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Fire Drills on Finnish Vessels

Factors of Efficiency

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Abstract

This thesis aims to study the efficiency of mandatory fire drills conducted on merchant ships under Finnish flag, or ships with significant share of Finnish crew onboard. My primary research is how fire drills prepare crew for real emergencies. Additionally, I tried to figure out what factors have negative impact on fire drills and what measures could make drills more relevant and effective.

The study consists of a theoretical and a practical part. The theoretical background includes a study of fire on board as one of the major risk factors, a review of legislative acts, previous studies on the topic, standards and guidelines for effective drills and some aspects of human behavior. The research method for the practical part is a survey which was conducted in a form of questionnaire among Novia UAS maritime students and other Finnish seafarers.

The results of the survey show that fire drills on Finnish vessels have moderate to good effect on crew preparedness for fire-related emergencies. Major factors that influence negatively on quality of drills are lack of time, an excessive workload and the attitudes of participants and management. The quality of fire drills may be improved through thorough planning and by encouraging the importance of safety culture on board. The study may be useful for marine engineers or officers in charge of organization and training firefighting parties on ships.

Language: English Key words: Safety, Training, Fire Drills, Quality, Emergency

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List of abbreviations used

Baltic MIRG	the Baltic Marine Incident Response Group
EEBD	Emergency Evacuation Breathing Device
EMSA	the European Maritime Safety Agency
IMO	the International Maritime Organization
ISM Code	International Safety Management Code developed by the IMO
LSA	Life Saving Appliances
PSC	Port State Control
PPE	Personal Protective Equipment
SOLAS	International Convention for Safety of Life at Sea adopted in in 1974, entry into the force in 1980, with later Amendments. Developed by the IMO.
SMS Manual	Company's Safety Management System Manual developed in accordance with provisions if ISM Code
STCW	Standards of Training, Certification and Watchkeeping for Seafarers, with amendments, developed by IMO
SOLAS Vessel	A vessel of 500 GT or more, or any passenger vessel, operating in international waters.

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Appendix

1 Introduction

Regular onboard safety drills are essential part of safe performance on every vessel. Safety training build up crew preparedness, teamwork and practical skills needed in actual emergency situations. According to maritime legislation, shipowners and masters are obliged to arrange and conduct safety drills in certain time intervals. Additionally, legal acts set general requirements for a drill's execution: what activities shall be taken, what kind of equipment shall be used, what competences shall be demonstrated by crew members and so forth.

Although these requirements may be precise and specific to some extent, there are still broad limits to apply different approaches to the safety training. Consequently, efficiency of drills may vary significantly in different shipping companies, and sometimes even on different ships within the same company's fleet. This aspect of safety training on board raises a question: Even if formal legal requirements are fulfilled, to what extent safety drills actually contribute to crew' preparedness for real emergencies, particularly on Finnish ships?

1.1 Background of the study

I found this subject of study interesting and important for my maritime career. For the last four years, I had chances to work on different vessels. During the periods spent on board I encountered contrasting approaches and attitudes towards safety training on all levels of organization: among the shipping companies' management and owners, vessel commanders, those who organize drills, and participants. In some cases, the drills were carefully planned and thoroughly executed with a maximum involvement of all the participants. In other cases, the drills were shallower and more formal.

On the passenger ships, the drills were arranged on a weekly basis. Other ships had the exercises once in a month. In some cases, due to some turmoil with a crew change or excessive working load, the drills were not conducted within a 6 weeks or even longer periods. Duration of each training session varied from 40 minutes to 2 hours.

Involvement of the crew in the safety trainings also differed. Some crew members participated actively and were keen to improve their skills and knowledge in firefighting. In opposite, others considered the drills as a dull but unavoidable routine and tried to limit their participation to a role of passive spectators.

Sometimes the drills were highly practical and intensive, in other cases more theoretical. In first case, a scenario for the each drill was developed in advance and included various situations. Most of the crew (and even some passengers) were intensively involved in the training. Emergency situations were simulated as close to reality as possible, and the participants utilized wide range of personal protective equipment, lifesaving appliances and means of communications. An additional equipment, such as smoke - generating machines and dummy training mannequins were also used. Post - drill debriefing, which has great effect on for further successful trainings, was very detailed: mistakes were analyzed, and new procedures were proposed for later utilization.

More theoretical drills were arranged in a different way. The crew gathered at the mess room, on a bridge or a muster station. A Safety officer lectured materials concerning studied topic and occasionally provided video tutorials. The crew members demonstrated their competence in use of LSA or PPE. Then everyone described their duties according to a muster list in different emergency situations.

To sum up, there is a variety of approaches and methods to implement mandatory drills requirements into normal daily life and operations on board. What factors hinder to thoroughly organize and to conduct effective drills? In my opinion, major aspects of ineffective drills are excessive workload, frequent crew rotation from ship to ship, and the attitudes of the crew. Nowadays, merchant shipping is highly competitive sector of economics. New players enter the market, and many of them fail. To survive and prosper, shipping companies try to reduce their costs and maximize profits. Amount of the crew onboard rarely exceed numbers set in a minimum safe manning certificate. Excessive working hours, wide variety of tasks and fatigue are known sore spots of the industry. Focus on board is always on activities related to fast and efficient commercial operations, such as navigation, cargo loading and discharging, and, to some extent, ship maintenance. And safety issues, including training, often considered as something extra to a normal duties. In this study I would like to compare this theory with opinions of other Finnish seafarers, and to find out methods that may improve the quality of drills.

1.2 Limitations and focus on fire drills training

Different approaches and altitude towards safety onboard concern all types of drills – abandon ship, entry to an enclosed space, an emergency steering, security training and so forth. With rare exceptions, quality of the different safety drills is same within one ship. I

decided to concentrate on only one type, otherwise the study would be enormously big. The fire drills are suitable subject to examine, for few reasons.

First, the fire drills are essential to safety. Quite often fire or explosion accidents, if not handled by a crew rapidly and with a great demonstration of teamwork, cause severe consequences, such as massive damage to the ship, the cargo, the environment, as well as injuries and fatalities. Second, the fire drills shall be conducted in relatively short intervals: at least once in a month on cargo vessels and once in a week on passenger ships. Thus, there is better chance for a constant improvement of procedures and techniques applied. Third, there is a lot of fire extinguishing systems and appliances to study ant to exercise with. Wide array of firefighting equipment may be utilized in a training. And finally, fire risks and fire threats onboard are variable, therefore there is a lot of diverse scenarios may be exercised in the fire drills.

Aside from the drill type limitation, I also wanted to focus on drills practices existing on Finnish – flagged vessels, or vessels with notable presence of Finnish crew on board. For this purpose, Finnish vessels are distinguished from other flags in the research questionnaire. Also, scope of the study are SOLAS-vessels – ships over 500 GT and all passenger ships operating in international waters, which shall comply with SOLAS requirements. This limitation excludes from the statistical analysis small vessels, such as leisure crafts or pilot boats, as well as navy ships.

1.3 Objective, synopsis and method

Wide range of approaches to safety training onboard implemented by shipping companies raises several questions, which I was planning to find out in this work:

- What is an effective fire drill? What actions constitute the effective fire drills? Are there any quantitative methods that allow to measure drills' effectiveness?
- What is the frequency of the fire drills on Finnish vessels? Is it enough only to fulfill legislative requirements, or drills conducted more often?
- How much time the crew devote to the fire drills?
- How participants themselves evaluate the effectiveness of the fire drills?
- What factors affect positively and negatively on drills' efficiency?
- What measures may improve the effectiveness of the fire drills?

The first part of the thesis is theoretical. It was written by gathering and analyzing of materials concerning safety training on board, which were obtained from the different sources. This part covers following topics:

Fire as a source of a major risk on board. Risk evaluation and risk assessment matrix. The statistics of maritime accidents caused by the fire or explosion within recent years and importance of the fire drills and crew preparedness.

Analysis of major legislative acts in maritime industry and their application to the fire drills. The SOLAS Convention and requirements for drills' contents and frequency. The STCW Code and requirements for seafarers' competence in firefighting, emergency management and drills arrangement. The ISM Code and a ship's overall preparedness and vigilance towards safety and emergency situations. Contingency plans and their constant improvement.

Previous researches on the topic and their conclusions. Most of the studies are performed by maritime students or younger seafarers and based on their practical experience on board.

Theoretical studies about methods of organization of an effective safety training. To seek additional knowledge about training objectives and methodological features of successful drills, I studied materials not only from maritime industry, but from other sectors. One example is the Safety Training Manual developed by Pan-American Health Association.

The second part of the paper is quantitative analysis of answers for the survey. The survey was conducted in a form of questionnaire which was distributed among seafarers of different rank and experience. The survey aims to identify at what extent the fire drills comply with drills' objectives and methodological recommendations. Among other, the questionnaire includes following questions:

- How often the fire drills are conducted on board?
- What is the average duration of the fire drill?
- In what form the fire drills are conducted?
- Are You satisfied with the quality of the fire drills?
- What factors effect on drills' frequency and quality positively or negatively?

Based on answers received, I tried to estimate the quality of firefighting training onboard and determine methods of improvement.

2 Theoretical background

2.1 Fire as one of the major risks in maritime industry

How dangerous are fire on board? What is the probability of emerging a fire on one specific vessel? Does it make sense to put so much time, money and efforts into the crew preparedness? Answers for these questions may be retrieved with such tools as statistical analysis of maritime accidents and risk assessment matrix.

Risk assessment is one of the main objectives of ISM Code and aims to identify all possible hazards in operational activities on board and minimizing or eliminating them by establishing preventive measures and procedures. Although risks are associated with something unexpected and uncertain, risk calculation methods exist for a long time and widely used in insurance and financial sector, inter alia. Risk is normally estimated with a formula:

R (Risk) = P (Probability) * C (Consequences)

Probability is a quantitative likelihood of specific hazard to occur, or it's frequency. Probability is measured in a time period, usually one year. For example, probability of fire on RoRo and container vessels in 2007 was 0,007, or 0,7%; on passenger ships – 1,6% (DNV, 2007).

Consequences is amount of possible losses caused by a hazard. Consequences vary in severity from minor to extreme. Detailed classification of marine accidents by severity is given in the IMO Casualty Investigation Code:

Marine casualty *– an event, or a sequence of events, which has occurred directly in connection with the operations of a ship and resulted in any of the following:*

- *the death, or serious injury, or the loss of a person from a ship;*
- *the loss, presumed loss or abandonment of a ship, or material damage to a ship;*
- *the stranding or disabling of a ship, or the involvement of a ship in a collision;*
- *material damage to marine infrastructure external to a ship, that could seriously endanger the safety of the ship, another ship or an individual;*
- *severe damage to the environment, or the potential for severe damage.*

Casualties are classified as **very serious** (involving the total loss of the ship, a death of a person or severe damage to the environment), **serious** (not qualify as very serious, but

involves a fire, explosion, collision, grounding, contact, heavy weather damage, ice damage, hull cracking, or suspected hull defect, etc., resulting in immobilization of main engines, extensive accommodation damage, severe structural damage, pollution, or a breakdown necessitating towage or shore assistance), and **less serious**.

Marine incident - an event, or sequence of events, other than a marine casualty, which has occurred directly in connection with the operations of a ship that endangered, or, if not corrected, would endanger the safety of the ship, its occupants or any other person or the environment. In other words, marine incidents are risky situations which, by different reasons, did not lead to casualty.

A**ccidental event** is an event that is assessed to be inappropriate and significant in the sequence of events that led to the marine casualty or marine incident.

Generally, very serious casualties are related to extreme consequences, serious to major and moderate, and less serious casualties and incidents form minor consequences.

Based on a probability and consequences risk classified as intolerable (High), tolerable (Medium), and negligible (Low). Risk levels may be presented in a form of risk assessment matrix (International Naval Surveys Bureau, Guide for Risk Assessment, 2010):

		Consequences			
		Minor	Moderate	Major	Extreme
Probability	Very Unlikely	Low	Low	Medium	Medium
	Unlikely	Low	Medium	Medium	Medium
	Likely	Medium	Medium	High	High
	Very Likely	Medium	High	High	High

Figure 1. Risk assessment matrix

Each level of risk shall be responded adequately. Higher levels require greater degree of response. For high risks, all activities which may lead to an accident shall be stopped immediately until preventive measures reduce risk's level to medium or low. In most cases, low risks require only proper monitoring of the situation or minimal-cost solutions.

Fire or explosion are high-risk accidents, and one of the most dangerous emergencies which may happen on board of the ship. In terms of risk assessment, these accidents belong to right side of the risk assessment matrix: they do not happen very often but may cause substantial damage. This is not the most common accident type. According to EMSA, during 2011 - 2015, only 8% of all reported casualties had fire as a main cause in European waters. At the same period, cases related to navigation mistakes (grounding, collision or contact of vessels) constitute 50% of all casualties (EMSA, Marine casualties and accidents. Summary

overview 2011 – 2015). Amount of registered fire/explosion cases does not decrease and stays on steady levels. During 2011 – 2017 130 – 150 occurrences were reported annually, peaking up to about 180 in 2013 and 2015.

Detailed research of ship fires in European waters during 2000 - 2015 was performed by Finnish Border Guard within Baltic Maritime Incident Response Group Project. The investigation provides data based on 570 investigated cases concerning fire casualties by ship type.

