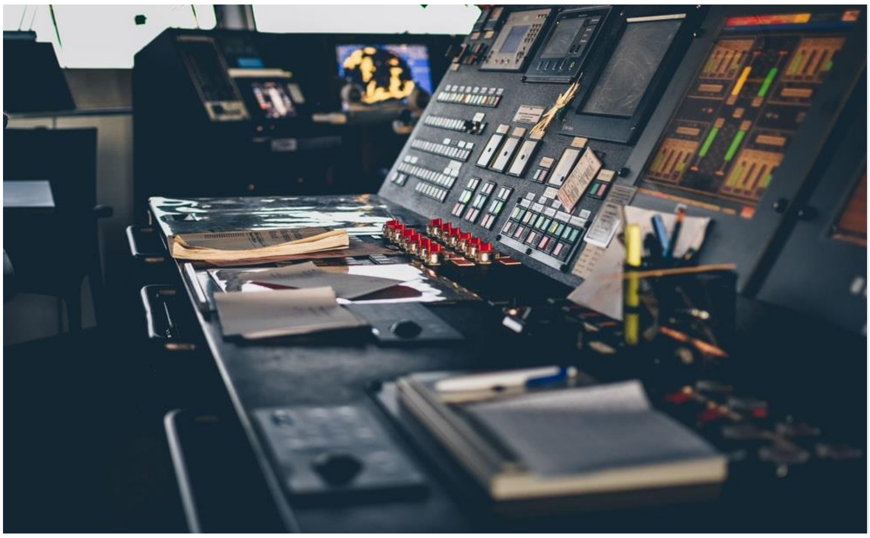
STM BALT SAFE



Document No: BS_WP6.2.3

Title: Validation of WP5

Date: 2021-12-21

Approved

DOCUMENT STATUS

Authors

Name	Organisation
Luis Sánchez-Heres	RISE Research Institute of Sweden
Peter Sjögren	RISE Research Institute of Sweden

Review

Name	Organisation
Joakim Lundman	RISE Research Institute of Sweden
Jarle Hauge	Kystverket
Fredrik Kokacka	Sjöfartsverket
Mika Nyrhilä Mikko Klang	Finntrafic

Approval

Name	Organisation	Signature	Date
Joakim Lundman	RISE	JL	211221

Document History

Version	Date	Status	Initials	Description
0.9	211130	Draft	LSH, PS	For review
0.95	211210	Draft	LSH, PS	For second review
0.96	211220	Draft	PS	Final review
1.0	211221	Approved	JL	Final

INTERREG PROJECT NO: R103

Table of contents

Executive Summary

The STM solution Automated Ship Reporting is the deliverable of Work Package 5 to the STM BALTSAFE project. This solution is meant to decrease the workload onboard by means of "standardized and automated ship reporting", one of the solutions described in IMO's e-navigation Strategy Implementation Plan.

The scope of the work carried out by Work Package 5 on the testbed activities changed during the STM BALTSAFE project. Due to COVID-19, the onboard system developed could not be deployed, or tested onboard, to the extent required for validation. However, the systems, procedures and data sets developed for the intended use cases has been evaluated as-is. The expected effects of reduced workload and administrative burden could not be corroborated. Nevertheless, no evidence of the contrary could be identified in the deliverables of the work package. The risk assessment was based on the use cases and identified several potential risks that can be mitigated in future developments of automated ship reporting.

1 Introduction

The STM solution Automated Ship Reporting is part of Work Package 5 to the STM BALTSAFE project. This solution is meant to decrease the workload onboard by means of “standardized and automated ship reporting”, one of the solutions described in IMO’s e-navigation Strategy Implementation Plan.

This document describes in detail the methodology used to validate this solution and the result of the validation. The description includes the methodologies used to evaluate the solution, changes in the solutions and its evaluation methods, and the results of the evaluations. The changes include, but are not limited to, the ones caused by the COVID19 global pandemic.

Overall, the purpose of this document is to present all the details that are omitted in the document *D6.2.0 Analysis and evaluation of the STM use case for tanker traffic*, where only a succinct summary of the validation results is presented.

Final remarks regarding the work can be found in D6.2.0 [1].

1.1 Terminology

Verification, validation, and evaluation are terms commonly understood differently by different actors. In the context of the STM solutions, the following definitions are used:

- *Verification* – determine whether a solution meets the specified requirements. Simply expressed: determine if the solution is built right according to pre-defined specifications (e.g. functional requirement specifications or standards).
- *Evaluation* – assess the general characteristics of a solution with respect to its intended purpose.
- *Validation* – determine whether the use of a solution results on the desired effects. Simply expressed: determine if the solution was the right one to develop.

These definitions are somewhat different from the ones presented in D6.1 [2], where no distinction between *validation* and *evaluation* was made.

