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Developing and Implementing Joint Simulator Training for Oil Spill Response (WP3)

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1. Introduction

This document describes the process of developing the Joint Simulator Training programme for Oil Spill Responders at the Gulf of Finland area. This was done under the Simrec project work package 3: Simulators based approaches for developing joint cross-the-border practices.

Overall objective of the project is to enhance the cross-border collaboration between research and development institutes and key authorities to reduce risks related to increased maritime traffic and oil spills in the Gulf of Finland area. South-Eastern Finland University of Applied Sciences (Xamk) conducts development of cross-border/transnational oil spill simulator training model for response authorities across the Gulf of Finland.

Xamk participated mainly in Activities 2 and 3 (i.e. work packages). Activity 2 is Technical Development of Maritime Simulators. The technical solution was implemented by EMSN: European Maritime Simulator Network. Admiral Makarov State University of Maritime and Inland Shipping (AMSUMIS) established connection to EMSN network together with FRAUNHOFER at the end of 2021. Xamk had already an active connection to the EMSN Network. The Network enables the simulator connectivity between maritime simulator centres in Russian and Finland. EMSN also enables joint training with several other European countries. (Fraunhofer.de, 2021)

Activity 3 is focused on the development of Common Training Programme for Marine Pollution Response. This programme aims to develop transnational oil spill simulator training model using maritime bridge simulators for response authorities across the Gulf of Finland. Training model integrates key results of the project activities, and acts as a testbed for demonstrating the feasibility of the response methods, practices and decision support tools. This activity was done coordinating the information, advise and resources of Aalto University (Activity 1: Traffic scenarios and risk control options) and Helsinki University (Activity 4: Decision making and decision support)

When the technical solution was established using EMSN it was possible to develop simulators based approaches for developing joint cross-the-border practices.

2. First steps of the planning and development

Simrec project Work Package 3: Simulator based approaches for developing joint cross-border practices is a joint development done by Xamk and AMSUMIS specialists. Previously it was taken into consideration the work of other activities (work packages: WP1, WP2, WP4 and WP5) and incorporated into WP3 implementation. Aalto-University presented traffic scenarios and ice condition studies in frames of WP1. WP2 made technical connectivity of centers possible with the help of the EMSN-system. Helsinki-University helped with defining steps for decision-making prosess in the situation of incident case in WP4. Enviromental Institute has made preparedness analyses in WP5.

The work package consists of four (4) tasks. First the common training needs were studied. Secondly the joint training model was developed incorporating the applicable outputs from other work packages and tasks. Then the training scenarios were developed and created using Wartsila NTPro simulator system. Last step was to conduct a “Pilot Exercise” to test and validate the training model with real authorities and oil spill responders in the simulator centers (in Finland and Russia).

During 2020, development tasks for WP3 was started and it took a lot of time to organize the details for common work. In the spring months work was conducted with AMSUMIS representative Boris Egorov and Xamk’s senior lecturer Antti Lanki. The work was suspended when staff changes happened in AMSUMIS. It took a while to get another simulator instructor on the Russian side. The work organization required active communication, meetings and workshops. In the beginning of the project the main focus was on finding a WP2 technical solution. For the common development work for both WP2 and WP3, the ”COMMON LOG” procedure was created. The common log was an excel -based worksheet which enabled simultaneous and coordinated documentation and note-making in both countries (see example: Annex 2). Meanwhile Xamk conducted a Training Need Survey, which was done using Webropol (web-based survey). The questionnaire was distributed to Finnish and Russian oil spill response personnel. Survey results were the foundation for setting the educational objectives of the simulation-based training programme.

The first task was to agree on the plan of action for the actual development process of the training programme. This was agreed in the first joint meeting sessions in 2020. The main questions were:

1. How to proceed with the planning (i.e. roadmap)?
2. Who is the training for (i.e. target groups)?
3. What are the trainees supposed to learn (i.e. the learning objectives)?

4. What is the scale and scope of the training programme (i.e. the framework and curriculum)
5. What are the individual exercises like and how to create them (i.e. the simulated scenarios)?

In addition to the main questions there were other things to be considered and agreed upon: What are extreme conditions at sea in an oil-spill operation? What are the vessel types conducting such operations (i.e. the virtual ship models)? What are the actual geographical locations for international operations (i.e. simulated area models)?

It was agreed that a "4-step" plan of action will be used to answer these question and to succeed in developing a modern and good quality training programme. Each step represented a task which was to be completed to enable the task in the next step. The 4-step plan was:

Step 1: Agree and define the target groups (both in Fin & Rus)
Step 2: Agree and define the educational objectives
Step 3: Plan and develop the training framework
Step 4: Plan and develop the individual scenarios and exercises

The next chapters in this document describe the the development process in each of the steps.

