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1 Introduction

1.1 Background to the Project and WP6

STM BALTSAFE is an Interreg project lead by the Swedish Maritime Administration with participants all around the Baltic Sea. The objectives of the STM BALTSAFE project are to:

- to improve the safety of navigation of the tanker shipping segment by means of STM: By the exchange of voyage plans, the situational awareness of the involved ships will increase as the ships will be aware of the other ships intentions and can plan their voyages accordingly.

- to provide ships and VTS centres with improved situational awareness: Sea Traffic Management and the ability for the VTS centres to see the ships voyage plans is the biggest operational improvement in the VTS centres since the AIS was implemented in the late 1990’s. The VTS centres will get a much better situational awareness and can support the ships in a completely better way than is the situation today with traffic information, traffic organization and navigational assistance.

- to offer involved ships added value services like for example route optimization, enhanced monitoring and automated reporting by providing an digital infrastructure and environment to operate in: By different maritime services, both public and commercial, the ships will be given easy accessible services like enhanced monitoring by VTS centres, automated reporting that provides a reduction of the administrative burden of the crew and allowing the officers on watch to focus on navigating the ship instead of managing administrative reporting.

- to develop and test new digital VTS services which will improve the speed and accuracy of ship-shore information exchange: Today, much of the interchange between VTS centres and shipping is done by VHF voice. Digital message exchange will bring certainty of information and VTS advice, increasing safety. Automated reporting will reduce the burden on the ships’ crews.

Expected project results contain:

- STM BALT SAFE will increase the institutional capacity in VTS centres and onboard ships and enhance the situational awareness of the bridge officers and VTS operators. This enhanced situational awareness among the operators in the authorities and onboard ships will improve maritime safety, reduce the risks for accidents and groundings and contribute to a sustainable development in the maritime transport system in the Baltic Sea region.

- The project will develop a concrete use case for large-scale testing of STM on tanker shipping in the Baltic Sea and verifying the exchange of voyage plans, integration of STM functions in VTS centres in accordance with HELCOM’s recommendation. Within the framework of the project, the digital Maritime Infrastructure for Maritime Services initiated in EfficienSea II, MONALISA 2.0 and the Sea Traffic Management Validation project is developing and ensures interoperability of information exchanges and the needs of this digital infrastructure found in the STM BALT SAFE project.
• Services for increased maritime traffic monitoring from VTS centres and other government agencies will be developed and verified. Prototypes for various automated reporting services to Ship Reporting Systems, such as GOFREP and SOUNDREP as well as automatic reporting to Maritime Single Windows, will be developed in the project.

• The expected result of this is reduced administrative burden on shipping as well as increased predictability in Estimated Time of Arrival (ETA) information in single windows that increases the usefulness of information for different user groups, such as ship inspectors, customs and other maritime shipping actors.

• BIMCO clauses will be tested and evaluated in the STM BALTSAFE.

The STM BALTSAFE project aims to facilitate the development and distribution of services with the ambition that they become operational, commercially viable and sustainable after the end of the project.

1.2 Scope and Aim of WP6

The primary aim of Work Package 6 is to analyze and validate the use case of STM for tanker shipping, with major focus on safety of navigation. A serious approach to verification will contribute to ensure safe and successful adoption of any new technology and will also help securing expected benefits with respect to safety, efficiency and environmental sustainability. Based on the services that will be applied to the use cases, relevant evaluation, validation and verification methods will be derived in the first stage of the project. The aimed impact on safety is taken as the basis as well as the effects on efficiency and sustainable transport of tankers in the Baltic Sea for this evaluation. The main methods consist of Pre/Post data analysis (i.e. before and after introduction) and Interview-based analysis of perceived values which give a picture of the effects that the services have achieved.

Relevant safety assessment methodologies will be applied to describe the relative changes in safety that the services will imply. Typical hazards connected to the tanker shipping will be described as well as root causes, consequences and risk-reducing measures. Cost-benefit considerations will be made in the safety assessment. The output of the WP6 will describe and highlight the impact that automated services derived based on the STM platform will give on tanker traffic in the Baltic.