1.2 Limitations

The goal of the Work Package 6 is to *verify* and *validate* the solutions developed within the STM BALTSAFE project. This document presents only the *validation* work for the solutions developed within the Work Package 6. The validation work consists of *evaluations* that may or may not be deemed sufficient to *validate* the solutions. The *verification* work is presented in D6.3 [3].

2 Background

Reporting to national and international authorities is one of the many obligations of a ship's master. The IMO regulation that governs reporting is Resolution A.851(20), adopted on 27 November 1997. Complying with the reporting obligation is commonly referred to as *ship reporting.* Ship reporting obligations can be grouped into two types:

- *Pre-arrival or departure reporting* – reporting related to the arrival or departure from a port as required by public authorities and/or the port itself. The reported information is generally extensive. For example, it may include information related to the ship's arrival or departure, dangerous goods, waste, border control, and customs. Furthermore, depending on the level of harmonization within a country or region, the reported information may vary between different public authorities and ports. Member states of the European Union must harmonize the national reporting requirements and accept the reports through an electronic "single window", commonly referred to as a Maritime Single Window (MSW).

- *Mandatory Reporting Systems (MRS) or Ship Reporting System (SRS)* – reporting related to the entrance of the ship into an area monitored by one or several port authorities to ensure navigational safety. The reported information may be split into a "full report" and "short report". If so, the "full report" may contain information mostly about the ships voyage, condition, and cargo, and the "short report" mostly about the location of the ship (e.g. the crossing of a reporting line). Some examples SRS are:
    - BAREP – Barents Sea.
    - SOUNDREP – Sound of Öresund.
    - GOFREP – Gulf of Finland.

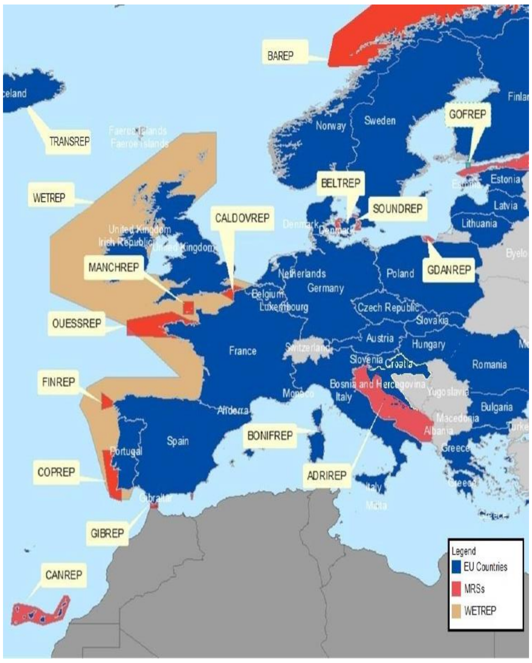


Figure 1: MRSs under MSs Jurisdiction (EMSA, 2014)

The STM BALTSAFE Automated Ship Reporting solution (ASR solution) aims to automate both types of reporting. The automation was envisioned to consist of three functions or "use cases" [4]:

1. Determine Reporting Obligations – Before or during a voyage, an onboard system requests the reporting requirements and obligations to a shore-based service.
2. Data Collection – After receiving the reporting requirements and obligations through (1), the onboard system collects the necessary information automatically from sensors and/or by prompting the user to supply the missing information.
3. Data Reporting – After collecting the necessary information, the onboard system automatically creates and submits the reports according as per the received requirements and obligations.

The ASR solution is related to the one being developed by the Norwegian Coastal Administration (NCA) in the project SESAME solution II [5]. In this project, the Norwegian Maritime Administration (NMA) and the NCA represent the end-users of the technology and provide testbed locations. Other partners in the project are the University of Southeast Norway, the Western Norway University of Applied Science, the Norwegian University of Science and Technology, and SINTEF Ocean.

"Solution II" refers to the IMO e-navigation Strategic Implementation Plan (SIP), which identifies five solutions, the second being automated electronic ship to shore reporting. The automation of ship to shore reporting, as well as automation of other e-navigation services, is a key aspect of this project.

The idea is that SESAME Solution II and STM BALTSAFE results will both contribute toward the goal of complete automated ship reporting.

2.1 Possible effects of the solution

Considering only the description of the STM solution and the problem it addresses, these are the envisioned possible effects of the solution.

Efficiency

- Reduction of the workload or effort necessary for ship reporting.
- Reduction on administrative burden of ship reporting.

3 Evaluation

3.1.1 Changes to the development with implications on UC validation

At the project outset the ASR solution was envisioned to include the development of onboard and onshore systems for pre-arrival and departure reporting (aka. Marine Single Window) and SRS [6]. But, due to COVID-19 restrictions, an onshore system for SRS was developed [7]. The onshore system provides two services:

- Request and Response Service (RRS) – for receiving and responding to requests of reporting requirements and obligations from onboard systems.
- Transmit and Receive Services (TRS) – for receiving reports and acknowledging their reception.