2.1. Defining the scope of Extreme Conditions in the simulator environment

As the project name (Simulators for improving Cross-Border Oil Spill Response *in Extreme Conditions*) implies the simulated training should account for extreme conditions. What do extreme conditions mean in regards to the project?

Firstly it is necessary to define the variables of extreme conditions at the geographical area of interest. Thus the first question is: *What are the prevailing conditions in reality, actual values and frequency?* Second question is: *What type of actual vessels operate in an oil-spill response at the area of interest and what are their operational limitations?* By answering these two main questions it is possible to conclude suggested limits and values as realistically as is possible.

The main variables which define conditions at sea (and which can be simulated) are: *wind, waves, ice and visibility*. Wind and waves are interdependent i.e. as the wind force increases, so do the variables of the

waves increase (amplitude, frequency, period). In maritime practice the most common value describing the sea waves is the *significant wave height* (average from trough to crest in meters) which shall be used in this study. Wind and waves mostly affect the manoeuvring of the vessel and work-safety on the deck. The Gulf of Finland as a sea area is subject to seasonal ice in the winter. Ice and freezing temperatures mostly affect the manoeuvring of the vessel, vessel integrity and stability and the operational condition of the equipment. Visibility as a variable consists of darkness (during night), fog and precipitation (rain, snow etc.). Visibility mostly affects the navigation of the vessel and emphasizes the correct use of different kinds of navigational aids and equipment.

In order to establish the prevailing conditions in the Eastern Gulf of Finland area Xamk reached out to the Finnish Metorological Institute (FMI). The FMI provided official measurement data from different weather measuring instruments. The main question was to find out the actual correlation of interdependency of wind force and wave height, i.e. *"What does the wind speed and direction need to be for the waveheight to reach one (1), two (2), three (3) [etc.] meters?"* The data from the two (2) closest measuring stations; wave measurement buoy (South of Helsinki) and a surface weather station (South of Porvoo) were selected and analysed. The analysed dataset consisted of (at least bi-hourly) observations from year 2020. Based on the analysis the average wind forces (m/s) could be assigned to waveheight categories and tabulated by half-cardinal (wind) directions. For example: In the Eastern Gulf of Finland a South-Westerly (SW) wind of (average) 12 m/s will produce waves of 2-3 meters (significant waveheight) but Southerly (S) wind needs to be 14 m/s to produce the same height.

Regarding the winter and seasonal ice conditions the FMI ice-charts from 2018 to 2020 were analysed. Seasonal variation is substantial – e.g. in the year 2019 there was almost no sea-ice at all, but in the year 2020 there was compact ice from approx. Kotka eastwards up to St. Petersburg of at least 20-30 centimeters thick. As a conclusion it is realistic to expect fast ice near the shoreline extending to outer islands (approx. 40 cm) and compacted ice floes and hummocks at open sea areas every winter.

The actual fleet of vessels which conduct oil-spill operations in Finland can be roughly categorized in two (2) categories: State owned vessels, which are typically larger in size and Communal sescue service vessels and boats, which are typically smaller in size. There are approximately 20 larger vessels and approximately 150-200 smaller vessels. The operational limitations are mainly based on two (2) factors: Vessel class (size etc.) and Organization (navy, coast guard etc.) (Jolma et al. 2018)

The main question regarding the actual fleet's operational limitations in extreme conditions needs to take in to account the smallest vessel's which are capable to operate near the Finnish-Russian border at sea areas of interest. This means mainly the rescue service's fleet of larger workboats which support the larger state operated fleet mostly near coastal areas. This medium/ large fleet is also operated by the most potential target group identified for the joint simulator training.

The operational limitations of the rescue service fleet has been studied in 2008 by an expert working group (Rissanen et. al). In their analysis on different conditions and environmental effects they conclude the following:

- Regarding *wind and waves*: limit of 10 m/s / 1,5 m waveheight (for bigger support vessels) and if the waveheight is higher than 0,5 m 50% of the fleet is unusable.
- Regarding *ice and winter* conditions: Vessels are not capable of any significant ice operations (fast ice)
- Regarding *visibility*: If the visibility is diminished, the other conditions should be as optimal as possible. Also; increase in training at night conditions is proposed.

The fleet and it's overall performance profile hasn't changed significantly since 2008. (Rissanen et al. 2008)

Based on the aforementioned study the chosen variables and limits for extreme environmental conditions (lower limits) were tabulated. Table will be used as reference and guideline when designing and creating the actual training scenarios in the simulator (software).

