the following chapters.

2 THEORETICAL BACKGROUND

It has not been possible to develop a common theory for safety and security. According to the psychologists Teemu Reiman and Pia Oedewald (2008) who have studied safety critical organizations the present fourth era of safety research highlights multidisciplinary and perceiving entities. That is because safety cannot be understood by means of the approaches.

Because there is no common theory for safety and security, we have chosen three theories that reflect and also guide our project. These are traditional engineering approach to risk management, resilience theory and complexity theory. Thus, we have chosen both traditional approaches and newer theories that help to understand the whole phenomena better and take into account for example complexity of the systems. These theories are shortly described in the following sub-chapters. Finally, a synthesis of the theories is presented in the last sub-chapter.

2.1 Traditional risk management

Safety critical industries, like aviation and nuclear industry, as well as maritime industry have tried to manage safety (and security) issues using tools such as safety and risk management systems. International Civil Aviation Organization (ICAO, 2008) has defined that: *“Safety risk management is the other core activity that supports the management of safety and contributes to other, indirectly related organizational processes. The term safety risk management, as opposed to the more generic term risk management, is meant to convey the notion that the management of safety does not aim – directly – at the management of financial risk, legal risk, economic risk and so forth, but it restricts itself primarily to the management of safety risks”*.

For example, International Safety Management Code (ISM) and International Ship and Port Facility Security Code (ISPS) codes include the basic requirements for these kinds of management systems in the maritime industry. The basic philosophy of these kinds of management systems is to identify all hazards (or threats) that might endanger operation, and through risk assessment process find the most severe risks which should be removed or minimized (see e.g. ICAO, 2008). The methods to remove or minimize the identified and analyzed risks are called risk management practices. Basic risk analyzing process is described in chapters 5.1 and 5.2.

Risk analysis process depends on the model of accident causation. Arguably, the best known and most widely referred accident model is James Reason’s Swiss Cheese Model of Accident Causation (see the figure 1).

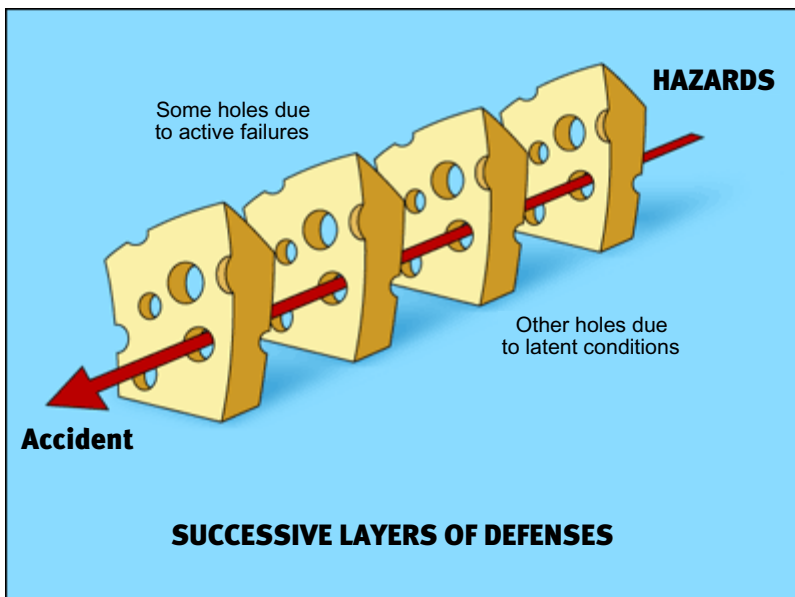


Figure 1. Professor James Reason's Swiss Cheese Model of Accident Causation (Duke University Medical Center, 2005).

The Swiss cheese slides in the model present the layers of defenses against potential error (active failures) impacting the outcome. These various defences are built deep into a safety critical system to protect against fluctuations in human performance or decisions with a downside at all levels of the system. The holes of the cheese refer to existing latent conditions that could lead to breaches in the systems defences. (ICAO, 2008.) If accidents happen like the Reason's model shows it, the risks are possible to find by searching of the combination of failures and conditions. Then, likelihood of weakened defenses and its combinations are evaluated during the risk assessment process. (Hollnagel, 2008.)

2.2 Resilience theory

Some experts have stated that instead of risk management we should learn to tolerate the fear and also recover from it (Airaksinen, 2011, according to Hanen & Huhtinen, 2011). Resilience theory is focused on these requirements. The framework and philosophy of the theory is very similar to the complexity theory described above.

The terms safety and risk stem from engineering tradition where risks are related to unreliable system components, human or technological. In contrast, resilience engineering focuses on how systems can be managed under varying and unpredictable conditions. Furthermore, safety assessment is usually focused on what can go wrong and how this could be prevented. However, in resilience engineer-

ing safety assessment is focused on what goes right, as well as on what should have gone right. (Hollnagel, 2008.)

2.3 Complexity theory

As mentioned earlier, there is no common theory for safety and security. According to Hanen and Huhtinen (2011), this is because safety and security are not only a complicated, but also complex and tightly interconnected matters. When several factors are effective in a situation the result is usually unpredictable and the cause consequence relation is difficult to determine.

All human systems are complex because they are multidimensional in social, cultural, political, physical, technical, economic and other dimensions which interact and influence each other. Complexity theory studies social systems holistically and therefore, it examines all factors that interact and influences each other. (Goergen, Malline, Mitleton-Kelly, Al-Hawamdeh, Hse-Yu Chiu, 2010.)

Formal counting risk assessment helps to understand only partially the hazards of socio-technical systems: it is very difficult or even impossible to predict potential problems related to the flow of information and for example potential hazards or security threats (Turner et al. 1997, according to Hanen & Huhtinen, 2011). When describing complexity systems, theoretical terms are used often although closely connected interaction fits rather poorly to the framework of systems thinking. An organization defined as a system considers its future known and deterministic. It also acts through rational planning process in order to achieve continuous stability. In contrast, complexity thinking considers the future unknown and constructs it all the time – the future can be influenced and is complex and paradoxal. (Lindell 2011, 56-71.)

2.4 Conclusion

We have chosen two different views for this study, namely the traditional engineering approach and resilience and complexity theory that, instead of risk analysis of small components, study the systems holistically (complexity theory) and concentrate how to tolerate the fear and how to recover from it (resilience theory). Resilience theory also encourages us to observe what can go right contrary to traditional engineering approach which seeks the possible failures and errors.

Based on the theories described above, we have decided to gather information about maritime security threats in the Baltic Sea region employing two methods. One method is based on the traditional risk management: that is asking maritime security experts to estimate the most relevant threats in the area and to evaluate the probability of occurrence and consequences. We will also analyze the threats using the certain analyzing method that will be developed during the project. This

analysis will be taken into account from the standpoint of both the security and safety and therefore we can have more holistic approach to the study. We will also study the security threats using an expert method Delphi to study complex systems. The methods and following phases of the study have been described in more detail in chapter 7.

3 MARITIME SAFETY

As described in the first chapter (1.4), the definition of maritime safety refers to accidental and natural danger, harm or damage while maritime security refers to intentional events. Often maritime safety has been defined as a combination of safety and security related aspects.

The main goal in the development of maritime safety is the prevention of accidents. When considering the prevention factors, the maritime safety must be first defined as well as its main factors. According to another definition, maritime safety is the safety of life and protection of property at sea from the environmental and operational threats, as well as the safety of maritime environment from pollution by the ships (Urbański, Morgaś & Mięsikowski, 2009).

Marine safety can be defined as follows consisting of four following components:

1. External safety, such as safe fairways, ports, safety equipment, environmental conditions. Typically these aspects are taking care of fairway designers, civil engineers, PIANC, IALA etc.
2. Internal safety, such as the ship's structure, the ship's damage stability, assessment of commercial premises, etc. Typically this sector of the safety is taking care of naval architects, Classification societies, Port state Control etc.
3. Human factor and which maybe forms the most interesting part of the safety definition. It is a known fact that roughly 80 % of all incidents and accidents are caused by human factor, thus this factors form the most essential item for the safety improvement plans. Typically this aspect is taken care by crew onboard, navigation skills, safety culture onboard and in the shipping company, human-machine interaction, VTS, etc.
4. Environmental impacts result from the complex interactions between the above-mentioned factors. (Nyman et al. 2010, 12.)

One important safety factor not mentioned in the above list is organizational factor. One term that includes both human factors (mariner's impact to safety) and organizational factors (whole the company's impact) is operational safety. Michael Salter (2006) has studied operational safety and has determined it as following: human factors (or people), working conditions (or equipment), operational procedures and organizational culture (and safety management system). As International Safety Management Code (ISM Code) has developed in order to force ship-

ping companies to take liability of the safety and security matters of their shipping operations, this kind of operational safety should be taken into the definitions of maritime safety.

Aviation is very often used as a reference domain when searching for best safety management practices because aviation safety has strongly improved during the last decades. International Civil Aviation Organization (ICAO) has created safety management system and guidelines for the aviation companies and national states. First, the safety concept is described in the safety management manual (ICAO, 2006). The concept includes the following connotations:

- a) *zero accidents (or serious incidents), a view widely held by the travelling public;*
- b) *the freedom from danger or risks, i.e. those factors which cause or are likely to cause harm;*
- c) *the attitude towards unsafe acts and conditions by employees (reflecting a “safe” corporate culture);*
- d) *the degree to which the inherent risks in aviation are “acceptable”;*
- e) *the process of hazard identification and risk management; and*
- f) *the control of accidental loss (of persons and property, and damage to the environment).*

ICAO's (2008) Safety Management Manual also defines safety: *“as the out-come of the management of a number of organizational processes. The management of these organizational processes has the objective of keeping safety risks under organizational control. Key in this perspective is the notion of safety as outcome, and safety risk management as process”*. So, aviation domain highlights the responsibility of organizations (shipping companies in this context) and risk management in safety ensuring process.

3.1 Maritime hazards

In spite of the criticism against traditional risk management (see the previous chapter 2), it is still considered by safety experts a cornerstone of safety management and one of the most important tools to prevent accidents (see chapter 5.1). Furthermore, hazard identification is the most important step to manage maritime safety risks.

International Civil Aviation Organization (ICAO, 2008) has defined a hazard as follows: *“Hazard is a condition or an object with the potential of causing injuries to*

personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function”. Thus, wind or other weather conditions are one example of the maritime hazards.

Supposedly, comprehensive lists of the maritime hazards do not exist, but of course many kinds of lists have been made. One list of maritime hazard has made in the study of maritime safety on short sea shipping. The hazard list is a combination of the researchers’ question list in the study and the answers of the open questions by the respondents, see enclosure 1. (Lappalainen, Storgård, Tapaninen, 2012.)

3.2 Maritime risks

Safety risks are defined by ICAO (2008) as follows: “Safety risk is defined as the assessment, expressed in terms of predicted probability and severity, of the consequence(s) of a hazard taking as reference the worst foreseeable situation”. According to this definition, the example of a maritime hazard in the previous subchapter, wind, is not a risk, but the possible consequences that the wind can cause, are. For example, if a ship’s master is unable to maneuver the vessel during adverse wind conditions in a harbor, the possible consequence, e.g. a collision with a port construction, is a risk. Thus, typically the possible accidents and incidents are maritime safety risks. Perhaps the most known maritime risks can be found from the following picture of Maritime accident types (Kristiansen, 2006).

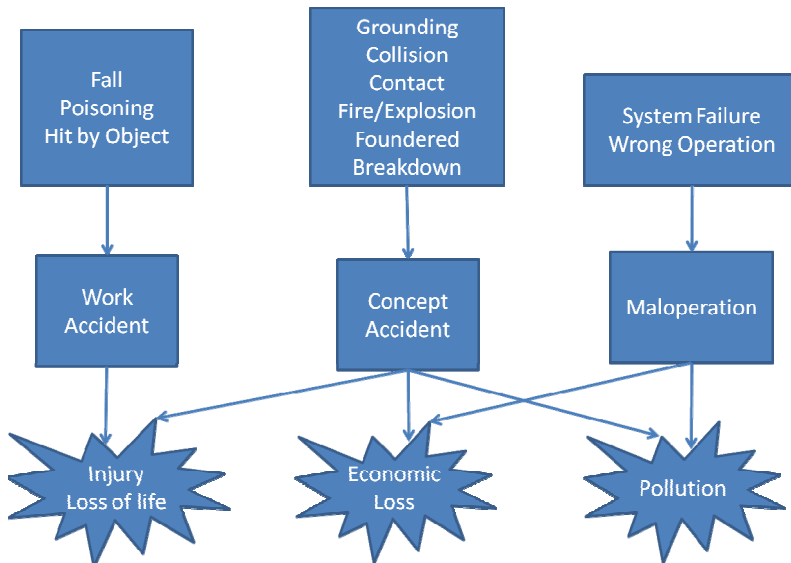


Figure 2. Maritime Accident Types (Kristiansen, 2005).

4 MARITIME SECURITY

The intentional acts are meant when the word security is used. In contrast, safety refers to unintentional events. Traditional safety concept reviews primarily random accidents, failures, errors, mistakes, malfunctions, and any result from these possible damages. Security's point of view brings to the examination of planned, appropriate actions whose aim is to influence harmfully to selected target. It is spoken in the context of sabotage, vandalism, terrorism, piracy, theft, espionage, or a variety of threats for the operations. The concept of security often also refers to organized criminal activity, such as tax evasion, extortion, smuggling and human trafficking, which are primary to design to produce a benefit for them. (Nyman et al. 2010, 14.)

Maritime security definitions as well as security threats and risks are discussed in this chapter. The threats are first defined and listed according to the literary sources and after that they have been classified in the meaning of our following phases of the project. Also, the threats are described more in detail in this context.

4.1 Maritime security definition

There are many definitions and meanings for the terms "security" and "maritime security". The meanings depend on who is using the term or in what context it is being used (Klein, 2011). Next, some definitions have been collected for the terms "security" and "maritime security" from literature.

Natalie Klein (2011, 4) discusses in her book of Maritime Security and the Law of the Sea the definition of the term security and states that from an academic perspective security has several meanings depending on the theoretical school. For example, The Copenhagen School (Bradford, J. 2004, according to Klein, 2011, 4) claims that:

"Security is a socially constructed concept and that discourse is a key element in the construction and identification of security issues. Based on the discourse which surrounds it, a public policy issue can be classified as non-politicized, politicized or securitized. - - A securitized issue is identified as a potential threat to the continued existence of the state. Once securitized, issues are perceived to be of such immediate importance that they are elevated above the ordinary norms of the political debate and the state acquires special rights to adopt extraordinary measures in order to protect itself".

Based on literature and interviews of enterprises Genserik Reniers (2011) has defined security as: *“taking all preventive measures in order to avoid harmful incidents caused by unauthorized (internal or external) persons who intend to seriously damage the company, as well as controlling such incidents and their adverse effects”*. Finnish Ministry of Defence defines comprehensive concept of security as follows *“The comprehensive concept of security comprises security issues which, if exacerbated, may turn into threats that can jeopardize or seriously harm Finland, Finns or the functions vital to Finnish society. Wide-ranging threats include premeditated action such as the use of military force, terrorism or interference with information networks. They can also occur spontaneously, such as widespread failures of the electric grid or extreme forces of nature”*. (Ministry of Defence, 2010.)

Natalie Klein (2011, 8) has stated that different actors use different meanings for the term maritime security. For example, military perspective on maritime security highlights different matters than maritime industry. US Naval Operations Concept refers to the aims of maritime security operations such as *“ensuring the freedom of navigation, the flow of commerce and the protection of ocean resources, as well as securing the maritime domain from nation-state threats, terrorism, drug trafficking and other forms of transnational crime, piracy, environmental destruction and illegal seaborne immigration”* (Chief of Naval Operations, 2004, ref. to Klein, 2011)

In contrast for ship owners, maritime security mainly implies a transport system and relates to the safe transport of cargo without interference or being subjected to criminal activity (Raymond & Morrien, 2008, according to Klein, 2011, 8). Referring to this ship owner’s view, Steven Jones (2006) explains in his book *“Maritime Security”* that the concept of security for them is *“the state of a shipping company/vessel/crew/port, being of feeling secure”*; or *“the safety of a shipping company/vessel/crew/port against such threats as terrorism, piracy, and other criminal activities”*.

The United Nations Secretary-General has said that there is no agreed definition of maritime security, and instead of trying to define it he identifies what activities are commonly perceived as threats to maritime security (UNGA, 2008). The maritime security threats will be defined and described in the following sub-chapters.

4.2 Security-related threats and threat scenarios

Criminal Intelligence Service Canada (2007, 27) presents the term “threat” as follows: *“Threat is a based on a group’s (or subject’s) intent and capability and is a measure of how likely the success in carrying out some activity that may cause harm.”*

According to the preliminary study of this MIMIC project, the most typical threats toward vessels, their crews, passengers and/or cargoes or infrastructure and operation of maritime transportation are sabotage or other intentional damage or distur-

bance, terrorist attack, hijack / piracy, blackmailing and threatening, theft and violence. Maritime transportation can be strived to utilize in criminal operations e.g. smuggling of forbidden goods, human trafficking or arrangement of illegal arrival to country, or terrorist attack / damage against external object. (Nyman et al., 2010, 32.)

UN's convention treaty (Nyman et al., 2010) and ISPS Code by International Maritime Organization list illegal acts related to maritime environment that can be considered security threats:

- intentional pollution, illegal emission
- smuggling and trafficking illicit drugs and psychoactive substance
- piracy
- armed robbery
- hijacking of the ship or of the persons on board
- terrorist attack
- use of the ship to carry those intending to cause a security incident and/or their equipment
- use of the ship itself as a weapon or as a means to cause damage or de-struction
- nuclear, biological and chemical attack
- blockage of the port entrances, locks, approaches etc.
- tampering with cargo, essential ship equipment or systems or ship's stores
- taking hostages
- stowaways
- smuggling weapons or equipment
- trafficking illegal firearms, their parts and components and ammunition
- illegal fishing
- damage to, or destruction of, the ship or of a port facility, e.g. by explosive devices, arson, sabotage or vandalism
- environmental activist.

Threat scenarios and possible disturbances have been defined in the Finnish Society Security Strategy. These scenarios are defined in order to secure the functions vital to society, and they are: serious disturbances in the power supply, serious disturbances in the telecommunications and information systems – cyber threats, serious disturbances in transport logistics, serious disruptions in public utilities, serious disturbances in food supply, serious disturbances in the financial and payment systems, disruptions in the availability of public funding, serious disturbances in the health and welfare of the population, major accidents, extreme natural phenomena and environmental threats, terrorism and other criminality that endanger social order, serious disturbances in border security, a political, economic and military pressure and the use of military force. (Ministry of Defense, 2011.)

This Strategy provides a comprehensive approach, but there are also several threat scenarios that have a close connection to the maritime domain. These maritime related threats and their connections to the defined disturbances are listed in the enclosure 2.

According to Finnish Defense (2011), threats may be studied from the perspective of the cause, by the way they manifest themselves or by their effects. In practice, maritime threat scenarios encompass a wide range of potential and individual scenarios which have distinct features. A relatively current report prepared for U.S. Congress (CRS, 2007) identifies five common dimensions of maritime threat scenarios. These dimensions are perpetrators, objectives, locations, targets and tactics.

- Perpetrators: Identifying potential perpetrators is important because perpetrator capabilities vary widely and therefore bear on the types of acts they might attempt.
- Objectives: Perpetrators have different objectives for their acts. They may seek to cause human casualties, economic losses, environmental damage, insecurity and fear among people or other negative impacts. Potential consequences for each scenario have to be considered and how well they correspond to the potential perpetrators' objectives.
- Locations: Where a potential attack could occur. Perpetrators' objectives and target selection limits the potential locations for attack.
- Targets: The potential targets for an attack. Understanding the potential targets' capabilities and objectives may offer valuable insight into credibility of attack scenarios.
- Tactics: The number of tactics used in the attacks has been identified. Artificial selection is limited by perpetrators' capabilities, objectives and selection of the target.

Table 1. Example Maritime Attack Characteristics (CRS, 2007, 7)

Dimensions	Example Characteristics	
Perpetrators	<ul style="list-style-type: none"> • Al Qaeda and affiliates • Islamist unaffiliated • Foreign nationalists 	<ul style="list-style-type: none"> • Disgruntled employees • Others
Objectives	<ul style="list-style-type: none"> • Mass casualties • Port disruption 	<ul style="list-style-type: none"> • Trade disruption • Environmental damage
Locations	<ul style="list-style-type: none"> • 360+ U.S ports • 165 foreign trade partners 	<ul style="list-style-type: none"> • 9 key shipping bottlenecks
Targets	<ul style="list-style-type: none"> • Military vessels • Cargo vessels • Fuel tankers • Ferries / cruise ships 	<ul style="list-style-type: none"> • Port area populations • Ship channels • Port industrial plants • Offshore platforms
Tactics	<ul style="list-style-type: none"> • Explosives in suicide boats • Explosives in light aircraft • Ramming with vessels • Ship-launched missiles • Harbor mines 	<ul style="list-style-type: none"> • Underwater swimmers • Unmanned submarine bombs • Exploding fuel tankers • Explosives in cargo ships • WMD in cargo ships

Table 1 provides a set of illustrative characteristics which could serve as the basis for the development of potential threat scenarios. Based on different combinations of perpetrators, objectives, locations, targets and actions it is possible to combine a large number of logically consistent and operationally credible threat scenarios. Acts can be carried out in so many different ways that realistically it is impossible to shelter from them all. The key feature is then the ability to distinguish real and significant security resources and measures in the right targets. (Nyman et al., 2010; CRS, 2007, 2-7.)

4.3 Classification of the threats

Different threats are described in this sub-chapter. The threats are classified into nine categories for the incoming study. The nine sections are: destroying the marine environment, illegal fishing, smuggling, stowaways, piracy, terrorism, environmental activist, vandalism and theft.

Destroying the marine environment

In this study the matter of destroying the marine environment is only a review from the perspective of security such as illegal emissions and intentional pollution.

It is prohibited to discharge into sea noxious liquid substances which have not been categorized, provisionally assessed or evaluated. Also any deliberate disposal of wastes or other matter from the ship is prohibited. (HELCOM, 2009, 6,9.)

Illegal fishing

Illegal, unreported and unregulated fishing destroys marine habitats, drains fish stocks, puts honest fishers at an unfair disadvantage, and weakens coastal communities, especially in developing countries. (European Commission Fisheries, 2011.)

Food and Agriculture Organization of the United Nations (FAO, 2001) defines activities that refer to illegal fishing as follows:

”Illegal fishing refers to activities:

- *conducted by national or foreign vessels in waters under the jurisdiction of a State, without the permission of that State, or in contravention of its laws and regulations;*
- *conducted by vessels flying the flag of States that are parties to a relevant regional fisheries management organization but operate in contravention of the conservation and management measures adopted by that organization and by*

which the States are bound, or relevant provisions of the applicable international law; or

- *in violation of national laws or international obligations, including those undertaken by cooperating States to a relevant regional fisheries management organization.* “

Smuggling

Majority of illegal drugs is smuggled in ships. This presents a significant challenge to commercial vessels and seaports. In terms of volume, the world's largest illicit drug product is cannabis, that is, the production of cannabis herb, followed by cannabis resin. The second largest illicit drug production is related to cocaine followed by heroin. Amphetamine-type stimulants are produced in quantities comparable to heroin. (McNicholas, 2008, 189; UNODC, 2011, 19.)

Stowaways

Stowaway is a person who hides in a ship or cargo without the consent of the Master or of any other authorized by the Master. Majority of persons who becomes a stowaway are looking for better life for themselves and likely to their families. Stowaways are linked to people smuggling and human trafficking. People smuggling and human trafficking are two different concepts. In people smuggling, the migrants are willing participants and organized criminals profit from facilitating their immigration. Human trafficking occurs when the intention is to exploit migrants in their destination. (Bist, 2000, 228; McNicholas, 2008, 173; Jones, 2006, 28.)

The UN Trafficking Protocol highlights the importance of exploitation: “Trafficking in persons shall mean the recruitment, transportation, harboring or receipt of persons, by means of the threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability or the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation. Exploitation shall include, at a minimum, the exploitation of the prostitution of others or other forms of sexual exploitation, forced labor or services, slavery or practices similar to slavery, servitude or the removal of organs.” (Jones, 2006, 28.)

Piracy

Michael McNicholas defines piracy in his book “Maritime Security An Introduction” as follows: “An assault on a vessel, cargo, passengers, or crew, usually from another vessel while at sea by persons acting for personal gain and not acting behalf of any recognized flag or International authority. Also includes acts of rioters who attack a ship from the shore for the purpose of theft or of passengers who attack the ship and its personnel from on board”.

Terrorism

United Nations define that terrorism is any action that is intended to cause death or serious bodily harm to civilians or non-combatants when the purpose of such an act is to intimidate a population or to compel a Government or an international organization to do or to abstain from doing any act. (Jones, 2006, 2.)

According to the Finnish Ministry of Defense, there is no generally accepted definition for terrorism. Usually it refers to violent, illegal, national or international, activity or the threat of violence with the objective of causing unrest and deep fear. The aim of a terrorist act is typically to force political leaders to give in to the terrorists' hopes. Terrorists often seek and exploit visibility in the media in order to achieve their goals." (Ministry of Defense, 2011.)

Environmental activist

Environmental activism is the combined political force of people who take action to protect the environment. The green movement is inspired by proactive opportunities to promote its vision of a better world. (OnWorld, 2012.)

Vandalism

Vandalism can be difficult to define because of the fact that evaluation of behavior depends on the perspective chosen. Three different approaches can be with focus varying between the damage, actor and context. (Christensen, H., Johnson, D., & Brookes, M. 1992.)

Point of view of the caused damage, the actor and the observer must be included into definition of vandalism. Despite the variety of the behaviors, the motivations that originate it, the diversity of targets and the consequences of damage caused the following definition can be proposed:

"Vandalism is a voluntary degradation of the environment with no motivation of profit whatsoever, the results of which are considered as damage by the actor(s) as well as by the victim in relation to the norms that rule the situation." (Christensen, H., Johnson, D., & Brookes, M. 1992.)

Theft

According to Washington State of Legislature (2004), theft is defined to be:

(a) To wrongfully obtain or exert unauthorized control over the property or services of another or the value thereof, with intent to deprive him or her of such property or services; or

(b) By color or aid of deception to obtain control over the property or services of another or the value thereof, with intent to deprive him or her of such property or services; or

(c) To appropriate lost or misdelivered property or services of another, or the value thereof, with intent to deprive him or her of such property or services.”

5 ANALYTICAL TOOLS TO ASSESS SECURITY RISKS

Some possible analytical tools for assessing maritime security risks are described in this chapter. This is not a complete list, and the methods employed are based on their relevance for the project.

First, conventional risk assessment and Formal Safety Assessment (FSA) method that is based also on traditional risk management process are described. After that, there is a short chapter about Delphi-method. Finally, some of the qualities of risk assessment tools used to evaluate security risks are listed. Because the analyzing method that will be used in this study will be developed later by a commissioned study, we have not added detailed information of available assessment tools.

5.1 Conventional Risk assessment

In order to assess risk, it is important to be aware of the distinction between hazard and risk. European Commissions' "Guidance of risk assessment at work" defines hazard and risk as following definitions:

Hazard: The intrinsic of property or ability of something (e.g. work materials, equipment, work methods and practices) with the potential to cause harm.

Risk: The likelihood that potential for harm will be attained under the conditions of use and/or exposure, and the possible extent of the harm.

European Commission has defined the term "risk" comprehensively. Criminal Intelligence Service Canada (2007, 25) in turn presents the term "risk" in more detail as follows: "*Risk refers to the uncertainty that future events and outcomes. It is measured in terms of likelihood and harm (consequences) of an event with the potential to influence the achievement of an important objective. Often expressed as: Threat + Vulnerability = Risk.*"

The conventional approach defines risk as being the chance of an accident or adverse occurrence. The process of risk assessment and management is generally based on the following three steps:

1. "*The assessment of risk in term of what can go wrong, the probability of it going wrong, and the possible consequences,*"

2. *The management of risk term of what can be done, the options and trade-offs available between the cost, the benefits and the risks, and*
3. *The impact of risk management decisions and policies on future options and undertakings.*“ (Bichou, 2008, 4-5.)

When there is a need for more extensive risk assessment, these following five steps can be used: identifying hazards and those at risk, evaluating and prioritizing risk, deciding on preventive action, taking action and Monitoring and reviewing. (European Agency for Safety and Health at Work.)

Risk assessment is a comprehensive and systematic method to identify and evaluate risks to health and safety. Risk management priorities are determined by evaluating and comparing the level of the risk against predetermined standards and other criteria. It also involves the decision between suitable control measures to prevent loss, damage or injury. The assessment should include the controls required to eliminate, reduce or minimize the risk. Risk analysis is a part of the risk assessment. Risk analysis consists of quantification of objects limits, identifications of hazards and evaluations of risk. Risk assessment requires a comprehensive analysis (European Commission, 1996, 11; Intelligence Service Canada, 2007, 26; Sosiaali- ja terveystieteiden ministeriö, 2003.)

5.2 Formal Safety Assessment (FSA)

Formal Safety Assessment (FSA) is a structured and systematic analysis tool. It aims at enhancing maritime safety, including protection of life, health, the marine environment and property. FSA study includes five steps: identification of hazards, risk analysis, risk control options, cost benefit assessment and recommendations for decision-making. The FSA process starts with the definition by the decision-makers of the problem that will be assessed along any relevant boundary conditions or constraints. (IMO, 2007, 3, 5.)

The purpose of step 1 is to identify and prioritize by risk level a list of hazards and associated scenarios which could lead to significant consequences. A combination of creative and analytical strategies is used for hazards identification. The output from step 1 is a list of hazards and their associated prioritization by risk level and descriptions of causes and effects (IMO, 2007, 8-9.)

The probabilities of occurrence and consequences of the most important scenarios identified in step 1 are being investigated in step 2. This can be achieved by using proper techniques that model the risk. The output from step 2 provides the identification of the high risk areas which need to be addressed. (IMO, 2007, 9-10.)

The aim of step 3 is to create risk control options (RCOs) that address both existing risks and risks introduced by new technology or new methods of operation

and management. A range of RCOs which are assessed for their effectiveness in reducing risk, a list of interested entities affected by the identified RCOs and a table stating the interdependencies between the identified RCOs are the output from this step. (IMO, 2007, 10, 12.)

Benefits and costs associated with the implementation of each RCO identified and defined in step 3 are in step 4 identified and compared. Cost and benefits should be as comprehensive as possible. The output from this step is costs and benefits for each RCO identified in step 3, costs and benefits for those interested entities which are the most influenced by the problem in question and cost effectiveness expressed in terms of suitable indices. (IMO, 2007, 12-13.)

Step 5 defines recommendations which should be presented to the relevant decision makers in an auditable and traceable manner. The recommendations are based on the comparison and ranking of all hazards and their underlying causes. The output from this step comprises an objective comparison of alternative options, based on the potential reduction of risk and cost effectiveness, in areas where legislation or rules should be reviewed or developed and feedback information to review the results generated in the previous steps. (IMO, 2007, 13.)

5.3 Delphi method

Delphi method is defined by Linstone and Turoff (2002) as follows:

“Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem” (Linstone and Turoff, 2002, 5).

In addition, the authors (Linstone and Turoff, 2002, 6) claim that there will be need for using Delphi method in the following cases:

- *“The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis*
- *The individuals needed to contribute to the examination of a broad or complex problem have no history of adequate communication and may represent diverse backgrounds with respect to experience or expertise*
- *More individuals are needed than can effectively interact in a face-to-face exchange*
- *Time and cost make frequent group meetings infeasible*
- *The efficiency of face-to-face meetings can be increased by a supplemental group communication process*

- *Disagreements among individuals are so severe or politically unpalatable that the communication process must be refereed and/or anonymity assured*
- *The heterogeneity of the participants must be preserved to assure validity of the results, i.e., avoidance of domination by quantity or by strength of personality (“bandwagon effect”).*

5.4 Security assessment tools

There is no consensus between risk assessment experts how to analyze security risks. A major challenge in risk analysis of security issues is that a terrorist or intentional actor, unlike engineered systems, is intelligent and may adapt to the defensive measures. Because of this adaptive nature, it is arguably problematic to assess probabilities of the security events or use traditional probabilistic risk analysis tools (PRA tools), such as event trees. Also, alternative tools e.g. extended forms of games or decision trees might be better solutions. (Ezell, Bennett, von Winterfeldt, Sokolowski & Collins, 2010.)

Ezell et al. (2010) have, however, stated in their study that it is possible to assess probabilities of terrorism risks and for example use event trees as a risk assessment tool. They indicate that the developed alternative tools have also limitations, and their conclusion was that multiple approaches in combination are needed to address the complex issue of terrorism. (Ezell et al., 2010.)

According to Ezell’s team, methodology is not so much a challenge for the Department of Homeland Security as how best to consult, incorporate, and transform relevant intelligence information into reasonable inputs for security risk analysis. In turn, the National Research Council’s Committee on Methodological Improvements to the Department of Homeland Security’s Biological Agent Risk Analysis has advised that when modeling bioterrorists, adversaries have to be assumed to make always the choice that maximizes his or her objectives. On that account, the focus should be on terrorism attack probabilities outputs of decision models, rather than incorporating intelligence information as input. (Ezell et al., 2010.)

There are many other security assesment tools found in literature e.g. PRA-based methodologies, logic trees, influence diagrams, Bayesian network analysis and game theoretic models. These tools are studied and analyzed more in detail in the following phases of this MIMIC project.

6 DEVELOPING COMPREHENSIVE SECURITY APPROACH

According to complexity theory, it is difficult to distinguish individual events from the whole (look at the chapter 2). Also, some expert has said that safety and security are difficult to distinguish from each other. Consequences of any security event, such as terrorist attack or smuggling human beings may cause harm to people. Because of that, safety risks have to be included in the risk assessment of security threats. Also, the Advisory Board of our project, Finnish Inter-agency Baltic Sea Network for Security Research, guided us to study the links between safety and security risk factors and risks. Thus, we wanted to study how to combine safety and security in the terms of their structures.

One way to combine safety and security is from the point of view of vessels or sea transports, and see all safety hazards or security threats as sources of a common risk factor that may cause harm to vessels or sea transport. This is a typical example for the authorities or states that try to estimate general levels of safety and security for a certain domain or industry. One good example of this is the Finnish security strategy where the potential objects of threat are described. “Sea transports are particularly critical for the functioning of society. In normal conditions, sea transports and vessels may be threatened by, among other things, disturbances in transports of critical materials or port functions, restrictions of maritime traffic, threats posed by vessels themselves as well as terrorism and accidents. In disturbances, maritime traffic may be impeded by the Gulf of Finland becoming non-navigable, sabotage against vessels and ports, restrictions against using foreign territorial waters or ports as well as the out flagging of Finnish-registered vessels. The vulnerability of transports to disturbances is on the increase and valid insurance on vessels, cargo and crew constitute a necessary precondition for the continuation of maritime traffic. When transport risks increase there may be a dramatic rise in insurance costs and international reinsurance markets cease to function. Decision-making of the Finnish transport business regarding key issues is gradually migrating abroad.” (Ministry of Defense, 2011.)

A Finnish model of corporate security based on the thought that there are several parts of security (and safety) (YTNK, 2009). If all these sections are managed by same basic functions and principles, well-functioning safety (and security) management system and safety culture is possible to achieve. The security and safety parts of the model are presented in the figure below. Personnel, reputation, environment, information and property are the targets (in the middle in the figure) that are protected by corporate operations.



Figure 3. The sections of corporation security (YTNK, 2009)

Safety and security aspects and various actors in the maritime field are illustrated in figure 4 below (Security subcommittee, 2010).

The key factor for the total safety concept is the wide co-operation between the real business related actors (shipping companies, ports, stevedoring companies) and governmental bodies (customs, maritime administrations, coast guard). The international character of the maritime business and certain features of the concept of security will underline the necessity of the regional co-operational of municipalities and governmental offices with the international domain.

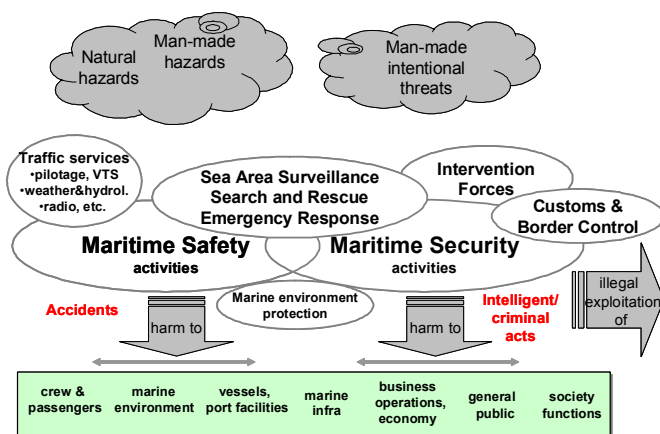


Figure 4. The sketch of the maritime total safety (Nyman et. al. 2010).

7 CONCLUSIONS

7.1 Summary

The purpose of this report was to create an actual review on maritime oil transportation security threats and to acquire preliminary information for the designing of holistic safety concept of maritime oil transport which was the main object of research in this literature review. The traditional safety is focused on stochastic events, failures, malfunctions, errors and consequences related to these events. Security view concentrates on intentionally planned actions and missions by which the initiators will make harm or distress to the selected target. Typical actions belonging to this category are sabotage, vandalism, terrorism, piracy, theft, espionage and various threats for normal operations.

The main research question in work package 3 (identification and assessment of security related risks) is defined as follows: How comprehensive safety concept of maritime transport can be defined?

This report aimed to create the theoretical background and framework for the project. It was discovered that there were many issues which have to be taken into account when the comprehensive safety concept of maritime transport is defined.

The list of maritime security threats which have been received as an outcome of this report have been utilized for forming the questions of theme structural interviews. Additionally, preliminary knowledge for the analyzing of maritime security threats was obtained. This knowledge will be used for selecting the most applicable analyzing tool for the assessment of maritime security threats.

The guidelines for the theoretical background will be made based on this literature review. Conventional risk assessment is used and will be used for analyzing of preliminary outcomes of theme structural interviews. Because the assessment of security threats is a very complicated and complex matter, other analysis methods such as Delphi will be used also.

7.2 Following phases of project

In the following section, the research problem and the applied research method of the whole work package 3 (identification and assessment of security related risks) are reviewed.

Research problem

The main purpose is to identify, gather and assess security threats, scenarios and risks related to marine oil transportation in the Baltic Sea. In this report, security threats have been gathered from literature. The following phase of the project will involve interviews of the experts of maritime security such as security managers of ship owners, oil harbors and authorities.

Answers to research problem will be sought by the following sub-research questions:

- What kind of security threats of maritime (oil transportation) sector will be targeted to Baltic Sea area?
- How the security threats could be analyzed from the comprehensive safety point of view?
- What kinds of actions are needed for the development of comprehensive safety of maritime sector, when the security threats are also taken into account in risk management?

The planned research method will be presented in the next chapter.

Research method

After this literature review, the project will be continued by empirical research. The collection of empirical material will be based on the list of maritime security threats which has been classified in paragraph 4.3. The continuing study will concentrate on two empirical research materials which are:

1. Maritime security threats and scenarios collected by structural theme interview and
2. Material gathered by Delphi survey.

The majority of empirical material of maritime security threats and scenarios will be collected, specified and verified by Delphi survey. According to the definition (see chapter 5.3.), the Delphi method will be suited to the processing of complicated and changing problems and subjects such as the scenarios of maritime security threats stand for. The Delphi method was chosen because it will clearly highlight the views of specialists.

The main aim is to choose a comprehensive group of specialists for evaluating the matter in question. Then the aspects of threats and scenarios will be presented to the specialists who will answer anonymously. In this study, the group of specialists

consists of authorities, representatives of oil shipping companies and oil ports in Finland and perhaps in Sweden.

Structure of study

The study will be carried out in several parts. The first part of the study will be executed as a structured theme interview. At the same time, the development of theoretical tool (method or model) for analyzing the maritime security threats and scenarios will be started. The theoretical method or model for estimation of security threats will be developed as a subcontract. The subcontract will be a study about alternative ways to analyze maritime security threats. With the aid of the theoretical method or model, optional approaches will be produced to process, estimate and analyze the maritime security threats at the Baltic Sea. Seriousness, probability and / or resilience of consequences for maritime security threats can be classified. The suitability of Formal Safety Assessment (FSA) procedure for estimation of security threats should also be estimated in the study. The second part of study will follow after execution of interviews and development of analyzing tool.

In the second part of the study the received identified threats and threat scenarios will be estimated by the developed theoretical method. Various aspects and arguments of maritime security threats and scenarios will be produced based on the information received from theme interviews and preliminary assessment of security threats by developed analyzing tool. Thereby, the structured theme interviews together with analyzing method or model will produce material for the next phase of study which will be Delphi.

Delphi has been described in chapter 5.3. The aspects and arguments of maritime security threats and scenarios will be presented to the selected group of specialists. There will be 3-5 rounds of aspects or arguments. The accurate variation of Delphi survey will be decided later.

Finally, after the results, discussion, formation of synthesis and answer to the research question will be executed.

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Enclosure 1

List of maritime hazard (Lappalainen, Storgård, Tapaninen, 2012)

- deteriorated ships,
- growth of ship size,
- competency of seafarers,
- fatigue of seafarers,
- safety culture onboard vessels,
- safety culture in shipping companies,
- complexity of maritime safety legislation,
- amount of bureaucracy,
- incompetency of maritime administration,
- lack of VTS authority,
- congestions in fairways,
- amount of dangerous cargoes,
- inadequate traffic arrangements,
- breaking the sea route rules,
- lack of pilotage obligations,
- safety devices (deficient maintenance or planning),
- nautical charts (deficient corrections or planning),
- lack of information about navigation conditions,
- marine insurers are not interested in real ship conditions, and
- sanctions are not enough serve,
- challenges of winter navigation,
- quality of equipment onboard a vessel,
- differences between flag states in standards of implementation and monitoring of safety regulation,
- number of mariners onboard,
- motivation of mariners,
- communication problems due to lack of language skills,
- high turnover of workers between ships and shipping companies, and
- monotonous watch keeping tasks.

Enclosure 2

Possible disturbances and their connections to threat scenarios (Ministry of Defense, 2011).

Possible disturbances and their connection to threat scenarios in the strategy	Serious disturbances in transport logistics	Major accidents, extreme natural phenomena and environmental threats	Terrorism and other criminality that endanger social order	Serious disturbances in border security
Disruption in the availability, transmission and distribution of electricity	x	x	x	
Disruption in the functioning of telecommunications and information systems	x	x	x	x
Damage in the ICT infrastructure	x	x	x	
Disturbance in the nation-wide radio and television broadcasts		x	x	
Transport disruptions	x	x	x	x
Disruptions in the availability of imported fuels	x			x
Disruption in the fuel supply	x	x	x	
Disruption in the supply of non-durable consumer goods	x	x		
Disruption in the water supply	x	x	x	
Disruption in waste management	x			
Failure of district heating		x	x	
Failure of financial transactions			x	
Disruption in the availability of cash	x		x	
Collapse of the credit rating of the state and municipalities				
Downfall of the solvency of reinsurance cover of an insurance company				
A pandemic or other widespread outbreak of serious infectious disease	x	x	x	
A serious animal or plant disease outbreak		x	x	x
Mass extinction of species		x	x	x
Declining conditions in primary production		x		
Widespread contamination of soil of waters		x		
A storm or flooding and a dam disaster	x	x		
An accident relating to CBRNE hazards		x	x	
Land, sea or air traffic accident	x	x	x	
An accident affecting Finns or action taken against them abroad		x	x	
A terrorist attack or a clear threat thereof			x	
A criminal act that widely endangers the population		x	x	
A criminal act that widely endangers functions in society	x		x	
Jeopardized border security			x	x
Major influx of asylum seekers		x	x	x
Adversely influencing the State's capability to function			x	
Disruption in foreign trade	x	x	x	x
Threatening with WMD		x	x	
Information operation	x		x	
Provocative violation of territorial integrity				x
An armed incident			x	x
The use of military force attempting to surprise	x			x
A large-scale use of military force	x	x	x	x

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