In addition, a shipboard client – was developed and deployed (Navtor Navstation), but the extensive testing of that system, initially anticipated, was not realised for the same reasons as described above.

Furthermore, in order need to harmonize and define the dataset related to MRS (ship reporting) and following a decision by the IMO Facilitation Committee (FAL), a recommendation was sent to the IMO Expert Group on Data Harmonization (EGDH), meeting EDGH2. The idea being, to include data contained in IMO Resolution A.851 (MRS reporting) into the IMO's reference dataset as an annex to the FAL Convention. This became a prerequisite to continue work toward ASR.

The work of defining the data set has been ongoing throughout STM BALTSAFE through several meetings of the EDGH working group. This summer, the work was completed. Some technical modelling work remains, but the results of the harmonization work will be sent to the next FAL meeting (May 2022) for approval.

The results of this work will provide an international data reference for Ship Reporting, and the data set will eventually be included in ISO, UNECE and WCO's data models.

3.1.2 Changes to the deployment with implications on UC validation

Following the changes in the developments, the onshore systems were deployed in the SRS shown in Table 1 and the RRS service was tested through a web client.

Table 1 Deployment and testing of the onshore system for SRS.

SRS	RRS	TRS
GOFREP	No	Yes
CALDOVREP	No	Yes
BAREP	Yes	Yes

The TRS reporting service has been tested in a commercial bridge software that have implemented the functionalities for ship MRS reporting according to the requirements developed by the WP. Successful reporting trails has been performed towards BAREP, GOFREP, CALDOVREP and also to some extent using the ISO std towards the AMVER MRS (US Coast Guard) using the NavStation back bridge solution [see Table 1].

3.1.3 Changes to the validation

Because of the changes on the development and deployment, the evaluation methods described in D6.1 [2], was modified.

The “Questionnaires and Human Performance Analysis” was removed because the functionalities testing was not performed using software clients installed onboard a physical ship, the extent of the systems deployment hindered the evaluation first anticipated for this use case. While the web client is useful to test and verify the implemented functionality, it does not provide relevant information regarding user interaction. The graphical user interface is too different, and it was not used in an actual voyage.

The risk identification analysis was still carried out, but with limitations in stakeholder diversity.

3.2 Evaluation methods

3.2.1 Risk Identification

The validation of the ARS solution consisted of a Risk Identification analysis. A group of participants with understanding of the ARS solution were invited to a workshop. In the workshop, the participants were prompted to identify possible hazards and their corresponding probabilities, consequences, risk, and possible risk reducing measures. Table 2 presents the risk matrix used in the analysis.

Table 2 Risk matrix

			Probability		
			Never heard of a similar event	Heard of a similar event	Heard many times of a similar event
			1	2	3
Consequence	No or minor damage.	1	Low Risk	Low Risk	Medium Risk
	Serious damages.	2	Low Risk	Medium Risk	High Risk
	Major damages (e.g. loss of life).	3	Medium Risk	High Risk	High Risk

4 Results and discussion

The participant profiles in the risk identification workshop were:

1. Researcher at RISE with a background shipping, Information Technology (IT), and risk analyses.
2. Researcher at RISE with a background in data analysis and IT.
3. Researcher at RISE with a background in shipping and innovation.
4. Researcher at RISE with a background in shipping, human factors, and risk analysis.
5. Leader of Work Package 5 with a background on shipping and IT.

The hazards identified by the participants and their associated consequences, probabilities and risks are presented in Table 3.

Table 3 Identified hazards/risks.

Id	Hazard	Description	Cons.	Prob.	Risk
1	Spoofing	An attacker pretends to be someone or something else to gain access to data.	2	3	H
2	Data tampering	An attacker tampers with data in transit or in a data store.	2	3	H
3	Information disclosure	An attacker discloses private or sensitive information.	2	3	H
4	Service interruption	An attacker interrupts a system's operation (e.g. jamming or denial-of-service attacks).	1	3	M
5	Incorrect information	Old or inaccurate information is reported because the system or user fails to update or detected it.	2	1	M
6	Reduced communication with VTS	Automated communication replaces radio communication which could reduce the capacity of VTS operators of evaluating the mental state of the crew (e.g. tiredness).	3	1	M
7	ASR system failure	The ASR system fails, and the reporting obligations are not fulfilled.	1	3	M

The hazards with a high risk (1-3) are related to security and have a major consequence (level 2). The interception, tampering, or disclosure of information could disturb the passage of a ship in SRS. For example, an attacker may report that a ship has deficiencies, prompting an inquiry or action by the respective authorities. Currently, the onshore system for automating SRS reporting is protected by user credentials (i.e. username and password) and encrypted communication (i.e. HTTPS instead of HTTP). While these protections may be sufficient, the security of the ASR system was not part of the planned work in Work Package 5, and therefore, no formal analysis of the security measures needed for the solution was carried out. A production version of the ASR system must consider secure communication and data protection of outmost importance.