Table 1. Variables of environmental conditions (limit values) for joint simulation.

Variable	**Lower limit**	**Notes**
Wind speed : Waveheight	**10 m/s : < 1,5 m** (SW) **13 m/s : < 1,5 m** (S) **9 m/s : < 1,5 m** (SE) **10 m/s : < 1,5 m** (E)	when from SouthWest when from South when from SouthEast when from East
Visibility	**Night** **Visibility < 1,5 nm** (other causes)	i.e. times between nautical dusk to nautical dawn Fog, mist, precipitation etc.
Ice	**Any** fast ice **Any** float ice	Typically thickness < 40 cm Typically compacted

3. Defining the target groups for training

Definition of target groups is essential to find the real-life learners for the oil-spill simulator training and it was based on existing rules, available experiece and methods of official oil spill response organizations. The objective was to develop new generation of training simulations for coordinated oil spill reponse operations through transnational cooperation. Discussions of the demand and opinions to target group defining led us to use the common log. The common log tables were created based on existing IMO organizational definitons which include Tiers and Levels. The table was filled by the Xamk team for the Finnish, and AMSUMIS team for the Russian responders and authorities independently. The objective was to name and designate the real authorities and actors on all the IMO levels and tiers and also to evaluate their applicability for participation in the simulator training.

Those, who were decided to take part in simulation training are the actual Oil Spill Responders in Finland and Russia. Finnish borderguards are mainly responsible of oil spill work at the international sea area. Rescue services support them mainly in the coastal areas. 'MorSpassluzhba' is the Russian rescue authority for international se areas and Port organizations from larger ports are supporting them.

Based on IMO rules we consider target groups in different levels to provide readyness of all the levels. First of all, operational staff, management and supervisors were observed on among local responders. And we organized levels by order, starting from operational staff on the first level, then Supervisors on the second level and management level was third. This order provides broad spectrum of training on extreme situation. Geographically closest fire-department from the local respondents of oil spill response service in Finland is situated in Hamina (IMO tier I). Closest departments in Russian side are St. Petersburg and Ust-Luga oil spill response teams. Next is the is regional rescue service, that is represented by Kymenlaakso Rescue Department in Finland, Kympe (IMO tier II). Governmental agency in Saint-Petersburg is sea rescue service: MorSpassluzhba Baltic Department. International (IMO tier III) respondents should be from Governmental agencies which is Finnish border guard in Finland and 'MorSpassluzhba', Sea rescue service of Moscow.

Finding the target group representatives with the help of the common log table made the list of participants defined and concrete. To help in finding the target groups and to visualize the setting for an international oil-spill operation an imaginary draft-case ("case 0") was discussed and used as a platform and reference (see: Fig. 1).

Figure 1. “Case 0” used as reference and visualization for finding target groups.

Local and national tiers in Finland on the operational level could be represented by Rescue Services field units and on the Supervisor level they are provided by Executive fire officers. Chief executive officer is on the managing level. Local operational and supervisor level in Russia is provided by Ust-Luga OSR team and St. Petersburg OSR team. National operational and supervisor levels are represented by MorSpassluzhba Baltic Department. Both local and national management level could be presumably covered by Deputy director of MorSpassluzhba Baltic Department. Finnish international representative for the oil spill training is Finnish border guard. Representatives from the operational level could be FBG Ship and crew (OSC), FBG Fleet command (SMC).

It was agreed and concluded that in the scale and scope of an exercise which is based on maritime (bridge) simulators the most suitable target groups should be on the two (2) lower levels of responsibility. It is the work of the operators and their executive officers which the maritime simulator mimics the most. This kind of simulation is by definition operational and practical ‘hands-on’ training. The target group definition is seen in table below (Table 2).

Table 2. Variables of environmental conditions (limit values) for joint simulation.