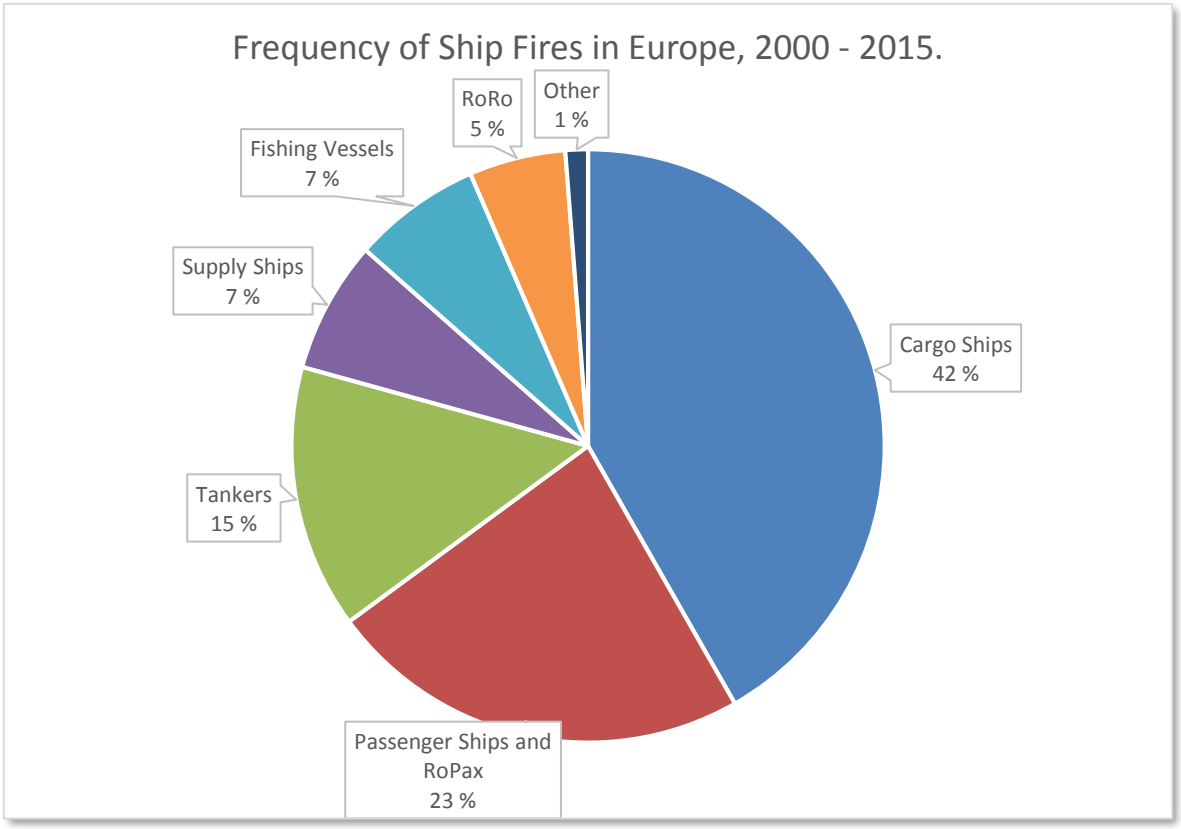

Figure 2. Frequency of Ship Fires in Europe, 2000 - 2015

During studied period, most considerable amount of fires (42 %) took place on different types of dry cargo vessels. Vessels carrying passengers or both passengers and cargo (Passenger Ships, Cruise Ships, RoPax, RoRo) encountered about every third of fire casualties.

Besides general statistics about frequency of ship fires, Baltic MIRG research provides specific information about reasons of explosions or ignitions and their distribution on board. This analysis shows that 2 out of 3 of fires on ships originate from engine rooms and other machinery spaces.

Origin of fire	Number (%)	Major Causes of Fire
Engine Room	63	Damage to fuel injection systems: fuel leaking onto hot surfaces.
Cargo Area	27	Transport conditions: excessive temperature in cargo hold or electrical short circuit. Cargo characteristics: chemical reactions of cargo with low spontaneous combustion temperatures.
Accommodation, Passenger Areas	10	Electrical short circuits, smoking.

Figure 3. Fire probability and major causes on board

Analysis of statistical data shows, that despite of relatively low and steady numbers of ship fires and explosions, these accidents often cause massive damage to ships, environment and cargo. Fires more often associated with very serious or serious casualties. Furthermore, according to Baltic MIRG Report, in terms of the risk of fatalities or serious injuries, "*ship fires pose the greatest risk to European maritime safety compared to other types of maritime accidents*".

Specific feature of fire accidents is rapid pace of fire spreading. The most effective measures shall be taken on early stages, when fire may be localized on relatively small area. To deal with emergency in first minutes, three things are crucial:

- Effective heat/smoke/fire detection system and early determination of fire source;
- Availability of fully operative technical means of firefighting;
- Competence and coordination of the crew, which is obtained via shore training and regular adequate drills on board.

During 2000 – 2015, in about every third ignition-related accident fire was eliminated with assistance, or completely by means of professional fire-fighters – SAR services and shore – based fire brigades. This ratio is higher in cases when ships encountered fire were in ports, port areas or port roadsteads. About 63% of fire happens at sea. In that case, on early stages of emergency crew may rely only on resources available onboard, and own knowledge, teamwork and skills - competences that they acquire during regular safety drills.

2.2 Legislative requirements for safety training and fire drills onboard

Each vessel in her operational activities shall comply with legal requirements. Recommendations for the crew competence, for frequency and quality of training on board are set by International Maritime Organization and national governing bodies. Most important legislative acts are SOLAS, ISM Code, and STCW.

2.2.1 SOLAS

International Convention of Safety of Life at Sea (SOLAS), 1974, is one of the fundamental international treaties concerning safety on merchant ships. SOLAS sets minimum requirements for ships' construction, equipment and safe operation on board. Complying with SOLAS regulations is obligatory for all passenger ships and non-passenger ships of 500 tons gross tonnage or more engaged on an international voyage.

Chapter II-2 of the Code determine Fire safety on board as measures including fire protection, fire detection and fire extinction. The purpose of the Regulation 15 of the Chapter is "*to mitigate the consequences of fire by means of proper instructions for training and drills of persons on board in correct procedures under emergency conditions. For this purpose, the crew shall have the necessary knowledge and skills to handle fire emergency cases, including passenger care".* The regulation prescribes that crew members should receive proper instruction on fire safety, including arrangement of the ship, location and use of EEBD, fire-fighting systems and appliances available on board. Instruction should include crew members' specific duties in case of fire emergency.
Ship's preparedness for the fire emergency shall always be maintained by means of organized fire-extinguishing parties. To ensure operational readiness and skills of fire-fighting parties and to determine areas to be improved, on-board training and drills shall be planned and conducted on a regular basis.

Chapter III of the Code establishes requirements for life-saving appliances and arrangements. Regulation 19 of the Chapter sets standards for organisation of safety drills. This Regulation gives quite precise and detailed explanation how drills shall be conducted.

Paragraph 3.1 of the Regulation states that *"Drills shall, as far as practicable, be conducted as if there were an actual emergency"*. Although this statement is short and vague, proper implementation of this recommendation is a key element of crew preparedness and shall not be underestimated both by those who arrange and organize drills and all participants. Unfortunately, for reasons which will be examined further, some drills are conducted in a

simplified, laconic and shallow manner. These shortcuts significantly reduce drills' effectiveness.

Paragraph 3.2 defines frequency and time frames of fire drills. According to Regulation, each crew member shall participate in the Fire drills at least once in every month. And drills shall be conducted "*within 24 h of the ship leaving a port if more than 25% of the crew have not participated in abandon ship and fire drills on board that particular ship in the previous month"*. Common practice on Finnish vessels is to keep drills once in a month for all the crew, or twice, in case if due to normal working duties crewmembers cannot participate all at once. To comply with 25% rule, drills are normally kept at port or right after the port where significant crew change took place. On a passenger ships, according to Regulation 30, fire drills shall be kept on a weekly basis, and passenger's participation is recommended.

Subparagraph 3.4 provides specific instructions regarding Fire drills:

3.4 Fire drills

3.4.1. Fire drills should be planned in such a way that due consideration is given to regular practice in the various emergencies that may occur depending on the type of ships and the cargo.
3.4.2. Each fire drill shall include:
.1. reporting to stations and preparing for the duties described in the muster list required by regulation 8;
.2. starting of a fire pump, using at least the two required jets of water to show that the system is in proper working order;
.3. checking of fireman's outfit and another personal rescue equipment;
.4. checking of relevant communication equipment;
.5. checking the operation of watertight doors, fire doors, fire dampers and main inlets and outlets of ventilation systems in the drill area; and
.6. checking the necessary arrangements for subsequent abandoning of the ship.
3.4.3. The equipment used during drills shall immediately be brought back to its fully operational condition and any faults and defects discovered during the drills shall be remedied as soon as possible.

Important to mention that Subparagraph 3.4.1. requires, that drills should be diverse and ship- and cargo- specific. In other words, drills shall be conducted according to different scenarios, which should reflect all possible risks existing on board – fire in cargo hold, machinery or accommodation spaces. Good example of cargo- specific drill is can be found on Finnish Ro-Ro vessels: techniques and methods of electrical cars extinguishing are supplemented into drills programs as a response to increasing number of electrical cars and risks related to them on board.

Paragraph 4 of Regulation 19 requires that on-board training regarding fire safety and use of fire extinguishing appliances to new crew members shall be conducted as soon as possible, but not longer than two weeks since new person being onboard. Paragraph 5 obliges masters

of the ships to keep proper records of conducted drills, musters or training. These records, as well as drills description, are to be filled into the ship's log book. In case if drills are not conducted at the appointed time, explanation of reasons for such delay also shall be provided.

2.2.2 STCW

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) at first was developed in 1978, and entered into force in 1984, with numerous amendments implemented after. The Code was first to establish standards for on-board personnel on international level. Before that, guidelines for training and watchkeeping were specified by national governments and local acts. These standards could vary significantly depending on a ship's flag

Chapter VI of the Code sets standards for emergency preparedness and survival functions of seafarers. The Chapter require that all crewmembers should know what to do if fire or smoke is detected of if fire alarm is sounded. Additionally, they should be able to locate muster stations and escape routes, to raise fire alarm, to use fire extinguishers, to provide first medical aid and to close and open fire, watertight and weathertight doors.

Table A-VI/1-2 Sets minimum standards for competence in fire prevention and fire-fighting:

COMPETENCE	***KNOWLEDGE, UNDERSTANDING AND PROFICIENCY***	***METHODS FOR DEMONSTRATING COMPETENCE***	***CRITERIA FOR EVALUATING COMPETENCE***
Minimize the risk of fire and maintain a state of readiness to respond to emergency situations involving fire	*Shipboard fire-fighting organization* *Location of fire-fighting appliances and emergency escape routes* *The elements of fire and explosion (the fire triangle)* *Types and sources of ignition* *Flammable materials, fire hazards and spread of fire* *The need for constant vigilance* *Actions to be taken on board ship* *Fire and smoke detection and automatic alarm systems* *Classification of fire and applicable extinguishing agents*	*Assessment of evidence obtained from approved instruction or attendance at an approved course*	*Initial actions on becoming aware of an emergency conform with accepted practices and procedures* *Action taken on identifying muster signals is appropriate to the indicated emergency and complies with established procedures*

COMPETENCE	***KNOWLEDGE, UNDERSTANDING AND PROFICIENCY***	***METHODS FOR DEMONSTRATING COMPETENCE***	***CRITERIA FOR EVALUATING COMPETENCE***
Fight and extinguish fires	*Fire-fighting equipment and its location on-board* *Instruction in:* *.1 fixed installations* *.2 firefighter's outfits* *.3 personal equipment* *.4 fire-fighting appliances and equipment* *.5 fire-fighting methods* *.6 fire-fighting agents* *.7 fire-fighting procedures* *.8 use of breathing apparatus for fighting fires and effecting rescues*	*Assessment of evidence obtained from approved instruction or during attendance at an approved course including practical demonstration in spaces which provide truly realistic training conditions (e.g. simulated shipboard conditions) and, whenever possible and practical, in darkness, of the ability to:* *.1 use various types of portable fire extinguishers* *.2 use self-contained breathing apparatus* *.3 extinguish smaller fires, e.g. electrical fires, oil fires, propane fires* *.4 extinguish extensive fires with water using jet and spray nozzles* *.5 extinguish fires with foam, powder or any other suitable chemical agent* *.6 enter and pass through with lifeline but without breathing apparatus a compartment into which high expansion foam has been injected* *.7 fight fire in smoke-filled enclosed spaces wearing self-contained breathing apparatus* *.8 extinguish fire with water fog, or any other suitable fire-fighting agent in an accommodation room or simulated engine-room with fire and heavy smoke* *.9 extinguish oil fire with fog applicator and spray nozzles, dry chemical powder or foam applicators* *.10 effect a rescue in a smoke-filled space wearing breathing apparatus*	*Clothing and equipment are appropriate to the nature of the fire-fighting operations* *The timing and sequence of individual actions are appropriate to the prevailing circumstances and conditions* *Extinguishment of fire is achieved using appropriate procedures, techniques and fire-fighting agents* *Breathing apparatus procedures and techniques comply with accepted practices and procedures*

Table A-VI/3 Sets standards for competence in advanced fire-fighting:

COMPETENCE	***KNOWLEDGE, UNDERSTANDING AND PROFICIENCY***	***METHODS FOR DEMONSTRATING COMPETENCE***	***CRITERIA FOR EVALUATING COMPETENCE***
Control fire-fighting operations aboard ships	*Fire-fighting procedures at sea and in port with particular emphasis on organization, tactics and command* *Use of water for fire-extinguishing, the effect on ship stability, precautions and corrective procedures* *Communication and co-ordination during fire-fighting operations* *Ventilation control, including smoke extractor* *Control of fuel and electrical systems* *Fire-fighting process hazards (dry distillation, chemical reactions, boiler uptake fires, etc.)* *Fire-fighting involving dangerous goods* *Fire precautions and hazards associated with the storage and handling of materials (paints, etc.)* *Management and control of injured persons* *Procedures for co-ordination with shore-based fire fighters*	*Practical exercises and instruction conducted under approved and truly realistic training conditions (e.g.: simulated shipboard conditions) and, whenever possible and practicable, in darkness*	*Actions taken to control fires are based on a full and accurate assessment of the incident using all available sources of information* *The order of priority, timing and sequence of actions are appropriate to the overall requirements of the incident and to minimize damage and potential damage to the ship, injuries to personnel and impairment of the operational effectiveness of the ship* *Transmission of information is prompt, accurate, complete and clear* *Personal safety during fire control activities is safeguarded at all times*
Organize and train fire parties	*Preparation of contingency plans* *Composition and allocation of personnel to fire parties* *Strategies and tactics for control of fires in various parts of the ship*	*Practical exercises and instruction conduct under approved and truly realistic training conditions, e.g. simulated shipboard conditions*	*Composition and organization of fire control parties ensure the prompt and effective implementation of emergency plans and procedures*
Inspect and service fire detection and extinguishing systems and equipment	*Fire detection systems; fixed fire-extinguishing systems; portable and mobile fire-extinguishing equipment including appliances, pumps and rescue, salvage, life support, personal protective and communication equipment* *Requirements for statutory and classification surveys*	*Practical exercises using approved equipment and systems in a realistic training environment*	*Operational effectiveness of all fire detection and extinguishing systems and equipment is maintained at all times in accordance with performance specifications and legislative requirements*
Investigate and compile reports on incidents involving fire	*Assessment of cause of incidents involving fire*	*Practical exercises in a realistic training environment*	*Causes of fire are identified and the effectiveness of counter measures are evaluated*

Competence in basic and advanced fire-fighting is mandatory for all deck officers and engineers on Finnish vessels. In Finland, these competences usually obtained with two special courses. Courses are arranged by Finnish Maritime Safety Training Centre (Meriturva), each course lasts 2-3 days. Certificate shall be reissued at least every 5 years by finishing 2-day refresher course. One of the compulsory competences in the table A-VI/3 is to organize and train fire parties. This competence shall be demonstrated by "*Practical exercises and instruction conduct under approved and truly realistic training conditions".*

2.2.3 ISM Code

In mid-eighties, maritime industry encountered significant degradation of safety matters on board of numerous vessels. Negligent operational activities and irresponsible management jeopardized safeness of ships, environment and human lives. That situation demanded IMO to establish new approaches to safety on board. On the 6th of March of 1987, fatal accident with MS Herald of Free Enterprise in the port of Zeebrugge triggered development and introduction of Intranational Safety Management Code.

ISM Code aims to ensure safety at sea and to prevent damage to personnel, property and environment. General principle of the Code that safety measures and procedures shall be handled with great attention on the top levels of the company and distributed to each employee. One of the objectives of the convention is *to "continuously improve safety management skills of personnel, including preparing for emergencies related both to safety and environmental protection".* The regulation obliges shipping companies to develop Safety Management System manuals and to pass auditions by national administrations or Classification societies. One of key features of SMS Manuals is that they should include procedures to prepare for and respond to emergency situations, as specified in Section 8:

> ***8 Emergency preparedness***
>
> *8.1 The Company should identify potential emergency shipboard situations and establish procedures to respond to them.*
>
> *8.2 The Company should establish programmes for drills and exercises to prepare for emergency actions.*
>
> *8.3 The SMS should provide for measures ensuring that the Company's organization can respond at any time to hazards, accidents and emergency situations involving its ships.*

On Finnish vessels, programmes for the drills often established for the whole year as a drill matrix. Since the program is ready, persons in charge of the drills simply follow the matrix and conduct trainings accordingly, in favourable conditions within the time frame.

After ISM Code was adopted, subsequent IMO Resolutions proposed detailed instructions for development of companies' SMS Manuals. One of them is IMO A.852(20), provides Guidelines for contingency planning for shipboard emergencies. This Resolution states that contingency plans in company's SMS are in no case static documents developed once and for all times, but flexible tools which should be constantly analyzed and corrected through "*sharing experience, ideas and feedback".* Thus, emergency training, including fire drills, shall not be considered only as an educative process, but also as a method of repetitive testing and improving of contingency plans.

2.3 Previous research

The study conducted in 2014 by Shanghai Maritime University students is based on authors' experience onboard of different vessels. They noticed that there is some burden in fire drills evaluation. Authors proposed simple and effective method based on appraisal of 22 certain actions performed during drill. Each action belongs to certain task (reporting the bridge on fire, initial actions, mustering and preparation, entering to the fire zone and firefighting, rescue operation and use of fixed fire extinguishing systems) and very specific. Every action is evaluated based on 5-score scale according to well defined criteria. For example, performing action "starting emergency fire pump" in less then 5 minutes considered as good result and ranks with score 5, less than 10 minutes – score 3 and over 10 minutes scored as 0. Total amount of scores gives an idea about overall preparedness for the emergency, and low scores in some tasks identify areas to be improved. Each drill report is supplemented with captain's comments concerning crew performance, attitude, and need for corrective actions and supplemental training.

The method suits for self-assessment of the crew and as a preparation tool for PSC inspections, since set of actions is the same set which usually audited by PSC officers, according to Tokyo MoU and Indian Ocean MoU inspection manuals (Wu, Jin, Fu, 2014).

In their study, Romanian students from Constanta Maritime University emphasises the importance of thorough planning of safety drills. Authors propose to implement preparation calendar as a tool for training arrangement. This method might be particularly useful for vessels with bigger crew, such as cruise ships, where many people from different departments are involved in drill preparation. Preparation calendar might be also useful for massive drills, which involve not only the crew, but also shore services: fire drills in

cooperation with port fire brigades or security training with port authorities and local police and border guard (Dragomir, Tureanu, 2015).

Gdynya Maritime University student's article is based on her personal and other apprentices' experience while being on board as a deck cadet. During training periods author was confused by often reckless approach of crew members towards drills and alarming methods of safety training. She also noticed how attitude onboard may affect on cadet's mindset concerning their future responsibilities and duties as deck officers. Positive examples were also provided, and author gave examples of improvements proposed by crew and implemented in drill practices in abandon ship, oil spill and fire drills. Together with drill timing, she proposes video recording as an effective tool for subsequent drill analysis (Szczesniak, 2013).

In his report, Main Maritime Academy student described procedures implemented on training ship "State of Maine" after entering into force ISPS Code provisions. Procedures included assignment and training of Security officer onboard, development of contingency plans for security-related emergencies, development of security exercises and training the crew (Wade, 2005).

2.4 Criteria of effective fire drills

As mentioned above, STCW standards for competence in advanced fire-fighting require that seafarer should be able to organize and train fire parties. That qualification include ability to prepare contingency plans for fire emergencies, ability to allocate personnel to fire parties, and ability to develop strategies and tactics for control of fires in various parts of the ship. During my studies at Novia UAS, I took firefighting course arranged by Meriturva Training Centre trice: Basic Firefighting in 2015, Advanced Firefighting in 2017, and Refresher course in Advanced Firefighting in 2019. Every time trainings were highly intensive, functional, and comprehensible. Students practiced in use of various types of firefighting systems and appliances. Different scenarios were realized, and participants mastered their skills in firefighting individually and in teams and tried themselves both as members of fire parties and emergency coordinators. Due to tight schedule more theoretical question of organizing fire drills was explained in short.

Thus, when seafarers like me are assigned for training of fire parties on board of a ship, they should seek for additional expertise about arranging of effective fire drills. There are different ways to gain this knowledge. Often it is obtained from own experience, and persons

in charge of fire safety rely on own background and organize drills similarly to those drills they participated before. In other cases, shipping companies have ready-to-use exercise scenarios, such as compilation of exercises for safety drills onboard Finnlines' Star Class ships (Nummi, 2011). However, it is always good to obtain supplementary instructions concerning safety training, both from maritime industry and other sectors. In this part, I compiled theoretical and practical information from several publications, including "Guidelines for developing emergency simulations and drills" by Pan-American Health Organisation (part of WHO), "European handbook of maritime security exercises and drills" by Port of Antwerp Harbour master office, and tried to apply those doctrines in context of fire drills onboard.

2.4.1 Objectives of fire drills

Every safety training shall pursue one or several specific goals. These goals may be following:

Training personnel. During repetitive exercises crew members master their individual skills in firefighting techniques, searching of missed persons and medical assistance. They learn to use personal protective equipment and to operate firefighting systems and appliances, considering its capabilities and limitations.

Preparing crew for real emergencies. This is psychological aspect of human behavior. Emergencies always cause different degree of stress, regardless of age, gender, experience and training. Stress is natural reaction, which motivates person to act in changed conditions. These conditions are different from normal: they often deadly dangerous, situation often uncertain and may develop rapidly, which require immediate decisions and actions. In emergency people act differently than in normal everyday life, and their actions not always rational and effective. Fire drills allow to develop habits of logical behavior and reasonable actions in case of real fires.

Improving of communication and teamwork. Drills is a great way to progress coordination between personnel in case of emergency. Participants learn to share crucial information regarding the situation, and to do it in the most effective way. They synchronize their efforts and allocate tasks to achieve better results. Drills help to identify lacunas or overlaps in duties stated in muster list, and to adjust the document accordingly.

Testing firefighting equipment. It is fire safety officer's responsibility to maintain firefighting equipment and to keep it in good working order. To perform this duty, tests and checks are conducted on a regular basis. These checks mostly done by visual inspections. Fire drills is a great opportunity to operate wide range of equipment, including firefighting pumps, lines, hydrants, hoses, firemen outfits and SCBA in real situations.

Testing and improvement of contingency plans. As prescribed in ISM Code, shipping companies shall develop contingency plans of initial actions for possible emergencies that are likely to happen on board. Contingency plan is not a static document. It should be evaluated on a regular basis and improved or adjusted, based on practical experience.

Appropriate tool for that improvement is management method called Deming circle. The method was introduced by American engineer and consultant William Deming. This mechanism also known as PDCA-Cycle (Plan-Do-Check-Act or Plan-Do-Check-Adjust). First, contingency plan is drawn up, and its' objectives defined. On the second stage, the plan is carried out within fire drill. Third stage is analysis: fire drills allow to estimate plan's effectiveness and relevance to objectives. On the final phase, corrective actions are implemented into plans.

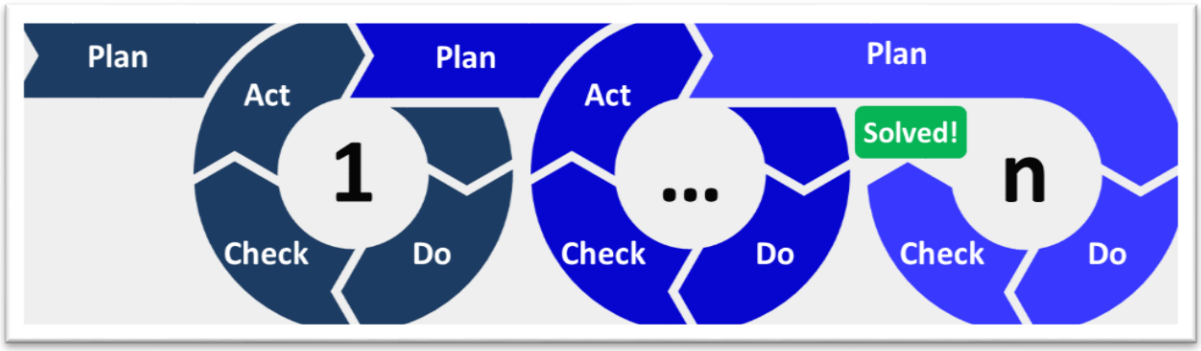

Figure 4. Graphical diagram of PDCA Cycle

PDCA-Cycle, with fire drills in its' active phase, help to appraise the effectiveness of contingency plan, to identify and eliminate plan's weaknesses, and to decide whether the plan is realistic, simple and easy to comprehend.

Training in resource management. Recourses needed to deal with possible emergency on board are always limited. This shortage if particularly crucial for smaller vessels, with less crew and less sophisticated firefighting systems and LSA. Ship management shall be able to demonstrate leadership, organize teamwork, establish steady communications and allocate available assets in the most effective way. Fire drill is a perfect way to practice these

competences. “What if…” method is a good tool to practice resource management. The crew shall learn how to act in different unexpected situations, such as “What if fire pump is not working?”, “What if one of smoke divers is injured and cannot participate in firefighting?”, and so on.

Time records of the drill is another valuable knowledge. Careful timing provides realistic data about duration of each operation: how much time does it take to muster the crew after alarm is sounded, how fast fire parties done fireman outfits and SCBA, how fast firefighting systems are deployed and prepared for use, and so on. Timing allows to pinpoint areas which shall be improved.

Fulfilling requirements of legislation. Finally, fire drills are conducted because it is required by law. Neglecting legal obligations is likely to cause serious consequences for the ship and the company. Ship may fail to pass annual surveys by Classification societies or flag administration. Ship may fail to pass external audit. Ship may be detained by Port State Control inspection. To avoid these negative consequences, fire drills shall be conducted in time and with due regard to formal provisions. Moreover, drills shall be carefully documented, and continuous detailed record of all conducted trainings shall always be available on board.

2.4.2 Methodological characteristics of effective fire drills

Effective drills shall meet all or most of following criteria.

Planning. Drill shall be thoroughly planned, and goals of the drill shall be clearly identified.

Realism. As prescribed by SOLAS, safety trainings shall be as realistic as possible. First, they should be practical. Participants shall try to perform all that duties which they would do in true emergency, not only mocking these actions of describe them verbally. Fire fighting appliances and systems shall be used and tested, when possible. For better realism, additional exercise equipment may be used, such as smoke-generating machines or dummy mannequins. Second, realism means that drills shall take place in real time, starting from the activation of the alarms. Time “jumps” shall be avoided.