The hazards 4 and 7 are related to the inability to automatically fulfil the reporting obligations. It is important to note that risk reducing measures are already in place: radio and email communication. Hazard 5, incorrect information, does not have any risk reducing measure, and should be considered in the future development of the ASR solution. Hazard 6, reduced communication with VTS, may or may not be relevant. A VTS operator with experience using the ASR system is necessary to determine its true relevance. Such an individual does not exist yet.

The list of hazards presented in Table 3 is not comprehensive for a complete ASR solution. A complete ASR solution would need at least 2 systems:

- Onshore system – capable of:
  - Determining the reporting requirements and obligations of a ship.
  - Receiving the reports.
- Onboard system – capable of:
  - Querying the shore-based system for the ships reporting requirements and obligations.
  - Collecting the necessary information.
  - Submitting the reports.

When operational systems (for both onshore and onboard) have been developed the risks identified ought to be revisited, the results enclosed in this report could also serve as a basis for further system development.

5 Conclusions and Recommendations

The scope of the work carried out by Work Package 5 changed considerably during the duration of the STM BALTSAFE project, work was added in the form of internationalisation [see section 3.1.1] work for the data sets see. Due to COVID-19, the onboard system could not be deployed, or tested, to the extent required for validation. However, the systems, procedures and data sets developed for the intended use cases has been evaluated as-is.

The expected effects of reduced workload and administrative burden could not be corroborated based on the data of this project. Nevertheless, no evidence of the contrary could be identified in the deliverables of the work package. It has been studied in the past, proofing, that the administrative burden of ship reporting is well known. Therefore, it stands to reason, the main principle of the ASR is to reduce workload and administrative misses in managing data. As much of the data points needed in reporting is repetitive and semi-static, automating this task ought to reduce the administrative burden.

Nonetheless, and as pointed out in the performed risk identification, the system needs checks and balances to assure old or wrong data is not being fed into the system as this could cascade into other systems in a wholly integrated data chain. Sending data needs to be done with caution. As such the summaries points of the risk identification can be used in that further work towards ASR. Needless to say, the identified hazards need to be considered. Thus, the authors recommend that the results from the risk identification analysis are considered in the future development of the ASR solution. Security measures should be treated as critical functionality of the ASR solution. Further research ought to be spent on ship crew experiences of this system and broadening the participating organisations of future HAZID analyses.

References

[1] L. Sanchez-Heres, P. Sjögren, B. Staffan, J. Burgén, E. Sandberg and P. Roshni, "Analysis and evaluation of the STM use case for tanker traffic.," RISE Research Institute of Sweden, Gothenburg, 2021.

[2] L. Sanchez-Heres and J. Hüffmeier, "D6.1 Evaluation method specification for the STM use-cases," RISE Research Institute of Sweden, Gothenburg, 2019.

[3] G. Psarros, "Report on verification of STM capabilities.," DNV, Hovik, 2021.

[4] J. Hauge, "D5.1 Use case, processes and data formats for automated ship reporting," Norwegian Coastal Administration, Ålesund, 2020.

[5] "SESAME solution II," 2018. [Online]. Available: https://sesamesolution2.org/. [Accessed 11 2021].

[6] J. Hauge , "D5.2 Automatic Ship Reporting pre-study and concepts document including use cases," Norwegian Coastal Administration, Ålesund, 2020.

[7] J. Hauge, "D5.3 Prototype applications for ship reporting to MSW and SRS," Norwegian Coastal Administration, Ålesund, 2021.

[8] L. Sanchez-Heres, P. Sjögren, S. Bram, V. Norrsjö, J. Burgén, E. Sandberg and R. Pramanik, "Analysis and Evaluation of the STM use case for tanker traffic," RISE Research Institute of Sweden, Gothenburg, 2021.

[9] EMSA, "Guidelines for Exchanging MRS notifications through SafeSeaNet," European Maritime Safety Agency, Lisbon, 2014.

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!

SAFETY - ENVIRONMENT - EFFICIENCY

Swedish Maritime Administration ◦ Fintraffic ◦ Estonian Transport Administration ◦ Norwegian Coastal Administration ◦ RISE Research Institutes of Sweden ◦ DNV

www.stmbaltsafe.eu
www.stmvalidation.eu/projects/stmbaltsafe

Interreg Baltic Sea Region
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND