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Test Report: Evaluation of STM services - Ice Scenario
### DOCUMENT STATUS

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Abbreviations
The following abbreviations are used in this document:

AIS Automatic Identification System
ARPA Automatic Radar Plotting Aid
COLREG International Regulations for Preventing Collisions at Sea
CPA Closest Point of Approach
ECDIS Electronic Chart Display and Information System
EMSN European Maritime Simulator Network
FSA Formal Safety Assessment
Navtex Navigational Text Messages
NW Navigational Warning
SC Shore Centre
STM Sea Traffic Management
S2SREX Ship to Ship Route Exchange
TCPA Time to Closest Point of Approach
WP Way point
1. Background

The primary purpose of the European Maritime Simulator Network (EMSN) is to gain experience with STM services and to understand how involved persons and institutions deal with its capabilities. This is done in a simulated environment, which saves large amounts of time, costs and environmental impact.

The scope and purpose of the various EMSN simulations are to reflect the STM concept and its services, to validate and evaluate the findings and to give input to various hypotheses and FSA developed by other activities within the project. The following services were implemented and available in the EMSN simulations:

**Ship-to-ship route exchange:**
This service provides the navigator with a route segment consisting of the next 7 waypoints of the monitored route of another vessel. Route segments are broadcasted through Automatic Identification System (AIS) and give additional information to the presently available data obtained by radar/ARPA and AIS. Nothing in the S2SREX information exonerates the navigator from applying the International Regulations for Preventing Collisions at Sea (COLREG) and rather than being used in a close quarters situation, the S2SREX may be used as a tactical tool for supporting decision-making and situational awareness at a longer range.

**Rendezvous Function:**
As an integral part of the S2SREX, this function allows the navigator to view where own ship will meet a target ship if both vessels continue along their monitored broadcasted route with the present speed over ground. This function provides route-based Closest Point of Arrival (CPA) and Time to Closest Point of Arrival (TCPA) based on AIS information.

**Shore-to-Ship Route Exchange (Receiving route suggestions from shore):**
This service allows the shore-centre to send a suggested route to the ship, to be reviewed by the bridge team and then either accepted or rejected. This service can be used in various situations, for example if several vessels are warned to avoid a certain area, the shore centre can plan a route based on all available information and directly send this route to the vessel.

**Receiving Navigational Warnings:**
This service provides a notification which overlays a Navigational Warning Message directly on the ECDIS. If the Navigational Warning involves a geographical area to avoid or be aware of, this will be automatically plotted onto the ECDIS, so it is visible to the bridge team.
Chat Function:
A standalone software like other programs (e.g. Skype) which was integrated on the same station as the ECDIS. Text communications with other stations with enabled STM tools such as Shore Centres and ships.

Enhanced Monitoring and Route Cross Check:
After having received a ship’s monitored route and schedule, shore centres will be able to detect if planned schedule is not kept or if ship deviates from monitored route. A shore centre can receive any planned route and cross check such route against any navigational dangers and if necessary send a route suggestion back to the ship.

2. Objective
The objective of this analysis is to determine whether the available STM services improve maritime traffic safety and efficiency in ice navigation and where STM services are seen to provide most of the added value.

3. Methodology
To determine whether the STM services have a measurable effect on maritime traffic safety, the following methodology was used:

1) Specify a set of maritime traffic scenarios.
2) Simulate the scenarios with and without the STM services (STM runs and Base Line runs).
3) Assess the traffic safety in each of the scenarios through observations, debrief and usability interviews with participating test participants.

4. Delimitation
This study is not attempting to make a comparative analysis of the possible effects of each individual STM service on traffic safety separately. Rather, this study is an attempt to capture the possible effects of several STM services being available at the time of the simulation runs based on observations and interviews. The services may have been used individually by the test participants or in combination with other services. Other factors which may have an influence when analysing possible effects of introducing STM services such as usability of ECDIS in general, the familiarization and training in the use of the services, the experience of the test participants, etc. have not been considered in this study.
5. Simulation scenarios

The Kvarken area between Finland and Sweden is the narrow region in the Gulf of Bothnia separating the Bothnian Bay (the inner part of the gulf) from the Bothnian Sea. The area was selected because the ice navigation is often difficult due to ridging ice in the area and the narrow passage often generates traffic congestions. Constant maritime traffic coordination is needed and usually done by an on-site icebreaker.

All together there were 6 manned bridges participating in the exercise, 3 bridges from Finland and 3 from Norway. The Finnish Traffic Agency tested their STM Tools (IBNext) during the first day, otherwise the Shore Centre was operated by Aboa Mare.

In the scenario, there were 3 northbound vessels and 3 southbound vessels, that needed to enter an ice channel made by an ice breaker. Meeting or overtaking was not possible in the ice channel. A meeting point was assigned (open water area), which was located approximately in the middle of the simulated ice channel. Vessels and their bridge teams were required to manage and plan the voyage how to enter the ice channel and how to meet other vessels at the assigned meeting point. The challenge was to navigate safely in the ice channel adjusting the speed according to the vessel both going the same direction and keeping in mind the meeting traffic.

During the exercise with STM services the vessels received the waypoints (i.e. a suggested route) from the icebreaker (Shore Centre) that appeared automatically on their ECDIS. In the
scenario without STM services the way points were given on a paper as a Navtex message. The ice channel was fixed and predefined in the exercise due to technical restrictions.

6. Participating simulator centres

The simulations were carried in the European Maritime Simulation Network (EMSN) during October 8-9, 2018 with two participating simulator centres Aboa Mare in Finland and Sikkerhetssenteret Rövik in Norway. The exercises involved 6 manned bridges, one Shore Centre (Aboa Mare) and the Finnish Traffic Agency testing their STM service for one day:

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<td>Aboa Mare</td>
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<tr>
<td>Sikkerhetssenteret Rövik</td>
<td>3</td>
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<tr>
<td>Finnish Traffic Agency (Shore Center)</td>
<td></td>
<td>1 (One day 8.10)</td>
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<tr>
<td>Aboa Mare Shore Centre</td>
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7. Data collection

The STM service usability data was collected by observations on the bridges, debriefing interviews and feedback questionnaires. It was considered that the usability of the services could be best determined through observations and interviews rather than analysing numerical data as the exercises were run only for two days (once with STM services and once without) and only encompassed a limited number of bridges participating in the exercises (6 manned bridges).

8. Results and Discussion

8.1 Notes from the bridge observers

The observers focused on two main areas, the general situational awareness of the bridge team and their communication.

**Situational Awareness - without STM services**

- The observations stated that the situational awareness was generally good. Teams with good communication and interaction had also good mutual shared understanding and situational awareness about the location of the ice channel and meeting point.
However, as there was only one ECDIS in use, it was difficult to follow the general traffic situation during the time that one bridge team member updated the ice channel into the ECDIS.

- Higher workload was noted on several bridges without STM Tools.
- One bridge team updated the ice channel into ECDIS for 20 minutes. This was because they were not familiar with the functionalities of ECDIS. Due to occupying the only ECDIS for such a long time, the bridge team lost their situational awareness completely. They were uncertain were they were (they did not reduce speed), where they were supposed to go (the entrance of the ice channel) and about the other traffic in the area. Due to this confusion the situation escalated and the bridge team could not make predictive plans about the future ending up crossing in front of other vessels, entering the ice channel in a wrong angle and getting stuck in the ice.

**Communication - without STM services**

- In general, there was quite a lot of ship to ship communication on the VHF regarding coordination about how to meet and the internal communication between the bridge team members was from good to excellent, even though a couple of points were made about less closed loop communication without STM services. Due to some unexpected behaviour of one vessel (getting stuck in ice while attempting to navigate outside the ice channel), the uncertainties of the situation were resolved by discussions over the VHF. Some pointed out, that following the external VHF discussion it is also possible to get hints about the general traffic situation.

**Other comments – without STM services**

Other comments/notes were about the wishes that the first simulator exercise should have been without STM Tools and ensuring that all bridges have the same information. One note also pointed out the importance of training to ensure appropriate skills to use the equipment.

**Situational Awareness – with STM services**

- In general, the situational awareness was better with STM services, because time was not spent on updating the waypoints into the ECDIS. It was also pointed out that the STM service suggesting a route is very helpful especially when you have a lot of waypoints. Receiving the new route and waypoints from the Shore Centre reduces workload.
- A couple of remarks were made about focusing too much on ECDIS (too much “head down” in ECDIS).
The messages like navigational warnings and chat were not noticed immediately. One observation stated that it took 3 minutes before the bridge team noted the new message even though their attention was mainly on the ECDIS.

Communication – with STM services

- In general, there was a lot of external communication over the VHF and some see it essential to resolve a dynamic situation. Some communication was about the ship that was stuck in ice and some about how to meet and other coordination issues (e.g. asking to slow down to meet in the open water etc.)
- Some participants pointed out that there was not as much need for VHF communication with STM services and that the STM Chat function is a good complement as it reduces the spoken mistakes and misunderstandings but in general, the STM services did not seem to have an impact on the external communication.
- Internal communication was seen as good on some bridges, some had some difficulties in the beginning and got better. Some slight confusion about the situation, as the bridge team did not firstly notice the new route on their ECDIS, but the situation was resolved after instructor assistance.

Other comments – with STM services

- There was a technical mismatch between the STM service from the Finnish Traffic Agency and the route created by Aboa Mare instructors/Shore Centre. The routes were sent in different formats, one with waypoints 0,1,2,3 and the other with waypoints 1, 2, 3, 4. This however was corrected by STM Chat-function.
- Rendez Vous function was not used much, because the route was the same for all participating bridges.
- One comment was made about using less radar (and more ECDIS).
- One test participant had some difficulties controlling the ship in the ice channel as he was replying to the chat-message while manually steering the ship.
- One remark was made about the bridge team having little experience in ice navigation and the bridge equipment, which resulted in tasks taking much more time to accomplish and more effort to establish a good situational awareness. Therefore, the need for training was again pointed out to fully utilize the STM Tools.

8.2 Feedback from participants

The exercise in ice with STM services was seen as a positive experience. The feedback states that the provided information (STM service suggested route/provided WPs for ice the channel and planned meeting point) improves safety and efficiency. The suggested route from the
Shore Centre together with the S2SREX service enhances the awareness of the traffic situation, lowers the navigator’s workload and releases mental resources for other matters. Suggested route sent from a local VTS/Shore Centre is also seen as a way of sharing local knowledge, which is seen valuable and useful information contributing to safe navigation.

More profound training is still needed, and the user manuals could be simpler. The general opinion was, that shipping companies could benefit from STM services. However, the investment would depend on whether shipping companies see an economic benefit in adopting the services. Also, some comments pointed out that the NW Messages and new Chat messages are sometimes difficult to detect.

9. Conclusions

A two-day exercise in ice condition was done to test the benefit and impact of some STM Services on the safety and efficiency of ice navigation. The results are positive towards the use of several services even though more training is needed. However, this does apply to the use of any kind of equipment as observed on one bridge team losing their situational awareness due to their lack of skills in using the ECDIS.

Sharing routes via STM services (suggested route and S2SREX) reduces workload and releases time for other matters which is important especially in safety critical and dynamic situations. However, at the same time, the Chat message service may take the attention away from the navigation if the same person is writing an answer and steering the ship. Written messages are also dependent on the language skills of the message sender, therefore there should be some button just to confirm message received. Also, different colours to highlight the urgency of the message are suggested to be implemented in the Chat service.

Two days of exercises were too little to state whether the selected and used STM services have an impact on the maritime safety and efficiency in ice conditions. However, the observations and feedback received are consistent with the data from other exercises held in the EMSN within the STM project. There is some indication that especially sending the waypoints as a route suggestion does reduce workload for navigators and therefore can have a positive effect on safety and efficiency.