Spontaneity. True emergencies are never scheduled. It is good practice to keep in secret time of upcoming drills – in that case initial actions and time of response for emergency demonstrated during drills are more realistic. This is not always possible. Drill coordinators must consider other daily routines – cargo operations and ship maintenance, for example.

Work and rest periods are also important factors, and drills shall be conducted so that they do not induce extra fatigue for the crew. It is usual practice on Finnish vessels, that day and time of safety training announced in advance, and drills take place in the most convenient time, when most of the crew is awake – from 12:00 to 16:00. It would be useful experience to keep at least some drills unannounced, and in different time intervals – particularly in periods of darkness. Good practice is implemented on one general cargo vessel – on certain intervals fire and abandon ship drills are kept unannounced and conducted in early morning hours on weekend. After lunch, crew have coupe extra hours of rest period.

Safety. With no exception drills shall be conducted as safe as possible. Safety training, if done in a hurry and recklessly, may lead to serious injuries or even fatal accidents. Sometimes, there is a contradiction between drill realism and safety. For example, use of emergency routes may require climbing few levels up or down by use of narrow ladders which located outside of superstructure. It is always up to captain which elements shall be implemented into exercise. If there is a degree risk exist, additional safeguards and precaution measures shall be carried out. Drills may cause stress, and it is good to encourage calm and productive atmosphere among crew. Participants shall act fast, but deliberately and with no rush.

Number of identified accidents during training is significant. To insure drills safeness, IMO and national governments develop additional guidelines and recommendations. For example, Guidance on safety during drills developed by Danish Maritime Authority advices following safety measures during fire drills:

- During fire drills watertight doors shall not be operated by means of remote controls, as that operation impose additional risk of injury for participants. Watertight doors shall be closed only in manual mode.
- Remote control release of fire doors may also injure participants. To avoid negative consequences, an announcement via public address system shall be done before doors release.
- In some drills stretcher hoist device may be used. Stretcher hoist devise is needed to recover helpless immobilized persons from confined spaces, such as cargo holds, tanks or bow thruster rooms. During drills, that operation shall never be done with crew members in a stretcher. Instead, dummy mannequin or other appropriate weight shall be used.

- To emulate restricted visibility, darkened glass on a fire helmet may be used instead of smoke machine. In this case, one of other participants can walk next to firefighter with impaired visibility and inform him when he is about to get trouble.

Diversity. As mentioned, different scenarios shall be performed during fire drills. These scenarios shall reflect most relevant risks existing on board, i.e. emulate these emergencies that are most likely to happen. Diversity of drills also awaken interest and sustain crew attitude, contrary to same-pattern drills, which seem to be dull and useless.

Another element of diversity is progression in drills. The crew first learn most simple and basic methods and techniques, and eventually drill become more complex and challenging. This feature requires three prerequisites. First, drills shall be conducted on a regular basis. Second, adequate progressive training plan for few next drills should exist. And finally, it is important that crew members have long-term work relationship with the company and the ship and stay on the same ship for many working rotations. Without these preconditions, especially is crew turnover is high, it is better to keep more simple drills.

Crew attitude is probably most important feature of effective fire drill. Proper attitude towards drills shall be cultivated and encouraged on all levels of companies' management and among participants themselves. Well planned and conducted drill is inspiring teambuilding event which stimulate seafarers to endeavour in other working activities.

Practical survey was aimed to figure out, at what extent fire drills on Finnish ships satisfy proposed criteria of effectiveness. In other words, are these drills focused on reaching one or few objectives and comply with methodological characteristics.

3 Practical survey

The survey was conducted in a form of questionnaire in English. Questionnaire consisted of 14 multiple choice questions and 3 open questions. The survey was organized on a public platform Google Forms. All questions were optional. The questionnaire was open for two weeks, was anonymous and confidential to encourage participants give more frank and straightforward answers. Questions were distributed among fellow seafarers via social media (Facebook) and among Novia Maritime Management students via school email server.

Since the topic was familiar and interesting to participants, total amount of answers received was 121, not including these which were not accepted as valid (empty surveys or surveys with only few questions answered, surveys with similar answers within short period of time).

I believe this is good result, and answers represent seafarers of different ranks and from different vessels. Most answers were received from request I sent to my Facebook peers. Some of them shared my post and distributed survey among their Facebook contacts. 5 of responses were not validated, since ship type was not specified (3 answers), or ship type was out of scope of this research (small sailing vessel, pilot boat).

3.1 Sorting of answers received: Finnish and non–Finnish vessels

The scope of this thesis is fire safety on Finnish – flagged vessels. Nevertheless, seafarers participated in the survey represent ship of many nationalities. Three groups of responses were received: ships of Finnish flag (68 answers), ships from Baltic and Nordic countries (31 answers), and other than above (22 answers).

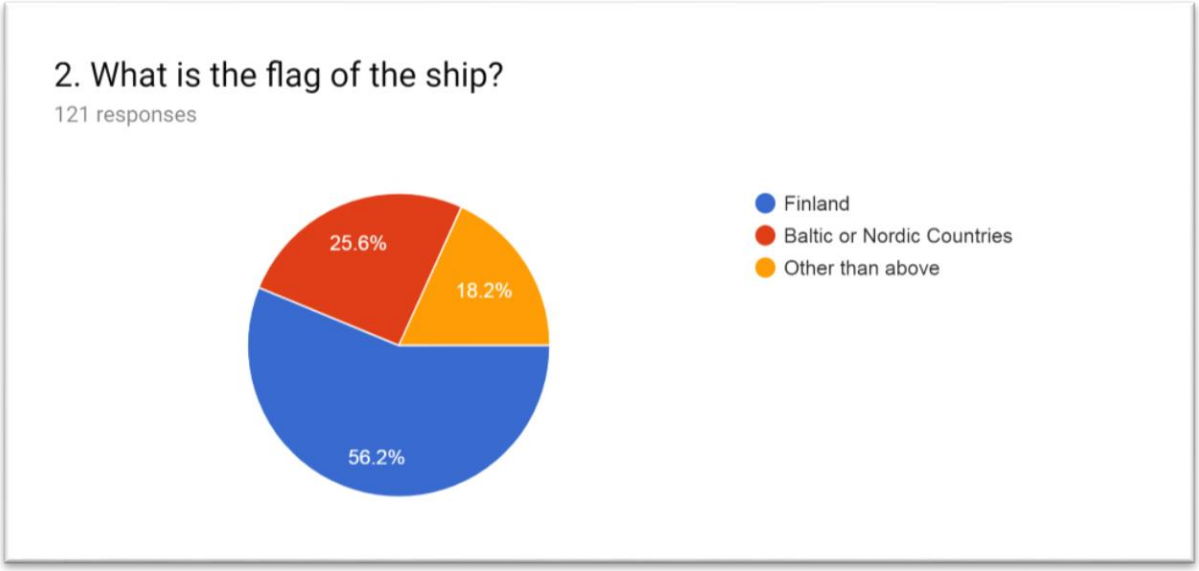

Figure 5. Answers for Question 2 - Flag of the ship

Finnish and non-Finnish vessels are represented by relatively close amount of answers: 68 and 53. First group is in the focus of the study, while answers from non-Finnish vessels provide useful statistical data for reference: it might be useful to compare drills on Finnish and non-Finnish vessels.

Group of ships that belongs to Baltic and Nordic countries was distinguished from all non-Finnish vessels for two reasons. First, some of these ships de facto operated by companies with Finnish roots and have notable share of Finnish crew onboard. For example, there is few ferries between Finland and Estonia, or Finland and Sweden, and few tugs in Baltic ports that are under management of Finnish companies. And second, even if these ships not

connected to Finnish management, working and safety culture onboard is quite close to Finnish vessels.

3.2 Results of the research

3.2.1 Ship type

The question about ship type was aimed to distinguish cargo and passenger ships, since ships engaged in passenger's transportation are obliged to comply with more strict legal regulations concerning safety training onboard. Besides, this question aims to specify crafts which are not obliged to comply with SOLAS requirements.

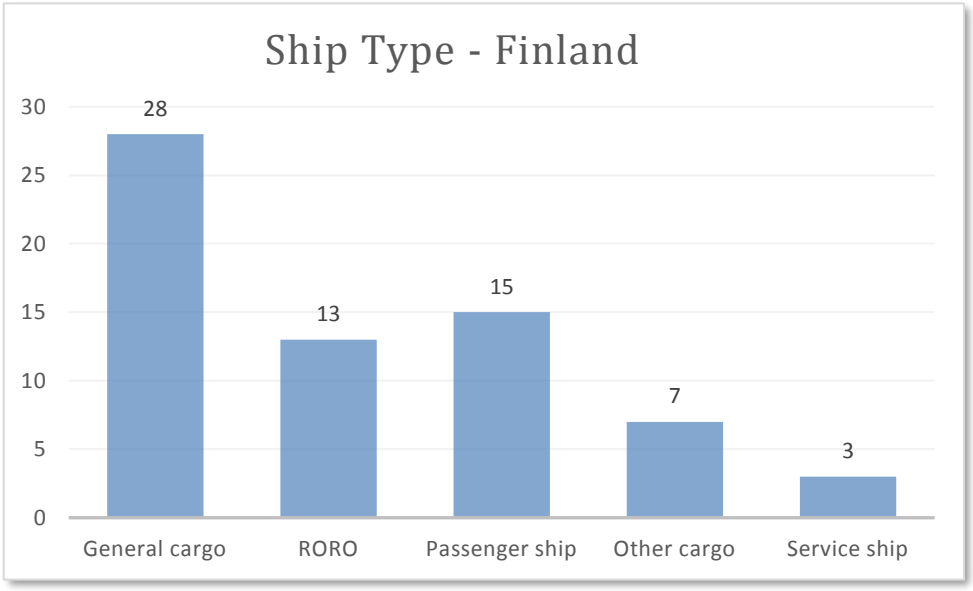

Figure 6. Question 1 - Ship type distribution (Finland)

Out of 66 valid answers from Finnish vessels, 42% (28 responses) represent General cargo ships. 13 answers received from RORO ships. Other cargo ships include Bulkers (4 answers), Tankers (2 answers), and a heavy deck cargo carrier.

Passenger ships (15 answers) represented by 13 Ferries (ROPAX) and 2 Cruise ships. Group of service ships include 2 tugboats and a SAR vessel.

Ratio of answers retrieved from Dry cargo ships, ROPAX, RORO and Tankers (33:13:13:2) quite precisely reflects amount of registered Finnish ships in last years. Numbers of ships of these types were 99, 49, 45 and 10 (2017 Finnish merchant fleet statistics; TRAFI, 2017). Thus, structure of ship types represented in questionnaire to a large degree correlates with the structure of Finnish merchant fleet.

3.2.2 Rank of the person in charge of Fire drills

Ranks of persons in charge of organizing and conducting of fire drills on board of Finnish vessels, depending on a ship type, presented in the table.

	General Cargo	RORO	Passenger Ship	Other Cargo ship	Service Ship	Total
Master	1	0	2	0	1	4
Chief Engineer	15	10	9	4	1	39
Chief Officer	7	1	1	1	1	11
2/3 Officer	4	2	2	2	0	10
Total	**27**	**13**	**14**	**7**	**3**	**64**

Figure 7. Rank of a person in charge of fire drills on Finnish ships

Total amount of valid answers is 66. Besides data in the table, one answer states that fire drills on a General cargo ship are arranged by Chief cook. In another case, drills on a ROPAX is responsibility of designated Safety officer, without rank specification.

According to answers received, fire safety and fire drills on Finnish vessels is responsibility of Chief Engineer in 59% (39 answers) of all cases. Situation is on non-Finnish vessels is very much alike: 26 out of 50 valid answers, or 52%. Chief Officers and 2nd/3rd Officers oversee fire drills in 11 and 10 cases respectively.

As for ship types, Chief Engineers in positions related to training of fire parties dominate on every type of vessel, with overwhelming majority of them on Passenger ships and RORO. Chief Officers and 2nd/3rd Officers are more likely to arrange drills on smaller ships, such as General cargo. Possible explanation of that fact is smaller crew on General cargo ships and consequent redistribution of working responsibilities.

In general, fire drills on board is considered as important and crucial duty, and usually performed by persons with higher rank and more extensive working experience (Masters, Chief Engineers and Chief Officers). Junior officers perform this duty only on 16% of vessels.

3.2.3 Frequency of fire drills on board of Finnish vessels

According to SOLAS requirements, fire drills shall be conducted at least once in a week on passenger ships and once in a month on other types of vessels. This is absolute minimum,

and drills shall be conducted more often if significant part of crew was changed. This question aims to identify whether frequency of fire drills on board comply with legislation. Depending on a ship type, drills regularity presented in the table.

	General Cargo	RORO	Passenger Ship	Other Cargo ship	Service Ship	Total
Once in a week	0	0	9	0	0	9
Once in 2 weeks	3	2	3	0	1	9
Once in a month	25	11	1	5	0	42
Less than once in a month	0	0	2	2	2	6
	28	**13**	**15**	**7**	**3**	**66**

Figure 8. Fire drill frequency on Finnish ships

On General cargo and RORO ships, drills conducted once in a month or, in some cases, once in two weeks. These intervals comply with legal requirements.

On some Bulker ships and service vessels intervals between fire drills may exceed one-month period. Both service vessels belong to tug ship type, and longer periods between fire drills may be explained by assumption that these ships operate as harbor tugboats in domestic waters and do not have to follow SOLAS recommendations.

Situation with Passenger ships (both Cruise and ROPAX) is more confusing. Out of 15 ships of that type, only 9 keep fire drills once in a week as prescribed by SOLAS. 3 vessels have drills once in two weeks and 3 – once in a month or less. On foreign passenger vessels fire safety training also not always conducted on a weekly basis, and frequency distribution was following:

Frequency	Ships, Total	Of which Passenger ships
Once in a week	19	19
Once in 2 weeks	14	10
Once in a month	14	2
Less than once in a month	3	1
	50	32

Figure 9. Drills frequency on non-Finnish ships

Only 19 out of 32 non-Finnish passenger ships have fire drills once in a week.

3.2.4 Fire drills planning - combining with other drills

This question was included in the questionnaire based on two assumptions. First, I believe that combined drills need better planning and thorough preparation. Scenarios of combined drills are more complex. Arranging of joined drills require cooperation of people from different departments – usually fire drills are arranged by engine department and abandon ship drills are arranged by deck department. And second, combined drills reflect better planning of operations and workload distribution on board: It is easier and more efficient to conduct two-hour combined training than two separate drills for one hour each. Distribution of combined and separate fire drills presented on a chart.

Figure 10. Fire drills combination with other safety training on Finnish ships

In 65% of cases (43 answers), fire drills are combined with other safety training. In 35% of cases, fire drills conducted as single exercise. It is worth to mention that more than half of stand-alone fire drills (12 answers out of 23) are conducted on passenger ships (ROPAX and Cruise), and conducted on a weekly basis, or once in two weeks. Same situation on non-Finnish vessels: 14 out of 20 fire drills which conducted separately are held on passenger vessels. Justification for that fact is legal requirements – fire drills on passenger ships shall be conducted at least once in a week. This explanation rises following question: Why fire drills on passenger ships are not combined with abandon ship drills, which also shall be conducted weekly?

3.2.5 Fire drills duration

This question aims to evaluate how much time crew spent on fire drill. Effective drill shall be realistic and include possible actions which may happen in actual emergency. List of actions forming a drill is quite extensive and may include: detecting the fire or smoke, raising an alarm, mustering the crew, searching of missed persons, first medical aid in case of injury, donning fireman outfits, deploying fire hydrants or other firefighting equipment, starting fire pumps, putting out the fire, fire watch after fire is extinguished. These actions shall be conducted at reasonable pace, fast, but not in a hurry. All uncertain or doubtful situations shal be clarified. After active phase, all equipment used shall be returned to its normal stowage position, and debriefing takes place.

Proper drill is extensive event which require active envolvement of many crew members. Shortcuts and simplifications reduce effectiveness of fire drills. The diagram represent duration of fire drills on Finnish ships:

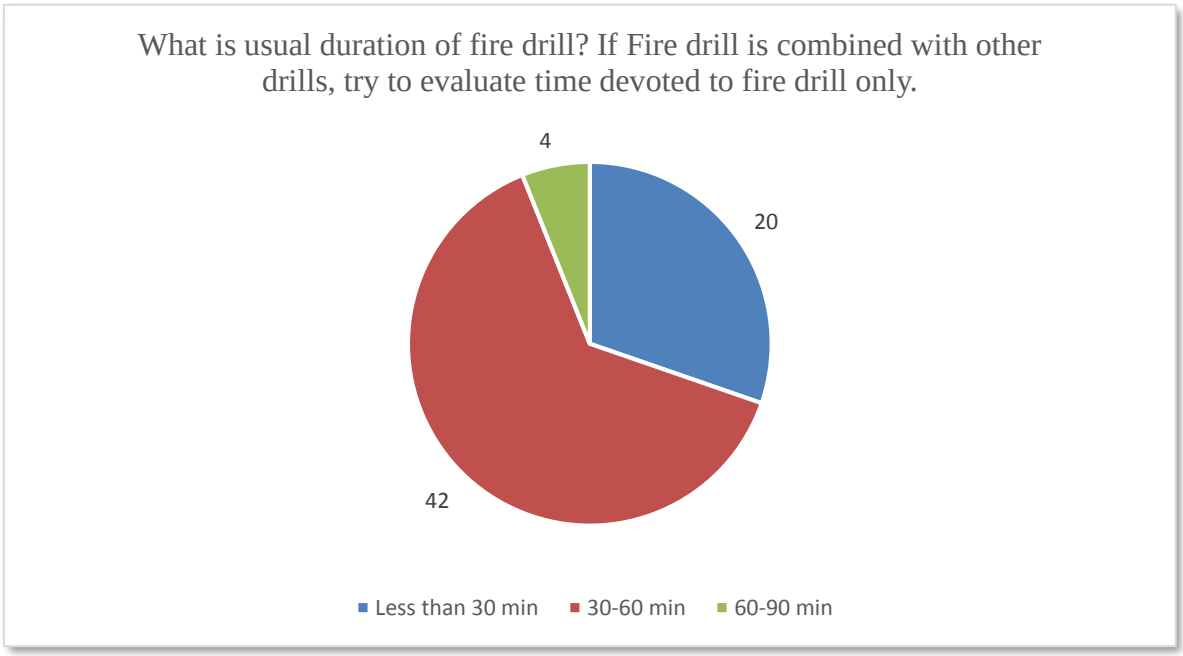

Figure 11. Fire drill duration

In most cases (42 answers) fire drills last 30-60 minutes. In 4 cases, drills last longer – 60-90 minutes. 20 respondents state that fire drills on their ships last less than 30 minutes. There is no obvious correlation between duration of fire drills and such factors as ship type or drills frequency.

3.2.6 Time of fire drills in ship's timetable.

In Question 7, participants were asked to choose all 4-hour time intervals when they had fire drills onboard. Each peer could choose few options, and total amount of answers was 103. The point of the question was to figure out how often fire drills conducted in a dark time, i.e. in conditions of imperfect visibility. It is always up to captain how to arrange drills schedule, and it is important to consider such factors as rest periods of the crew and other ongoing activities on board. But occasional drills in a dark time could better prepare participants for real emergency. Answers distribution is presented in the diagram.

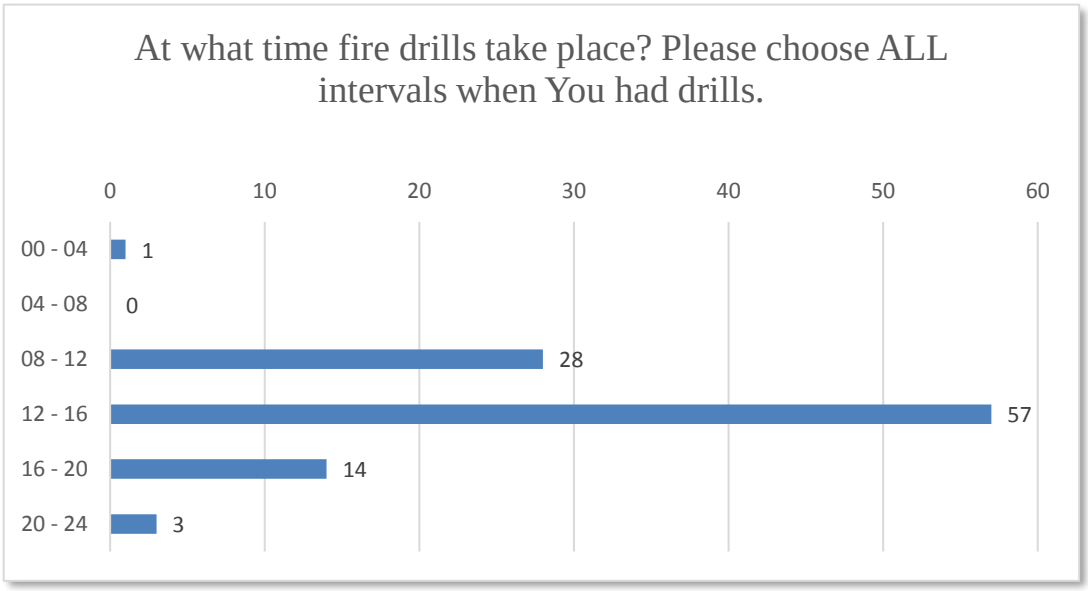

Figure 12. Time intervals of fire drills on Finnish ships

In most cases, fire drills are conducted in normal working hours, between breakfast and dinner. 30 out of 66 respondents had fire drills only between 12 and 16 hours, 18 respondents had drills between 08 and 16 hours. Only 16 seafarers participated in fire drills in the evening or night tome.

3.2.7 Informing the crew about upcoming drills

The point of the question was to figure out how crew members get knowledge about next drills' time. Spontaneous drills improve crew preparedness better than drills announced in advance. When time of the drill is known it is always a temptation to make some small preparations, such as preliminary check of equipment to be used, dressing up properly or gathering closer to muster stations. Thus, assumptions about time of response in case of actual may be distorted. On other hand, spontaneous drills may cause extra stress and disturb resting hors of the crew. Answers about drills anouncement presented in the diagram.

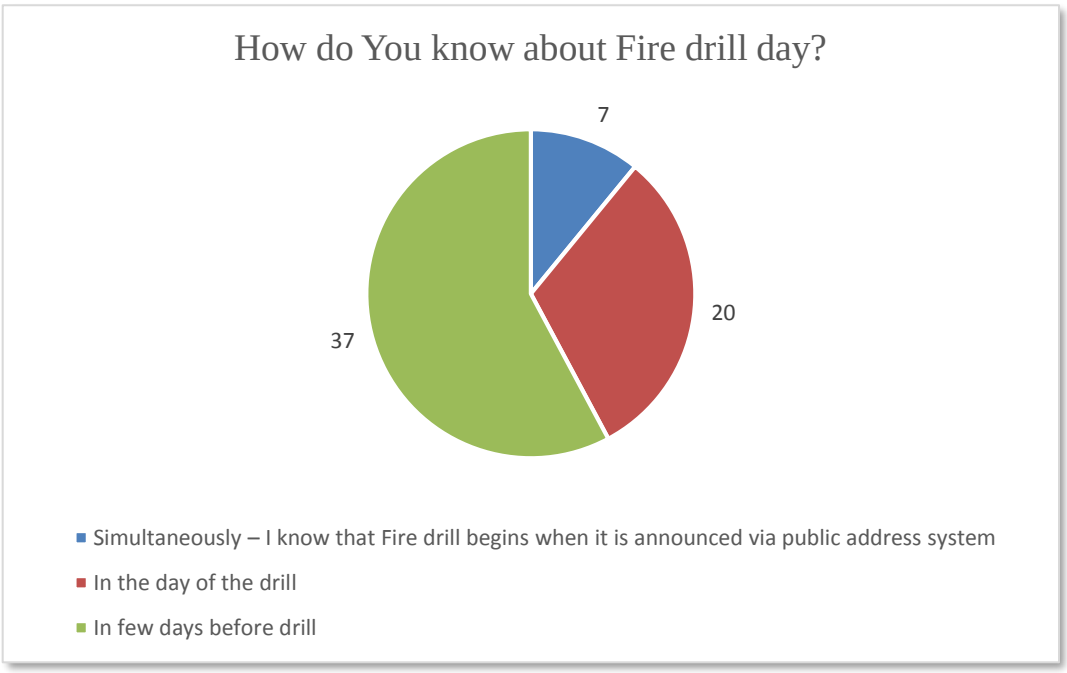

Figure 13. Fire drill announcement on Finnish ships

In most cases, participant know about upcoming fire drills in advance – in the day of the drill or few days before. Only 7 respondents have drills without prior announcement, 4 of them work on General cargo ships. Two participants who work on ROPAX vessels answered that there is 4-6-month drill schedule with specific dates on board. On foreign ships is very similar statistics – 8 out of 50 respondents had spontaneous drills.

3.2.8 Drill scenarios – general

In this question, seafarers were asked to indicate if fire drills are conducted according to specific scenarios on their ships. Preparing and performing the drill according to realistic scenario is more time-consuming, but more efficient in terms of crew preparedness, then drills with simple describing of everyone's duties and checking the equipment. Answers about drills scenarios are presented in the diagram.

In 44 received answers, participants have drills conducted according to scenarios. 18 participants have drills which may be described as tabletop exercises, without practical firefighting operations in specific area. 4 answers are "Both options" in different variations: "*Both alternatives 50/50*", "*Both of the above were used*", "*Both options. Maybe every second drill is a scenario*", and "*Sometimes the drill is more active with scenarios and sometimes more relax where everyone explain their duties in case of fire*".

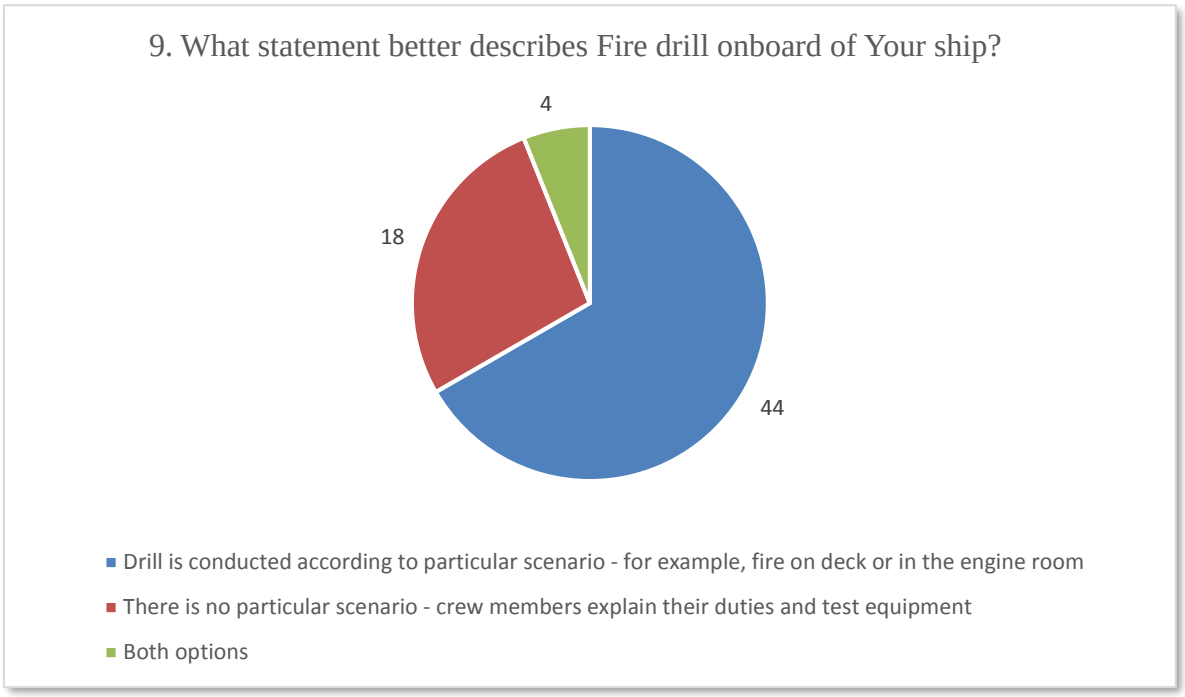

Figure 14. Fire drills scenarios on Finnish ships

There is no significant correlation between answers and ship types of respondents. But in all cases, drills without scenarios are conducted once in a month or even with larger intervals between trainings. On non-Finnish vessels, ratio of fire drills without scenarios is slightly lower than on Finnish ships (20% and 27% of answers correspondingly).

3.2.9 Drill scenarios – location

The point of the question was to analyze the diversity of fire drills scenarios. Training on board shall be realistic and prepare the crew for majority of possible risks, and it is important to keep drills in different places of the ship. Different locations also make drills less boring and work up motivation of the crew. In this question, participants could choose few options from proposed list, or write down own answer.

Based on answers, fire drills are not very diverse on Finnish ships. In 21 cases, drills are conducted in one same location on board. In 17 cases drills take place in 2 different locations. Only 27 respondents, or 40%, had drills in 3 or more locations. The most common place for fire drills is engine room or other machinery spaces (45 answers). This number is well corresponding with statistics provided by Baltic MIRG report – fire on board originates from machinery spaces in 63% of cases. On the other hand, amount of drills conducted in galley, sauna and accommodation area (52 cases in total) might be too excessive, since only 10% of fire starts in living quarters. Distribution of drills locations presented in the diagram.

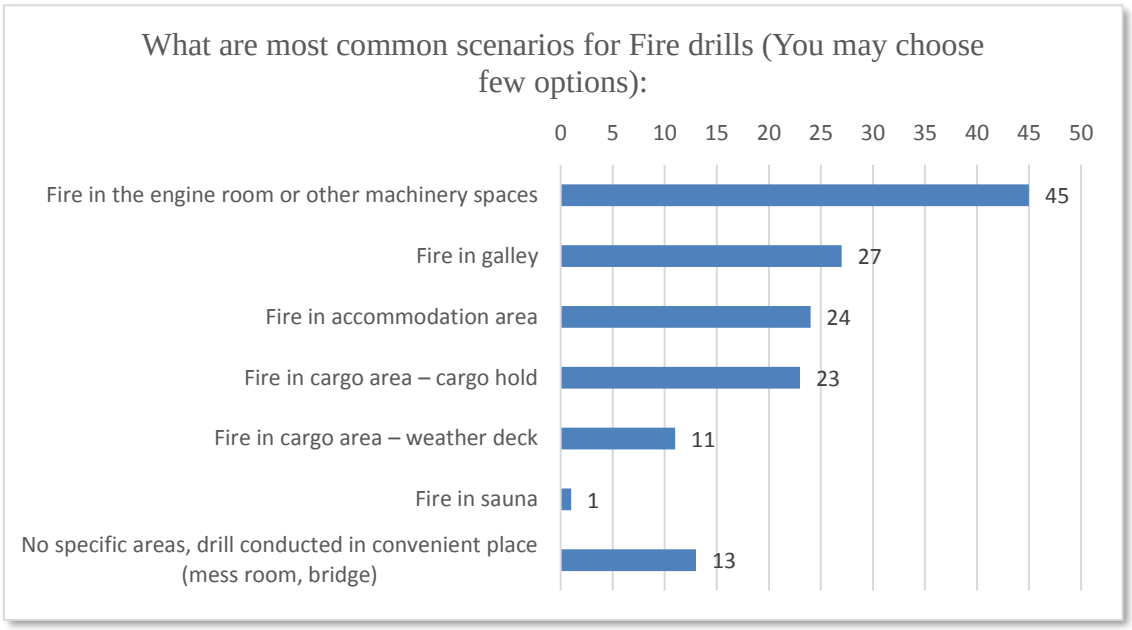

Figure 15. Drills' locations on Finnish ships

There is no significant correlation between drills location and ship type, except obvious fact that drills in cargo areas (cargo hold and weather deck) are conducted on cargo vessels.

3.2.10 Contents of fire drills

In this question, participants of the survey were asked to choose operations which usually constitute fire drills on board of their vessels. The list is quite extensive, and all operations may be divided into few groups: alarm and mustering, explanation of emergency – related duties, evacuation, search and rescue, medical first aid, preaparation of smoke diving parties, use of portable and stationery firefighting equipment. In total, 66 Finnish seafarers answered the question. Distribution of actions usually included in fire drills presented in the diagram.

At least 2 out of 3 fire drills include following actions: After fire alarm is sounded, the crew gather at muster station. Members of Fire teams don fireman outfits, they use SCBA devices, or functioning of SCBA devices is explained and demonstrated. Few fire hoses are connected to hydrants and prepared for use. After that, fire pumps are started and the crew putting out the fire using hydrants and hoses. Before or after that actions, crew members describe their duties in case of fire, and use od fixed firefighting installations (CO_2 of inert gas systems) is explained or demonstrated.

Apart of to these basic operations, about every second drill include such features as use of hend – held radios and explanation by the crew which fire doors, dumpers, vent inlets and outlets to be closed in case of fire.

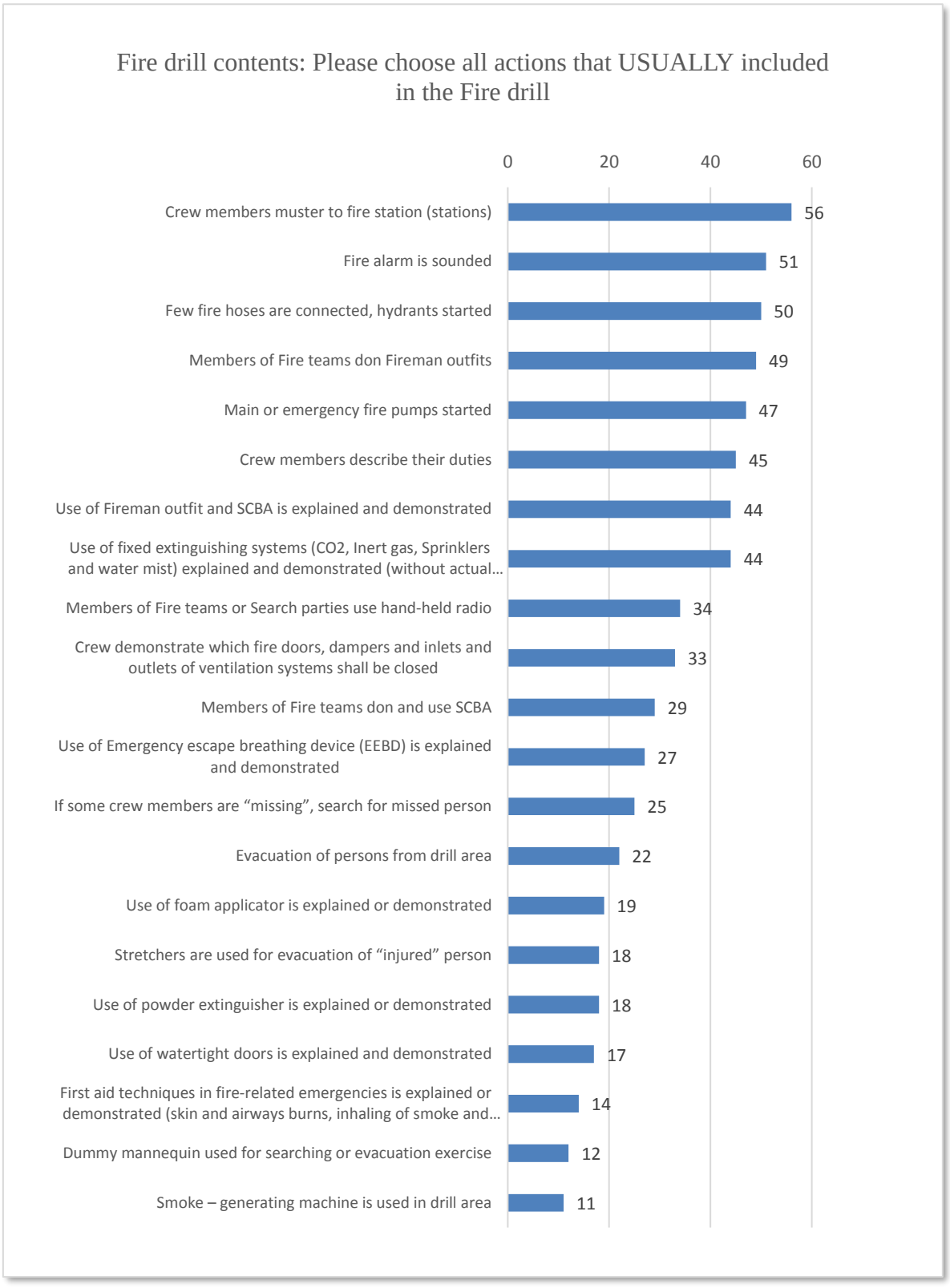

Figure 16. Actions included in Fire drills on Finnish ships

Explanation of use portable fire extinguishers and EEBD is not very common. Survey also shows that fire drills lack such elements as search and rescue of persons from fire area and medical treatment of victims. Search of missed persons is included only in 38% of all training, and first aid techniques - only in 21% of fire drills. Use of supplementary equipment

is not common practice on Finnish ships – only 17% of respondents usually have smoke-generating machines or dummy mannequins.

To sum up, set of actions included in a typical fire drill on Finnish ship is less than needed for proper training. Significant part of drills not even include these obligatory operations which prescribed by legislative requirements, particularly SOLAS.

3.2.11 Contents of debriefing

Training debriefing, among with planning, preparation and execution, is essential part of fire drill. Thorough debriefing may reveal possible flaws in crew performance, lack and malfunction of equipment available on board. Debriefing is a tool of improvement of contingency plans. It is important to devote sufficient time for after-training communications, and to encourage participants to share their comments and proposals freely. Topics discussed on debriefing presented in the diagram.

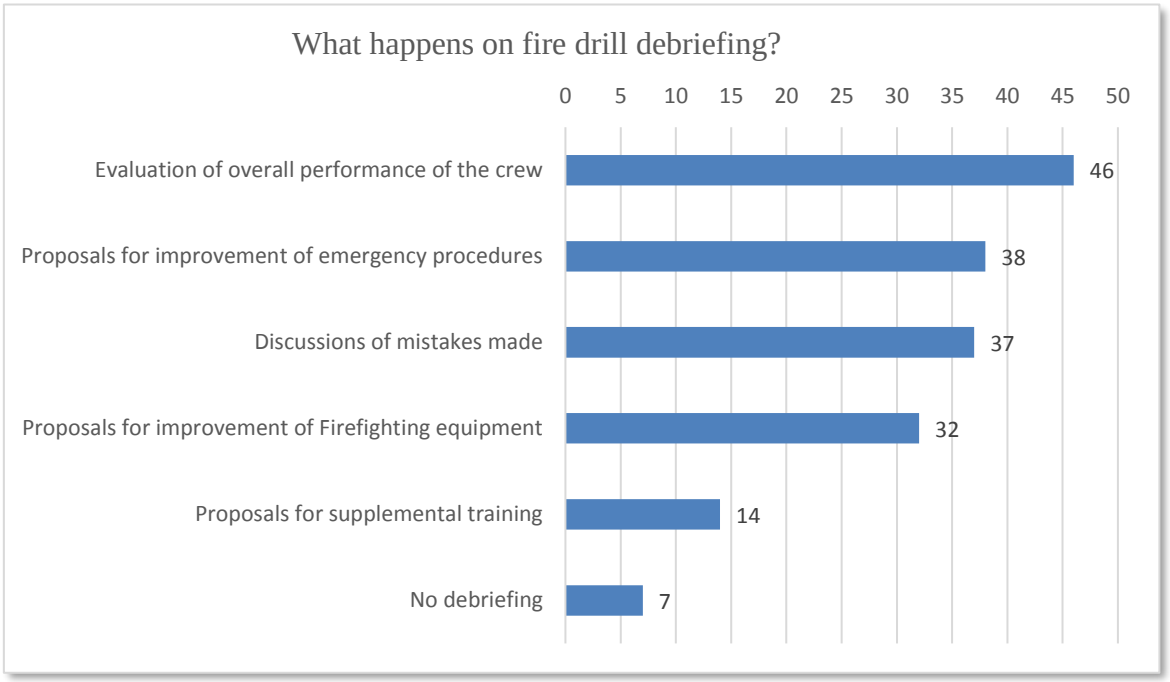

Figure 17. Fire drills debriefing on Finnish ships

Out of 66 Finnish respondents, 7 answered that there is no debriefing after fire drill. In 70% of cases, participants exchange their views on performance of the crew during the drill. Proposals for improvement of emergency procedures are discussed in 57% of cases, and proposals on improving of firefighting equipment – in 48% of cases. Supplemental training is rare topic of debriefing communications.

3.2.12 Seafarers' opinion on quality of fire drills

In this question ("How Fire drills prepare You for real emergency onboard? Input number 1 to 5. 1 - "Do not prepare", 5 - "Prepare a lot""), participants were asked to evaluate quality of fire drills on scale from 1 to 5. Distribution of answers presented on the diagram.

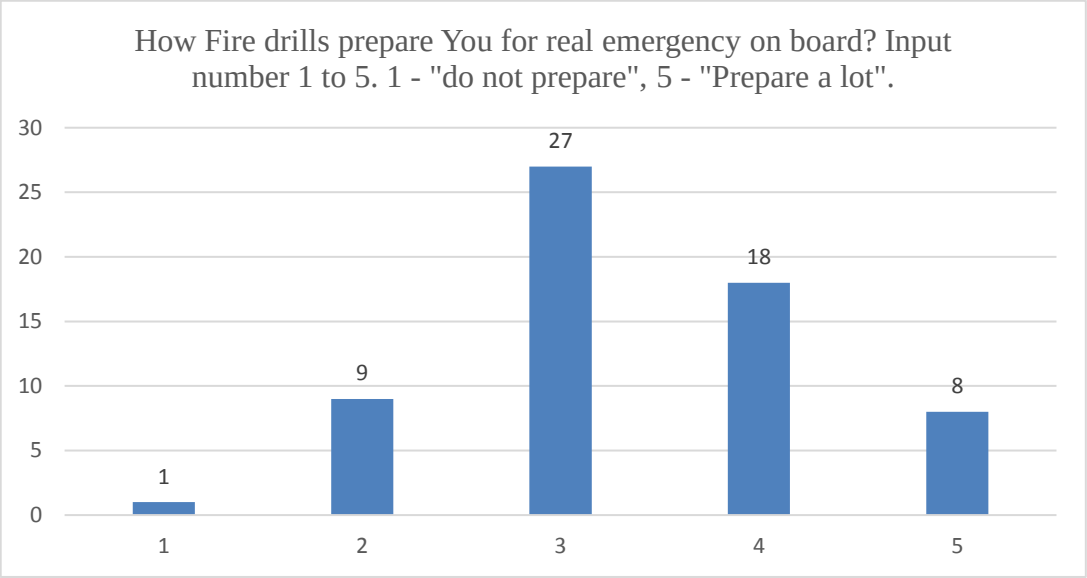

Figure 18. Seafarers' opinion about Fire drills relevance on Finnish ships

Most common answer is "3" – 27 answers. These seafarers estimate quality of fire drills as average. 24 participants believe that quality of fire drills is better than average (answers "4" and "5"), and only 10 participants think that fire drills do not contribute significantly in their preparedness for actual emergency (answers "1" and "2").

Total average score among all 66 participants is **3,21**, which is slightly higher than average. It is interesting to mention that average score among these 12 participants who are in charge of organizing and conducting fire drills is **3,42**, which is very close to total average score. These people do not tend to overestimate effectiveness of drills, even if it is area of their responsibility. Average score on non-Finnish vessels is higher and equals to **3,68**, based on 50 received answers.

There is no evident relation between scores and ship types or rank of the person in charge of fire drill. But two types of correlation are obvious.

First, time devoted to training is essential and affect to its effectiveness. If we look at lower scores ("1" and "2"), 7 out of 10 seafarers who choose these scores have drills that last only 30 or less minutes. In rest 3 cases, drills last 30 - 60 minutes. In opposite, higher scores ("4" and "5") are given to drills that last 30 - 60 minutes, and in some cases 60 – 90 minutes.

Second significant factor is training frequency. Most of drills associated with lower scores ("1" and "2") are conducted once in a month or in longer intervals. Only two participants have drills more often. Contrary, out of 26 answers with higher scores ("4" and "5"), 5 participants have drills once in a week, and 6 – once in two weeks.

3.2.13 Measures that can improve efficiency of fire drills

In this open question ("What measures onboard of Your ship may improve efficiency of Fire drills? You may answer shortly in few words.") I asked participants about possible actions that can make fire drills better. Out of 66 respondents, 42 shared their visions about possible improvements. Most common ideas are following.

There is definitely a need for better planning of drills. Scenarios shall be more realistic and diverse. Participants answered that they need "*Better planning, bigger scenarios*", "*to have different case scenarios every drill*", "*The drills should have been more carefully planned and not as spontaneous as they've been*", "*Change scenarios more often*" and "*Well thought out, full scale drills*".

Another obvious aspect is that crew members shall study their duties in case of emergencies more thoroughly: "*Know your duties and familiarize the fire and safety plan*", "*Familiarizing one's duties thoroughly*", "*Everybody knows their duty*".

Drills shall be more practical. In many cases, drills are more like tabletop exercises, where crew members just describe their duties. Participants answered that they need "*Serious drills, not only talking and showing... should be more action*", "*Actual training, not just discussing or putting on suit*", "*More realism*", "*More practicing*", "*Focusing on given duties and do the drills as they should - not just because the schedule says so*" and "*To not demonstrate only but do*". Particular attention shall be paid to preparation of smoke-divers: "*Better smoke diving drills should be organized*", "*Better training for smoke divers*", "*Donning of fireman's outfit as faster as they can*". It is good to have more training air cylinders or refilling compressor on board. Other equipment shall be tested and used frequently: "*Using enough time go to through usage of all required equipment*", "*Try the gear*".

Drill shall not be straightforward and predictable. Respondents proposed to introduce "*Element of surprise*" and that "*The exact time of drill is not told beforehand. Also, the location of fire comes as a surprise for the crew*".

And finally, there should be better motivation methods, both for crew and those who arrange drills: "*Find a way to motivate the crew to actively take part in the drill*", "*Good orientation and attitude*", "*Skills to motivate older seafarers...*". No specific methods were proposed, but one seafarer answered that "*A real accident that changes attitudes*" will improve participants' motivation toward fire drills.

3.2.14 Factors that have negative impact on efficiency of fire drills

In this open question ("What factors onboard of Your ship have negative impact on efficiency of Fire drills? You may answer shortly in few words.") seafarers were asked which factors, in their opinion, compromise quality of fire drills. 2 participants answered that there are no such factors ("*So far none*"), and more 15 left the field blank. Rest 49 received answers revealed following weaknesses in training.

Workload and lack of time (19 answers) is the most frequent answer. Safety training is considered not as normal working routines but as some extra duties. Respondents provided following comments: "*Crew is too busy due to ship schedule*", "*Lack of time due to cargo ops*", "*Drills are kept short as possible so that crew can concentrate on their work*". Variety and volume of working duties during extensive periods may cause exhaustion. Seafarers point out on such factors as "*Tired crew makes the drills a lot sloppier with more mistakes*", "*Concerns with interrupting rest time*", and "*Fatigue*". Shorter answers are "*Lack of time*", "*Watchkeeping schedule*", "*Normal duties*", "*Restricted time*" and "*Timetable*".

Attitude of the crew (16 answers). This is the second most common answer – 16 respondents found this factor important. In 3 cases, respondents mentioned attitude of persons in charge of fire drills: "*Lack of interest from higher ranking officers and ship owners*", "*Most of the fire crew is people from the engine room, and they are lazy*", "*Lazy chief engineer*". Another significant group who do not take drills seriously are experienced seafarers (3 answers): "*Usually it is the older crew members that do not show any interest in the drills*", "*Old generation of sailor's "know everything already" - attitude*", "*Older crew members are not interested on drills*". Other similar answers are "*People not interested in safety issues*", "*Attitude that drills are annoying necessity you have to be done with*", "*Ship culture doesn't allow for taking drills seriously*", "*Drills has not been taken serious enough*" and "*Indifference*".

Methodological mistakes during fire drills (7 answers). In some cases, persons in charge of fire drills shall do more efforts to keep drills relevant. Respondents gave following answers:

"*Since we have fire drills quite often the crew don't find the drills interesting*" (drills are kept once in a week), "*Boring drills*". Sometimes it is too much information given, or not all explanations comprehended by participants: "*If there is too much information at once*", "*Unclearness*". In certain cases, drills do not include all necessary elements: "*Crew want the drill to be over as quickly as possible and because of that they take shortcuts in procedures*", "*Sometimes no have proper training on firefighting equipment*".

Flaws in equipment (3 answers). Sometimes it is hard to conduct proper drill due to lack of proper equipment or its location: "*We do not use the equipment*", "*Placement of gear*", "*Lack of safety equipment*".

Language difficulties (3 answers). On ships with multilingual crew, drills are not always conducted on a language which is comprehensible by all participants: "*Sometimes the drills are not done in the safety language onboard (English) so there is always somebody that doesn't understand what is explained*", "*Language skills*", "*Working language is Swedish, although not everybody speaks the language*".

Slow response of the crew (3 answers). In some cases, the crew reacts on fire drills alarms slow: "*In case of unexpected fire alarm on board, it can take long time before any actions are performed and crew start to muster*", "*Slowly proper execution of the crew*", "*Slow response*". On one ship, frequent false fire alarm caused a situation when "*All crew is just waiting for silencing the bell and trusting that it is "false alarm again"!*".

Among other reasons also named "*The age of the vessel and the limited space onboard*", and "*Not all involved*", due to tight working schedule.

Situation on foreign ships looks familiar – respondents from non-Finnish vessels also named tight working schedules, crew motivation and attitude, language and communication issues, and limitations of use of firefighting equipment.

3.2.15 Purpose of fire drills

The meaning of this question was to figure out what seafarers' vision on drills' goals is, and how they see usefulness of safety training. Most of the questions were not very specific.

Common opinion is that fire drills shall prepare the crew for real emergencies. Firefighting training is needed "*To prepare and be ready in case of fire onboard*", or to "*Prepare crew to take action in "real" situation*". Every third answer is similar. More specific answers point

out that drills are needed to develop knowledge and practical skills of participants: "*To learn how to put out a fire onboard and locate and evacuate crew members*", "*To prepare the crew to take proper action in case of an emergency*", "*To exercise the crew and familiar their own duties and responsibility in case of emergency*". Another objective of drills is to familiarize participants with available equipment on board: "*To familiarize the crew with ff equipment and the locations of equipment*", "*Familiarize crew to correct use of equipment and testing of equipment*", "*To know how to use the fire extinguish systems*", "*To get to know all the firefighting equipment/systems on the ship*", "*To know the equipment and areas and different scenarios*" and "*To get familiar with the equipment onboard*".

Only few participants mentioned that drills are tools of developing teamwork and effective communications: drills are needed for "*To prepare the crew to operate together as efficiently and safe as possible*", "*efficient communication*". And only one survey's participant stated that drill is needed "*To improve emergency plans*".

3.2.16 Rank of Survey Participants

The final question of survey is about participants' position on board. Most of the answers received from persons who perform different duties in deck department. There are only 3 recipients from the engine side. Distribution of participants' ranks presented in the diagram.

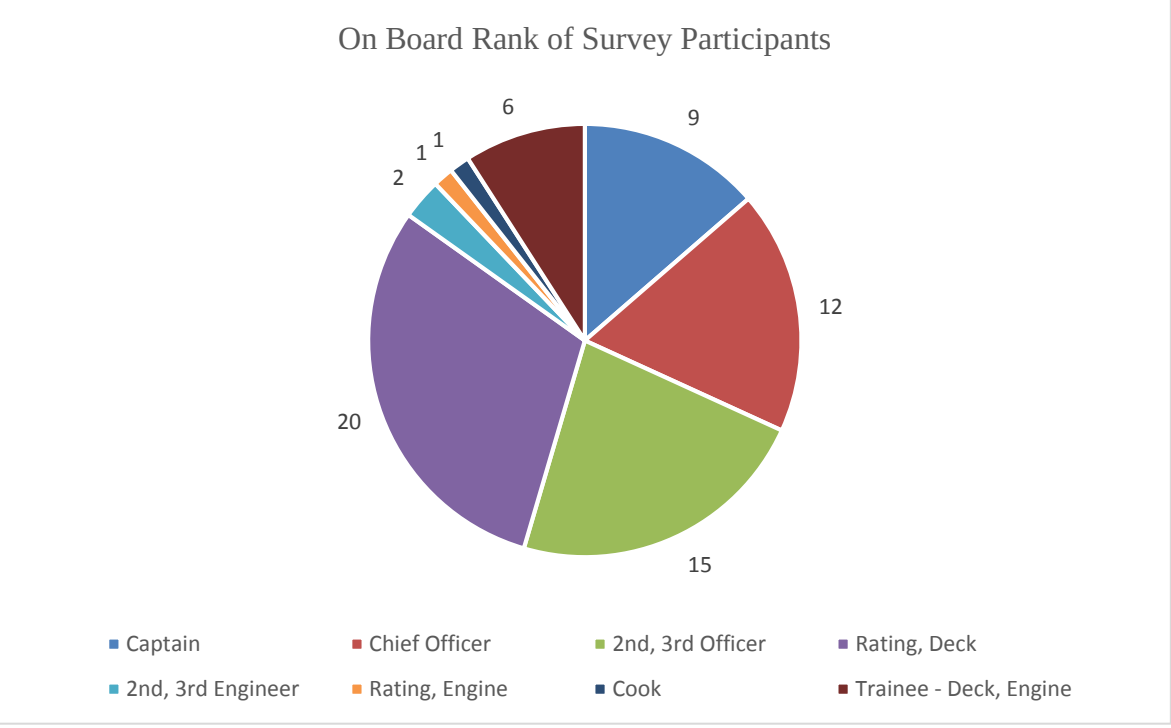

Figure 19. Rank of Survey participants - Finnish ships

4 Analysis

4.1 Conclusions

In my opinion, conducted survey was successful. The number of seafarers who submitted their answers was large, and their rank and structure of fleet they work on (ship types) was diverse and representative. After publishing the survey, I received a lot of messages from colleagues, who told me about their interest in the topic and its relevance to their concerns about safety issues on board of their ships. Based on analysis of theoretical materials and gathered answers, I can make following conclusions.

First, approaches to arranging and conducting fire drills on Finnish vessels vary significantly from ship to ship. My starting theory was that there are no specific standard guidelines for safety training which implemented on all ships. Instead of that, ship owners and ship management are guided by requirements of legislation, which sets quite wide margins for persons in charge of training firefighting units. This theory turned out to true, and on each ship fire drills are conducted in different manner.

Second, average effectiveness of fire drills on Finnish vessels is decent, and that training have moderate to good effect on crew preparedness for actual emergencies. In some cases, seafarers believe that drills have little to no relevance to real fires. Good side is that there are much more sailors who consider drills as effective.

To keep drills more effective, a person in charge of firefighting training shall avoid following mistakes which are quite common on Finnish ships.

- Drills shall comply with legislation. It is worth to mention two types of negligence that occur on Finnish vessels. First, drills are conducted not as often as prescribed by SOLAS, Chapter III, Reg. 19, Paragraph 3.2. And second, drills not always include obligatory elements prescribed in Paragraph 3.4 of the same Regulation.

- Drills shall be thoroughly planned, and not conducted spontaneously. Drills objectives should be clearly defined. Training shall be based on a practical scenario which reflects possible risks on board. Drill coordinator should seek for additional knowledge about arrangement of proper drills.

- Drills shall be practical. Participants shall as much as reasonable act like in real emergency, with use of all necessary equipment. Description of duties and

demonstration of equipment can be useful supplement to training but should not replace practical training completely.

- Drills should be diverse. Drill coordinator should implement different scenarios, considering prevailing hazards on board. Diverse drills prepare the crew for variety of possible accidents and make training less boring.

- It is essential to keep drills frequently and regularly. Aside from legislative requirements, more often drills, according to survey, associated with their better effectiveness.

- It is essential to devote enough time for firefighting training. Proper drill, which conducted not in a hurry, without shortcuts, which include all mandatory elements and detailed debriefing, should last 60-90 minutes minimum. According to survey, drills that last less than 30 min more often associated with their lower efficiency (Correlation between answers for Questions 6 and 13).

- Drills shall not be always predictable and straightforward. Good practice is to keep drill's time and location of fire in secret. Another element of surprise which can be implemented is changing the roles of participants.

- Aside from firefighting itself, SAR procedures (searching of missed persons on board) and practices of medical care shall be a part of the training.

- Drill coordinator shall pay due attention to debriefing. This part of training is equally important as planning and execution. Participants shall be encouraged to share their thoughts and ideas about procedures, equipment, and other safety issues.

- It is important to remember about such function of safety training as testing of contingency plans. Contingency plans shall be constantly checked and improved, based on feedback received during drills.

According to starting theory, major factors that compromise training effectiveness are excessive workload, crew attitude and frequent crew rotation from ship to ship. First two assumptions fully comply with results of the survey: every third seafarer answered that amount of other working duties and low motivation (particularly among drill coordinators and older seafarers) have negative effect on drills' performance. Only one responder said that crew rotation is important factor. Besides these three aspects, participants named poor

organization of drills (flaws in planning and methodology), lack of equipment, slow response of the crew, and conducting drills in a language which is not comprehensible by all participants.

Another objective of this study was to find out methods which may improve quality of training. Since every ship is different, and every crew follow different approaches, there is no universal recipe, except that person in charge of fire training shall avoid mistakes listed in this paragraph. Common weak spots are inadequate planning and analysis of drills and crew attitude – in these areas there are always a room for improvement. Better planning can be achieved through self-study. Crew attitude is a part of broader task: encouraging and implementing of safety-oriented working culture on all levels of the companies.

4.2 Critical review and future research

The most challenging part of this research was choosing a subject that would be interesting and relevant to my previous studies and working experience. Since the subject was specified, I could define the structure of the paper from the very beginning of writing process.

Some concerns at the starting point were related to chosen research method (survey in a form of questionnaire), but proper distribution method and participants' interest in the topic allowed to collect significant amount of answers. In my opinion, set of answers is representative, except that most of respondents work in deck departments. More answers from marine engineers, who usually arrange and conduct fire drills could give some interesting ideas from their side. But even without their answers, analysis allows to make conclusions about fire drills on Finnish vessels. Statistical calculations were made with Microsoft Excel tools.

As a starting point for further studies on this topic, it would be useful to conduct bigger scale survey among Finnish sailors. This could be done via different Facebook groups, other maritime schools of Finland or maritime unions.

As a suggestion for future research I would propose two topics.

First, it is human behavior in case of real emergency situations, and how training can improve people's performance and help to cope with mental stress. I had a plan to include this subject in the thesis, but this field is so big that it shall be done in separate study.

Second possible subject is attitude of experienced seafarers to their working duties, including participation in safety training. Few respondents of the survey pointed out on that factor as compromising quality of fire drills, since these seafarers have *"know everything already" – attitude".* Since I also encountered that mentality on different ships, it would be interesting to know is that kind of behavior justified on board and people try to work effectively avoiding excessive instructions and regulations, or they jeopardize overall crew performance, own lives and lives of other crew members.

5 Bibliography

Danish Maritime Authority Guidance no. 5 of 22 November 2002
Guidance on safety during abandon ship drills and fire drills on board ships. Retrieved 10.10.2019 from: https://www.dma.dk/Vaekst/Rammevilkaar/Legislation/Guidances/Guidance%20on%20safety%20during%20abandon%20ship%20drills%20and%20fire%20drills%20on%20board%20ships.pdf

DRAGOMIR, Christina. UTURINAU, Simona. *Drills and training on board ship in Maritime Transport.* Retrieved 2.10.2019 from: http://stec.univ-ovidius.ro/html/anale/RO/2016/2016-II-full/s4/7_2.pdf

European Maritime Safety Agency. *Summary Overview of Marine Casualties and Accidents 2011-2015*. Retrieved 01.09.2019 from: http://www.emsa.europa.eu/accident-investigation-publications/annual-overview.html

Finnish Border Guard. *Baltic Sea Marine Incident Response Group Project 2014 – 2016. Ship Fire Incident Analysis.* Retrieved 01.09.2019 from: https://www.raja.fi/download/70757_SHIP_FIRE_INCIDENT_ANALYSIS_FINAL.pdf?d9253720b21ad588

IMO. *Casualty Investigation Code*, 2008

IMO. *Directive 2009/18/EC.* Retrieved 10.10.2019 from: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:131:0114:0127:EN:PDF

IMO. *International Convention for the Safety of Life at Sea (SOLAS), 1974.* 2014 Edition

IMO. *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, with Amendments*. 2017 Edition

IMO. *International Safety Management Code*, 2018 Edition

IMO. *Lessons learned. Consolidated version Fire-Explosion.* Retrieved 10.10.2019 from: http://www.imo.org/en/OurWork/MSAS/Casualties/Documents/Consolidated%20version%20of%20Lessons%20Learned/Consolidated%20version%20Fire%20explosion.pdf

IMO. *Resolution A.852(20).* Retrieved 01.10.2019 from: http://www.imo.org/en/KnowledgeCentre/IndexofIMOResolutions/Assembly/Documents/A.852(20).pdf

NUMMI, Timo. *Compilation of exercises for safety drills onboard. Bachelor thesis.* Satakunta University of Applied Studies, Rauma. 2011. Retrieved 01.10.2019 from: https://www.theseus.fi/bitstream/handle/10024/28801/Nummi_Timo.pdf.pdf?sequence=1&isAllowed=y

Pan American Health Organization. *Guidelines for developing Emergency Simulations and Drills.* 2011. Retrieved 10.10.2019 from: https://www.paho.org/disasters/index.php?option=com_docman&view=download&category_slug=books&alias=1952-guidelines-for-developing-emergency-simulations-and-drills&Itemid=1179&lang=en

SZCZESNIAK. Johanna A. *Importance of the on board trainings and drills for the improvement of the vessels' safety*. Prace wydzialu nawigacyjego Akademii morskiej w Gdyni, nr 28, 2013 Retrieved 10.10.2019 from: https://docplayer.net/21624938-Importance-of-the-on-board-crew-trainings-and-drills-for-the-improvement-of-the-vessels-safety.html

TRAFI. *Finnish merchant fleet statistics 2017. Official statistics of Finland.* 2018. Retrieved 10.10.2019 from https://arkisto.trafi.fi/filebank/a/1529063473/eed320de954f81a3667d2b0363e9660c/30924-Kauppalaivasto_2017_vuositilasto.pdf

WADE, Laurence V. *Maritime security: Training, Drills and Exercises (Inherent value).* Maine Maritime Academy, USA. 2005. Retrieved 10.10.2019 from: https://www.scribd.com/document/55158549/1-014-s2-wade

WU, J, et al. *Effectiveness Evaluation on Fire Drills for Emergency and PSC Inspections onboard.* The International Journal on Marine Navigation and Safety of Sea Transportation. Vol 8, Nr 2, 2014. Retrieved 10.10.2019 from: http://www.transnav.eu/Article_Effectiveness_Evaluation_on_Fire_Wu,30,502.html

Appendix

Survey - Fire drills on board

This survey studies efficiency of Fire drills conducted onboard. The survey consists of 17 questions.

I welcome to participate all seafarers who are currently working on a ship, or have relevant working experience, or had onboard training. While answering questions please consider Your present working place, or Your last ship if You are not working now.

The survey is anonymous and confidential. It will take few minutes to fill in a form.

1. Please specify Your ship type.
    - Passenger ship - Cruise ship
    - Passenger ship – Ferry, RoPax
    - RoRo
    - Container Ship
    - Tanker
    - General Cargo
    - Bulker
    - Icebreaker
    - Tug
    - Other (please specify)
2. What is the flag of the ship?
    - Finland
    - Baltic or Nordic countries
    - Other than above
3. Rank of the person in charge of Fire drills.
    - Captain
    - Chief Engineer
    - Chief Officer
    - First / Second engineer
    - First / Second officer

- Other (please specify)

4. How often Fire drills are conducted onboard?
    - More often than once in a week
    - Once in a week
    - Once in two weeks
    - Once in a month
    - More seldom then once in a month
    - Other (You may specify drill periods below)
5. Is Fire drill usually conducted separately, or combined with other safety drills?
    - Fire drill usually conducted separately.
    - Fire drill usually combined with other safety drills in one session.
6. What is the usual duration of Fire drill? If Fire drill is combined with other drills, try to evaluate time devoted to Fire drill only.
    - 30 min or less
    - 30 - 60 min
    - 60 – 90 min
    - More than 90 min
7. At what time Fire drills take place? Please choose ALL time periods when You had drills.
    - 00-04
    - 04-08
    - 08-12
    - 12-16
    - 16-20
    - 20-24
8. How do You know about Fire drill time?
    - Time of Fire drill is announced in advance in few days before drill.
    - Time of Fire drill is announced in the day of the drill.
    - Simultaneously – I know that Fire drill begins when it is announced via public address system.
    - Other, please specify.
9. What statement better describes Fire drill onboard of Your ship?
    - Drill is conducted according to particular scenario – for example, fire on deck or in the engine room

- There is no particular scenario – crew members describe their duties and test equipment
- Other …

10. What are most common scenarios for Fire drills (You may choose few options):
    - Fire in the engine room or other machinery spaces.
    - Fire in cargo area – cargo hold.
    - Fire in cargo area – weather deck.
    - Fire in galley.
    - Fire in accommodation area.
    - No specific areas, drill conducted in convenient place (mess room, bridge).
    - Other (please specify).
11. Fire drill contents: Please choose all actions that USUALLY included in the Fire drill.
    - Fire alarm is sounded
    - Crew members muster to fire station (stations)
    - Crew members describe their duties
    - Use of Emergency escape breathing device (EEBD) is explained and demonstrated
    - Use of Fireman outfit and SCBA is explained and demonstrated
    - Members of Fire teams don Fireman outfits
    - Members of Fire teams don and use SCBA
    - Members of Fire teams or Search parties use hand-held radio
    - Main or emergency fire pumps started
    - Few fire hoses are connected, hydrants started
    - Crew demonstrate which fire doors, dampers and inlets and outlets of ventilation systems shall be closed
    - Use of watertight doors is explained and demonstrated
    - If some crew members are “missing”, search for missed person
    - Evacuation of persons from drill area
    - Stretchers are used for evacuation of “injured” person
    - Dummy mannequin used for searching or evacuation exercise
    - Use of fixed extinguishing systems (CO_2, Inert gas, Sprinklers and water mist) explained and demonstrated (without actual start of the system)
    - Use of powder extinguisher is explained or demonstrated

- Use of foam applicator is explained or demonstrated
- First aid techniques in fire-related emergencies is explained or demonstrated (skin and airways burn, inhaling of smoke and toxic fumes)
- Smoke – generating machine is used in drill area
- Other

12. What happens on Fire drill debriefing?
    - Evaluation of overall performance of the crew
    - Discussions of mistakes made
    - Proposals for improvement of emergency procedures
    - Proposals for improvement of Firefighting equipment
    - Proposals for supplemental training
    - Other
13. How are You satisfied with quality of Fire drills onboard of Your ship?
    Input number from 1 to 5, 1 – "Not satisfied", 5 – "Completely satisfied".
14. What measures onboard of Your ship may improve efficiency of Fire drills? You may answer shortly in few words.
15. What factors onboard of Your ship have negative impact on efficiency of Fire drills? You may answer shortly in few words.
16. What is the purpose of Fire drills?
17. What is You position onboard?
    - Captain
    - Chief Engineer
    - Chief Officer
    - 2nd, 3rd Officer
    - 2nd, 3rd Engineer
    - Rating – Deck
    - Rating – Engine
    - Trainee – Deck, Engine
    - Other

    Thank You!

Survey is available by following web address:

https://docs.google.com/forms/d/e/1FAIpQLSdbe3dvkn3pbz26MUjYh9eRoZv7r1e_jWTGEc37w08vxfLlUw/viewform?usp=sf_link