1.3 Purpose of this Report

This document contains the results of a literature survey concerning the problems that STM BaltSafe project addresses and the results of similar projects. This literature survey provides a context for the development of the evaluation methods.

1.4 Methods

The content of this report has been derived by a literature study.

The following methods will be used for the scope of the study in order to evaluate the services as shown below. This report covers the first step.
1.5 Delimitations

The project is limited to the scope of the project application, i.e. focusing on tanker traffic in the Baltic, applying certain and not all of the STM services to the shipping industry here. The evaluation as such is limited to effects on safety, efficiency and environmental impact. Any evaluation depends on proper usage of the tools, in order to get sufficiently with data for the use cases, whenever required. Even a sufficiently long duration of the measurement period is crucial to scientifically be able to prove effects of the STM services.
2 Background

The countries of the Baltic Sea region are heavily dependent on shipping for imports and exports as well as for internal trade. Passenger transport and cruise tourism is also considerable. Consequently, the Baltic Sea is one of the most heavily trafficked seas in the world. The volume of shipping in the region has been growing in recent years and represents up to 15% of the world’s cargo traffic. Simultaneously, ships are growing in size and draught. Such dense traffic inevitably presents a risk of maritime accidents, which can be detrimental and have substantial negative consequences for the Baltic Sea states, due to their dependence of the sea and the fragile ecosystem. Due to its strategic position, the Baltic Sea region is a natural route for oil transport, in particular from Russia. This is reflected in the considerable amount of oil transported through the Baltic Sea. (European Commission, 2017)

The Finnish National Audit Office has estimated that an accident of a large crude oil tanker in the Gulf of Finland could result in an oil spill between 50 000 and 60 000 tonnes. The average response and clean-up costs resulting from such an accident could grow up to 650 million euros. (Soukainen & Turtiainen, 2014)

According to the post-evaluation of the Gulf of Finland reporting (GOFREP) system given the evidence and experience gained since 2004, two of the main suggestions to improve the safety and fluency of the maritime traffic in the GOFREP area are electronic route plan exchange service both between ships and between ships and GOFREP centres and improved e-navigation services in general (Rosqvist, Berglund, & Hänninen, 2017).

The current high level of ship traffic combined with the expected growth increases the risk of maritime accidents in the future unless improved maritime safety and security procedures are set in place. At the core of the required procedural improvements are traffic management and traffic control measures involving the monitoring of ship movements, with the aim to prevent dangerous situations. (European Commission, 2017) Measures in the field of safety of navigation are needed to reduce accident risks. There is a need to improve the exchange of information between ships and between ships and shore for increased situational awareness and as a catalyst for improved safety of navigation, optimized capacity utilization, and just-in-time operations.

The digitization of shipping information is still very much in its infancy. At present, a ship’s voyage information is produced, as well as held, by a number of institutions, organizations, and individuals. A ship’s master typically facilitates the information flow between these stakeholders while the ship is at sea. As a ship approaches its port of destination, responsibility for information flow moves to a shore-based ship agent. In both cases, most information is retrieved and distributed manually by the use of emails and phone calls.

Sea Traffic Management (STM) is an answer to the need for improved safety, environmental performance and efficiency in maritime transport; within port areas as well as between ports. The STM concept takes a holistic view on services within shipping, from berth to berth. Instant exchange of information is an important facilitator for increased situational awareness as a catalyst for improved safety of navigation, optimized capacity utilization, and just-in-time operations. STM has already shown great socio-economic benefits as well as solid business cases for the industry, e.g. improved
maritime safety and minimized risks, bunker/fuel savings, decreased greenhouse gas emissions from shipping and improved utilization of resources.

According to the Norwegian Maritime Authority, human errors are the cause behind 65% of navigational accidents. Sea Traffic Management focuses on risk reduction by aiming to lower the amount of groundings and collisions caused by human factors.

There is also a need for improved institutional capacity and improved situational awareness in the Vessel Traffic Services (VTS) centres in the Baltic Sea region to provide services that make use of the new technologies available and that are adopted to cope with the increased maritime traffic in the Baltic Sea Region. With the trends to more automated navigation and autonomy, the information exchange between vessels need to be more automated as well.

HELCOM is recognizing the potential of Sea Traffic Management (STM) and exchange of voyage plans in the Baltic Sea for increased safety of navigation and improved environmental performance as well as for increased competitiveness of environmentally friendly maritime transport. HELCOM recommends the Governments of the Baltic Sea countries to bring forward/develop concrete solutions suitable for testing and validating e-navigation services and to take necessary actions to support the technical developments. There is a need for further developing the digital infrastructure to support interoperable, stable and secure digital exchange of information between ships and between ships and shore. International Maritime Organization (IMO) has in its e-navigation Strategy Implementation Plan (SIP) (IMO, 2014) recognised solutions that focus on efficient transfer of maritime information and data between all appropriate users (ship-ship, ship-shore, shore-ship and shore-shore). One of the main solutions is the improved communication of VTS service portfolio. This STM BALT SAFE project is fully in line with the international development and will contribute to the implementation of e-navigation services.

IALA is the recognized authority for VTS training standards and operational standards, and for digital services related to VTS, and the project will play a significant role in developing the harmonized digital VTS services of the future.

2.1 Tanker traffic in the Baltic

The Baltic Sea is a busy sea area with a significant amount of tankers sailing in and out, exporting and importing oil and oil products. The main ports in the Baltic for oil, gas and chemicals are divided by region as per below:

1. Gulf of Finland: Vysotek, Primorsk, St Petersburg, Ust-Luga, Tallinn, Sköldvik, Hamina/ Kotka
2. Central Baltic Sea: Klaipeda, Nynäs, Stockholm, Gävle
3. Danish east coast/ Swedish West coast: Fredericia, Gothenburg, Brofjorden, Stenungsund
4. Norwegian coast: Bergen Area, Tønsberg, Haugesund (Karmsund), Hammerfest, Porsgrunn (Grenland), Svelgen (Bremanger), Molde, Oslo, Kristiansund
5. Transports in the Baltic region of products are summarized in the diagram below exemplifying the main internal streams (excluding Norway and imports to the region).

![Energy Trading Patterns and Consumption in the Baltic Sea](image)

*Figure 1: Energy Trading Patterns and Consumption in the Baltic Sea (Shadurskiy, Westphal, Daborowski, & Liuhto, 2015)*

### 2.2 Technical trends in Shipping

ECMAR has stated a couple of trends related to shipping (ECMAR). Digitalisation will spur automation and positively impact safety and environmental performance. New cloud technologies will dramatically affect the design, manufacture and operation of vessels and their components. The Internet of Things will help to deliver smart vessels with shore-based control. Cybersecurity and Human Factors will become important issues with digitalisation and automation.

The next generation of connectivity between ship and shore will help shipowners to reduce costs, avoid expensive repairs and improve operational efficiency. Digitalisation, sensors and automated processes and the introduction of “big data” in maritime operations will lead to optimising energy use and fuel efficiency, vessel performance and condition monitoring, and real-time weather data and routing.

![Technical trends identified in shipping](image)

*Figure 2: Technical trends identified in shipping (ECMAR)*
2.3 Impact of Automation and Digitalisation on Shipping

Increased automation and digitalization have had both positive and negative impact. While the introduction of certain technical equipment has significantly improved safety (such as ECDIS through improved knowledge of ship position, automation in the engine room, etc.) these techniques have introduced new risks at the same time. Increased automation and digitalization lead often to more systems becoming safety critical or having adverse impact on operations. An example is the dependency of many navigational applications including ECDIS on reliable AIS data, where safety is jeopardized by parts of the fleet going dark (The Maritime Executive, 2019).

Examples have been found on IT related challenges including freezing screens, self-updating software, account/ firmware issues and operation system related failures (ForeSea, 2019). Failures are occurring on a regular basis and are of a complexity that often require external help and physical visits of supplier’s personnel. At the same time have many of the measures that are based on automation and digitalization eased work, made processes smoother, improved quality, avoided accidents and reduced risks.

Looking into the impacts to accidents, it was concluded (Hüffmeier & Bram, 2018) that smart ships are already part of everyday life, societal trends such as electrification, increased automation and digitization will further affect the development. Decision support and HMI are an important part of smart shipping. Increased automation can provide economic benefits, more environmentally friendly transport, safer shipping and a more efficient global community. Smart shipping will increase safety, lower environmental impact and will be more efficient. Smart crews/humans have an important role in the safe handling of ships. The crew typically will do its best based on the conditions given, but they cannot affect all factors. The introduction of more automation requires a system perspective and will not be a straightforward development. Many aspects of shipping will be affected by increased automation – business models, regulations, organization, workplace, working methods, HMI, roles and skills. Training, skills, experience, openness in the organization and familiarization will be central success factors even in the future. The ISM code needs to consider land-based monitoring and control to a greater extent.
3 Challenges identified

In this chapter various challenges are described which need to be overcome in order to improve vessel safety, efficiency and reduce environmental impact. Some of the points are described in general for the shipping industry, other are more specific for tankers or shipping in the Baltic. These parts describe possible areas of improvement in line with the project application.

3.1 Tanker Safety in general

Safety of shipping steers of many factors. Distributions of oil spills historically have different causes related to the size of the sub-consequent spill and number of spills have a positive trend. This can be seen in the diagram based on data by ITOPF (ITOPF, 2019).

Figure 3: Main categories for oil spills worldwide between 1978-2018 worldwide for different spill sizes and total number per year including 10-years average

3.2 Tanker Safety in the Baltic and Norwegian Waters

Accident statistics in general and in the Baltic in particular indicate that tankers have a lower probability of being involved in serious accidents. Statistics below are presented in order to provide information on typical accident scenarios in the Baltic. When analyzing data, it is important to consider that reporting requirements and registration practices have changed over time, which is visible in the analysed data.
3.2.1 HELCOM

HELCOM collects data from the various national authorities to get an overview on where and which shipping accidents occur. HELCOMs data (HELCOM, 2018) provide therefore an overview about the more serious accidents that have occurred between 1989 and 2017. Differences get visible when comparing all accidents in the database, where relative comparisons indicate that tankers, if involved in accidents are more probable involved in collisions and pollutions and less likely in groundings and ship stability related accidents.

![Figure 4: HELCOM database on accidents in the Baltic, share of different accident categories for all ship types and tankers specifically.](Image)

There is in the data no direct link to bigger spills caused by tankers, the amount spilled is mainly related to the ship size as such. This is also reflected in the description on which type of pollutant has been spilled, which is mainly fuel oil and hydraulic oils. Causes for tanker accidents have relatively less impact on human error or technical failure compared to the other ship types which could imply a higher standard in technical equipment, maintenance and crew performance. The share of human performance indicators, when available, indicate that violation of rules was more present on tankers relatively, while mistakes were more present on the other ship types.

3.2.2 Norwegian Sjöfartsdirektoratet (NMA)

The Norwegian Maritime Authority/ NMA records accidents as either a ship accident or a work and personal accident, depending on whether the accident causes damage to the ship or not. In addition, injuries are recorded. The data series dates back to 1981. Accidents on / with Norwegian ships and accidents on / with foreign ships in Norwegian waters are registered.

The data presented by the NMA (Sjöfartsdirektoratet, 2019) indicate that certain types of accidents are less probable for tankers to occur than for other ship types. The analysis of this data shows that the share of fire accidents and environmental damage/ pollution have decreased while the share of engine breakdowns, collisions, groundings and contact damages have increased. The total amount of accidents per year has been rather constant. Compared to other ship types in the statistics, collisions and environmental damage/ pollution are overrepresented as indicated in the figure below.
As no information was easily available on exposure of the vessels to accidents, the figures are compared to port calls (Sandnes, 2018). When comparing the data with number of port calls it can be seen that the risk of ships involved in accidents has decreased for most of the ship types during the last ten years period and that tankers have a lower frequency than other vessel types.

### 3.2.3 Swedish Transportstyrelsen

Masters and shipowners are obliged to report accidents and incidents that have occurred on Swedish ships or on foreign vessels located on Swedish territorial waters. In addition, others on board or employees in the country are encouraged to submit incident and accident reports. The reporting obligation applies to commercial, fishing and state vessels, as well as other vessels engaged in commercial activities. The database has been used to extract all accidents registered that involved tankers in the Baltic. Dominating events are groundings, collisions and engine failures.
Accidents occur throughout the typical fairways that the tankers act in, it is even reflected in the data that accidents occur more often in congested and crowded fairways as well as during maneuvering.

The activities onboard are dominated by normal navigation, minor shares are related to cargo handling, bunkering, mooring and maintenance.
The database shows that technical failure of equipment and external factors have the major share of causes together with human factors. Most of the accidents are classed as minor serious, about 8% where classed as serious. Most of the damages (if present) that occurred are damages to the hull, mainly in the lower part and in the foremost parts of the hull, which is typical for groundings and collisions. When leakages occurred, seldom a large leakage was the consequence, mainly minor spills. Manning on the bridge varied, sometimes a pilot was onboard, sometime double or single manning on the bridge was present.

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**Figure 8:** Activity onboard the vessel when accident occurs based on data from Transportstyrelsen.

**Figure 9:** Causes of accidents involving tankers in the Swedish EEZ of the Baltic based on data from Transportstyrelsen.
3.3 Administrative Burden on ships

DMA has published a report on the administrative burden on ships (COWI, 2013). The analysis found that Danish seafarers use up to 20% of their working time on tasks they deem as administrative burdens. Among employees in shipowners’ landbased offices the figure was 9%. The following observations were made by the authors:

- Observation 1 Seafarers of all nationalities perceive administrative burdens in the maritime sector as frustrating and burdensome. Our international survey indicates that the perception of administrative burdens among seafarers is more or less universal.

- Observation 2 Seafarers are concerned about ship safety and take great professional pride in their jobs. Many requirements and procedures are thus understood and accepted as a natural part of working routines.

- Observation 3 Seafarers and shipowners experience that there are significant potentials for standardisation and optimisation concerning port and pre-arrival documents and processes.

- Observation 4 The seafarers find ISPS rules to be somewhat burdensome and do not always acknowledge that they lead to a reduction of the risk of terror actions in ports.

- Observation 5 The seafarers and shipowners consider possibilities for the exchange and sharing of inspection data among those responsible to be under-utilised.

- Observation 6 The seafarers experience that various incentive schemes in place for those per-forming inspections lead to increased burdens for well-performing ships and have a detrimental effect on the ability of the inspections to actually serve their purpose.

- Observation 7 Despite a general acceptance of the need for inspections, seafarers and shipowners perceive the inspection regime to have grown to a disproportionate level where inspections focus on unnecessary detail.

- Observation 8 The seafarers acknowledge that QMS is installed for a reason but there is a perception among seafarers that QMS procedures are becoming more and more burdensome. On the other hand, shipowners find it frustrating to implement new rules with various national interpretation or implementation forcing them to produce large QMS to encompass all the national differences.

- Observation 9 Seafarers find that there is a lack of responsiveness to look into the consequences of new procedures and paperwork introduced to the vessels.

- Observation 10 The Danish shipowners mention a range of special Danish requirements and conditions that produce unnecessary administrative burdens for the shipowners’ offices.

- Observation 11 It is the sum of burdens that matters. Many seafarers and shipowners indicate that it is not a specific burden, which causes frustration. Instead, it is the
sheer sum of burdens, which has accumulated over the years. Seafarers and shipowners indicate that rules and procedures have accumulated over the last 5-10 years to an extent where it is now becoming counter-productive.

Conclusions of the DMA report include suggested ways forward:

- “Introducing 'work smart digital solutions' instead of manual procedures: authorities and inspections should allow for shipowners and seafarers to store digital data instead of printed and signed copies of everything.
- Introducing a more balanced and sustainable inspection culture focusing more on competences, culture and real observations and less on endless paper reports.
- Continued efforts to widen and implement standardisations and digitalization of port- and pre-arrival documents in the EU through SafeSeaNet and other places.
- Analysis of the potential for optimal standardisation/digitalisation solution fitting for a global business as the maritime industry. This could be based on the preliminary lessons learned from SafeSeaNet. Considering that the technical tools to support increased digitalisation are available, why has limited progress been made in this area and why do national and port differences continue to exist?
- Harmonious implemented standardisations of in particular port-, pre-arrival and ISPS documents globally based on the IMO Conventions and FAL forms. As a first step within the same country where information is shared between ports and public authorities.”

3.4 Quality of reported data from ship reporting

According to Regulation 11, chapter V of SOLAS, Ship Reporting Systems, SRS, shall be used for the improvement of the safety of life at sea, the safety and efficiency of navigation and/or to increase the protection of the marine environment. Mandatory reporting schemes are found in various parts of the coasts worldwide. In the areas for the project relevant areas these are shown in the figure below. Further reporting areas are the local VTS along the coastlines. Communication on and from/to ships is one of the causal contributors to shipping incidents and accidents. There are no direct statistics available on the quality of ship reports, despite studies on quality of AIS data (both static and dynamic information). Various issues with AIS quality have been collected, referenced and summarized in a.o. (Iphar, Napoli, & Ray, 2015). No information on quality of SRS reports has been identified but an automated ship reporting would allow automated cross-checks of information with available other sources of information, a motivation given by amongst others EMSA (EMSA, 2014). In a different paper (IMO, 2016), it is claimed that automated ship reporting could even harmonize requirements which will have an indirect effect on quality of reports received by authorities.
### 3.5 Ship Emissions and environmental impact

The IMO and EU have adapted regulations regulating emissions of air pollutants and aiming limitation of greenhouse gases (e.g. MARPOL 73/78 Annex VI, EU Sulphur Directive - 2005/33/EC, MEPC 74¹). According to the report prepared for HELCOM (Jalkanen & Johansson, 2018), the total emissions from all vessels in the Baltic Sea in 2017 were 315 kt of NOx, 10 kt of SOx, 10 kt of PM, 22 kt of CO and 15 Mt of CO2. The CO2 amount corresponds to 4.9 million tonnes of fuel, of which 30% was associated to auxiliary engines. These emissions do not include any contribution from inland waterway traffic.

The most significant contribution to emissions can be associated with RoPax vessels, tankers, cargo ships and container ships. In terms of fuel consumption, the respective shares for these vessel types in the presented order are 1200 (-3.8% decrease from previous year), 1000 (-8.3%), 891 (+6.2%) and 780 (+0.6%) kt of fuel consumed.

The emissions of some pollutants have decreased, like NOx (-2.3%) and CO (-1.3%) but emissions of SOx (+0.6%), PM (+0.4%) and CO2 (+0.4%) have slightly increased, when compared to year 2016. The emissions of CO2 from non-IMO registered vessels were 5.0% of total CO2 emitted from ships. During the 2017 study period, the number of IMO-registered vessels has decreased by -4%.

Overall transport work has decreased by -8.4% while the total travelling distance of IMO-registered vessels has decreased by -4.4%. The transport work of containership segment decreased by -8% whereas the transport work of tankers and cargo ships decreased by -13% and -2%. For RoPax vessels a decrease of -11% was observed.

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Figure 11: Emissions and the transport work of Baltic Sea shipping during 2006-2017. The colored symbols represent NOx, SOx, PM2.5, and CO2 emissions and transport work obtained with STEAM2 model for the period 2006-2015. The corresponding color lines indicate sa quantities obtained with a new STEAM3 model version for years 2014-2017. (Jalkanen & Johansson, 2018)

Geographical distributions are closely related to the main shipping lines in the area.

Figure 12: Geographical distribution of CO2 emissions from Baltic Sea shipping during year 2017. All values are reported as mass (kg) of CO2 emitted inside a grid cell of 15.65 km2. (Jalkanen & Johansson, 2018)

Especially emissions outside port areas are of concerns for policy makers and populations. Reducing emissions in port and coastal areas is therefore a focal point not
only for ports but even for EU legislative incitements. Other shipping externalities such as noise (over and underwater) emission, dust and odours, anti-fouling paints, ballast water, invasive species, scrubber and pollutants to water connected with cargo handling as well as sewage and marine litter. Moreover, in ports and their inlets, dredging may sometimes cause environmental problems as well.

Decarbonisation is achieved as recommended by McKinnon (McKinnon, 2018) through

1. reduce the need for freight transport;
2. shift to traffic types with lower CO2 emissions,
3. optimize utilization of cargo capacity in transport,
4. increase energy efficiency in freight transport, and
5. reduce the proportion of fossil fuels for energy supply of the freight transport system.

Increasing energy efficiency can have a positive impact on almost all of the environmental issues described above. This increased efficiency can be achieved internally onboard or externally in the whole transport chain. Even though the figure below is older, the potential of various systems is still valid in many respects.

Figure 13: Marginal costs for different approaches reducing carbon footprint. (Eide, Longva, Hoffmann, Endresen, & Dalsoren, 2011)
4 Success Factors identified

In this chapter various success factors are described which have had a positive impact on vessel safety, efficiency and reduce environmental impact. Some of the points are described in general for the shipping industry, other are more specific for tankers or shipping in the Baltic. These parts can be used to build on success stories and learn from the improvements made for the use cases described in the project application.

4.1 Vetting

Vetting for tanker vessels have significantly increased safety of this ship type segment. The SIRE Programme was originally launched in 1993 to specifically address concerns about sub-standard shipping. Since its introduction, more than 180,000 inspection reports have been submitted to SIRE. Currently there are over 22,500 reports on over 8000 vessels for inspections that have been conducted in the last 12 months. On average Programme Recipients access the SIRE database at a rate of more than 8000 reports per month.

4.2 Human contribution to Safety on Shipping

Human mankind's role and contribution in the management and operation of ships is great. Many studies show that the human factor is involved in accidents, but rarely studies focus on all accidents that are avoided due to the human factor. “Human error” is often referred to as the main cause of accidents (70-95%), but studies have shown that the underlying causes can relate to totally different aspects (Hüffmeier & Bram, 2018):

![Figure 14: Accident statistics – caused by “human error” according to IHS Fairplay’s database but having statistically significant correlations between ships being more likely to be involved in accidents and the factors described above. (Hüffmeier & Bram, 2018)](image)

Furthermore, an analysis of accidents correlated to outcome of port state controls show that

Huge difference in performances and outcome of port state controls, strongly correlated to ship types, flag states, and classification societies.
Some deficiency categories are strongly correlated to the probability of being involved in accidents.

ISM code, Cleanliness, Cleanliness of the engine room, fire safety related issues and the amount of deficiencies or the fact that the ship has been detained.

The impact of the organization on the safety performance of ships was then concluded. So instead of having the approach on how to replace humans in crucial operational functions, techniques should be developed that allow humans to act best as an operational success factor. Bringing in the Human - Technology – Organisation perspective, the following questions shall be approached:

- What's inside the human factor? What does it explain?
- How can we provide the best possible support?
- How can we transfer knowledge?
- How do we design the entire system?

4.3 VTS and mandatory ship reporting

The evaluation performed by VTT in 2017 (Rosqvist, Berglund, & Hänninen, 2017) indicates that the ratio of accidents (collision and grounding) and incidents in the GOFREP area vs. non-GOFREP area are approximately 0.5% and 10%, respectively, suggesting that the GOFREP area is very effective in controlling incidents. Average distances (in nautical miles) between crossing vessels during the ice free period (months 4–10) have grown during 2010–2015. The general opinion of mariners/officers and GOFREP-operators is that the collision probabilities in the GOFREP area have decreased over the past 10 years, both during the ice free and the ice period.

4.4 Shipping Efficiency in the Baltic

Ship resistance increases in shallow waters. Route optimization in the relatively shallow waters of the Baltic Sea will have a potential to decrease fuel consumption compared to when sailing in deeper waters. A study by (Costa & Holm, 2019) within the FAMOS Odin project revealed based on historical AIS data that “out of 19,159 AIS tanker tracks, 8,273 (approximately 43%) benefited from optimisation in fuel efficiency.” The results show that key changes in traffic patterns, specifically fairway shortcuts that could be taken if there are no safety concerns would make a change, but the study does not consider voluntary speed reduction.

A study on the post-evaluation of GOFREP, the Mandatory Ship Reporting System in the Gulf of Finland (Rosqvist, Berglund, & Hänninen, 2017), a number of risk-reducing measures for the region have been derived that could increase the safety of shipping further. Items that have been suggested in the project related workshop with VTS personnel and ship crews in order to increase safety are:

- More uniform procedures for intervention across operators and areas. All parties should intervene in same kind of navigational situations at same distances / time frames and in same way.
• The surveillance could be stricter with a lower threshold to intervene.

• Electronic route plan exchange service both between vessels and between vessels and GOFREP centres.

• Improved e-navigation services in general.

On request with the authors from VTT, the following services had been brought up with regards to the last bullet point (Berglund & Hänninen, 2019):

• AIS that shows the passage plan on the electronic chart displays of other vessels (#1)

• Route plan exchange between all parties. -> Routeplans to be seen on vessels ECDIS systems as well as on VTS systems. (#2)

• E-navigation systems (Mona-Lisa, ENSI). (#3)

4.5 Efficiency of icebreaking operations

Icebreaking and advises given by icebreakers are complex tasks as shown by (Boström, 2018). Coordination of these complex processes is done in US-American/ Canadian waters and in the Baltic by the different responsible entities (in the Baltic between Sweden and Finland by IBNET). Experience from using the IB-net and IB-plot software used by the Finnish and Swedish icebreakers for communication and monitoring of shipping activities shows an increased efficiency and safety, as the tool allows for common principals of setting restrictions and issuing dispenses based on HELCOM recommendations, common prioritization and cost sharing principles (Toivola, 2016).

According to (Boström & Osterman, Improving operational safety during icebreaker operations, 2017): “An ECDIS with target tracking capability can be a valuable tool for both icebreakers and merchant vessels during ice navigation and ice operations. The past tracks of merchant vessels indicate with which speed the vessels have been able to progress through ice, thus indicating to other merchant vessels whether or not that route is favourable. The same information can help icebreakers to assess whether or not a vessel is beset in ice and in need of icebreaker assistance.”
4.6 Usage of STM

An important part of the evaluation is that a large share of the equipped vessels is using STM services. Feedback from SMA is that few vessels of the equipped one’s are making use of the STM services and exchange the routes and time schedule. User feedback is that STM in the ECDIS has caused trouble in operations and that little education has been given to the end-users, which reduces the usage and potential of STM services. This will have an impact on the evaluation of the services.
5 References


6 Reference Material


7 Appendices
Using STM to increase BALTic Sea SAFETY

Making the Baltic Sea even safer by improving the situational awareness on ships and shore, building tools that automate work and provide decision support to prevent risk situations and accidents.

Making STM happen!

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