Identification of Finnish and Russian oil spill responders as target groups		ndidate for joint traini		
Responders	**FIN (according to XAMK)**	**FIN**	**RUS**	**RUS (according to AMSUMIS)**
IMO Tier I - Local responders	Geographically closest fire-department ** Hamina*			Geographically closest OSR team ** St. Petersburg - Ust-Luga*
T.I - Level 1 - Operational staff	Rescue units (operators)	YES	YES	Ust-Luga OSR team + SPb OSR team
T.I - Level 2 - Supervisors	Executive fire officer (P41)	YES	YES	Ust-Luga OSR team + SPb OSR team leaders
T.I - Level 3 - Management	Chief executive officer (P20)	POSSIBLE	POSSIBLE	Deputy director or ? from Morspassluzhba
IMO Tier II - Regional/national responders	Regional rescue service ** Kympe (Kymenlaakso Rescue Department)*			Governmental agency (St. Petersburg) ** MorSpassluzhba Baltic Department*
T.II - Level 1 - Operational staff	Rescue units (operators)	YES	POSSIBLE	Crew one of rescue vessel " Morspassluzhba"
T.II - Level 2 - Supervisors	Executive fire officer (P31)	YES	POSSIBLE	Officers one of rescue vessel "Morspassluzhba"
T.II - Level 3 - Management	Chief executive officer (P1)	POSSIBLE	YES	Deputy director or ? from Morspassluzhba
IMO Tier III - International responders	Governmental agency ** Finnish border guard*			Governmental agency (Moscow) ** MorSpassluzhba*
T.III - Level 1 - Operational staff	FBG Ship and crew (OSC)	POSSIBLE	POSSIBLE	Crew one of rescue vessel " Morspassluzhba"
T.III - Level 2 - Supervisors	FBG Fleet command (SMC)	POSSIBLE	POSSIBLE	Officers one of rescue vessel "Morspassluzhba"
T.III - Level 3 - Management	Commander of the Coast Guard District	NO	NO	

4. Setting the educational objectives for training

All practical training should be goal-oriented and meaningful. This is especially true for simulation-based learning. Clear and reachable objectives should be the basis of any exercise. To find commonly agreed learning objectives Xamk conducted a survey directed for oil-spill responders in Finland and Russia. The results of this survey were presented and discussed with project partner's teams (i.e. teachers and instructors) and a consensus decision on the main learning objectives for the actual simulator training was made. In the survey there were a wide range of topics, in twelve (12) themes. The working group decided to focus on the three (3) most applicable themes which work as the main functions containing the learning objectives for the exercises (see: Fig.2). The results of the survey are found in more detail in a separate report. (Lanki & Halonen 2022)

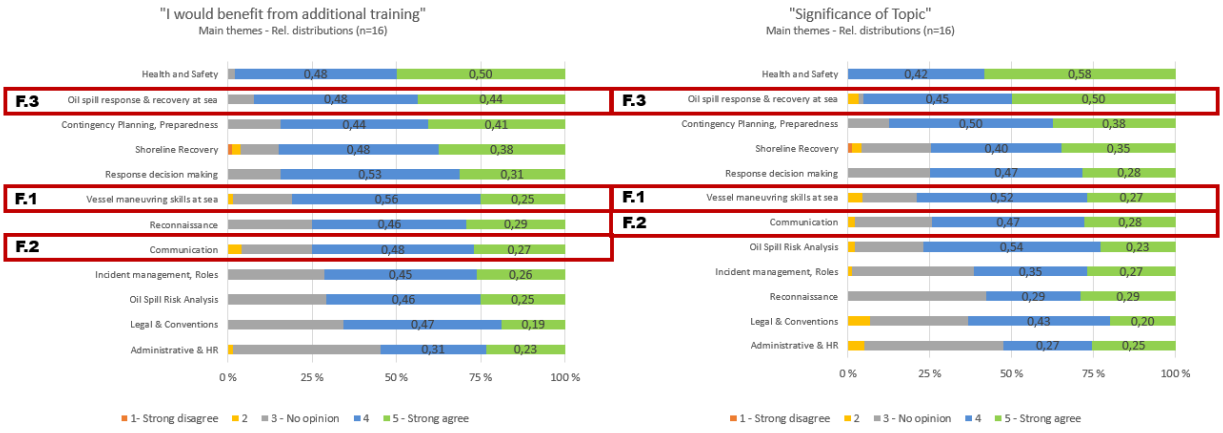

Figure 2. Learning functions were decided based on the results of a wider survey.

During 2020 the work was slowed down due to AMSUMIS representative leaving the project and focus being shifted on finding the technical solutions (WP2). Year 2020 was also the year when Covid-19 pandemic began and affected international travel in a massive way. In 2021 the work resumed up-to speed due to new specialists being hired in AMSUMIS and distance-working methods being agreed on.

In April 2021 the three distinctive temporal phases (’timeline’) of an oil spill incident were created and approved with the help and consultation of the team’s oil spill specialists. In defining of the target groups (see: chapter 3) the working group used an imaginary reference “case 0“. The reference case was expanded into a larger concept (chain of events) by asking: *What are the main phases or stages in such an accident? What happens before the response starts? How does the response operation begin? What happens when the units are in the accident scene?* This led to the division of phases which will be used in the later steps of development and work as the background setting for the individual exercises. The phases are:

1. Reconnaissance and Planning → 2. Response Operations → 3. Continued Operations

In phase 1 (*Reconnaissance and Planning*) the response organization is formed and the operational planning begins. Control and communication links are established and first assignments to the operational teams are given. The phase ends when the response units deploy the response materiel according to orders. In phase 2 (*Response Operations*) the actual response measures are taken (e.g. towing booms). The phase ends when the initial response actions are finished and the collection and waste logistics commence. Phase 3 (*Continued Operations*) contains all operations and actions after the initial phases.

In April 2021 the three educational functions (F.1 – F.3) were introduced to the working group and in June (2021) they were jointly approved. Every function was also divided according to the level of responsibility of the learner. This allowed the team to move on the next step and start to develop the more precice learning objectives inside the functions. The three main educational functions of maritime simulation-based oil spill training are:

F.1 Controlling the vessel
F.2 Communication and Coordination
F.3 Response tactics and operations

All of which are split by the levels of responsibility of the learner:

- Supervisors and executive officers
- Operational staff

The common log was updated with a new table (matrix) so that the project teams could collect notes and information regarding the relevant learning objectives in all the distinct phases of an oill accident (see: Fig.

3). Controlling the vessel (F.1) contains all the objectives for learning the skills and competences related to navigation, manoeuvring and correct use of navigational aids and equipment onboard. For the supervisors it happens on a more strategic level (as they are not operating the vessels themselves) and for the operators it is practical hands-on skills. Communication and Coordination (F.2) contains all the skills and competences related to the management and control of the joint operation as well as the (radio)communication. For the supervisors it means (e.g.) effectively receiving and transmitting correct and precise information and for the operators it is correct interpretation and relaying of information and data. Response Operations (F.3) contains all the skills and competences required to execute coordinated response measures. For the supervisors it means (e.g.) the skills for managing fleet-level operations and for the operators it is the skills of operating the vessel's response material and understanding their positions as "a link in the chain".

Table 3. Example of notes and information in the common log regarding the first phase of an oil spill accident.

F1. Reconnaissance and Planning	Supervisors	Operational staff
F1.Controlling the vessel	Strategic understanding • Reasonable speed	Practical skills • Applying reasonable speed • Navigating as per COLREG
F2.Communication and coordination	Transmitting effectively and understandably	Receiving / relaying correctly
F3.Response operations	Awareness of "fleet" movement and positions	Understanding own position in relation to others

It is important to note that there are are many other important functions (and learning objectives) in an international oil spill scenario, like leadership, risk analysis, organization, resource allocation and management, but these should be trained separately by other means and methods.

5. Model and framework for joint training

Next step (step 3) in the development was to draft an outline of the entire training programme and the 'curriculum'. This was done in many online meetings and discussion between the partner teams during 2021 and early 2022. As the Covid-19 situation had not subsided and the travelling restrictions were still in place, it was difficult to conduct workshop sessions. In practical development the preferred method of planning and drafting is face-to-face tabletop sessions. This was the main reason for delays in producing the outputs.

There was a lot of discussion about the duration of the training programme ranging from two (2) days to eight (8) days. As the traveling and arranging live events was severely restricted (Covid-19) it was decided that the duration should be limited to less than three (3) days. In the workshops it was decided that during one (1) day of training in the simulator center it is possible to conduct three (3) individual training scenarios (exercises) which last approximately one (1) to two (2) hours each. One important aspect and topic of discussion was the familiarization of the learners (target groups) to the simulator interface. Many of the responders are competent in the operation of their actual vessels and equipment, but simulation is always an approximation of reality, thus it is important to familiarize and use the simulated interface before conducting a real objective-oriented exercise – especially when the system is in the online mode (via EMSN). Finally, the selection of the simulated (geographical) areas commenced in this stage of development in coordination with the technical specialists working in activity 2.

In the setting of the learning objectives there was the agreed template of the oil spill (temporal) phases (see: chapter 4). The working group decided to create at least one (1) exercise based in every phase. For example: exercise one (1) would be in the setting of *Reconnaissance and Planning* -phase of an oil spill. Reconnaissance means locating the spill and creating joint situational awareness between the teams inside the center (national supervisors with their operators) as well as externally (center to center). Planning means creating a joint plan of initial response actions based on the situational awareness provided. Based on the workshops and discussion the draft of a two (2) day training programme (schedule) was developed (see: Fig. 3).

Time	Day 1 *Local Familiarization*	Day 2 *Joint EMSN Training*
08:00 – 09:00	Technical set-up and preparations	Technical set-up and preparations
09:00 – 10:00	Introduction and tour of the simulation centre	Common briefing
10:00 – 11:30	Basic facilities and equipment demonstration	**Exercise 1**: Locating and reporting the oil-spill
11:30 – 12:30	Lunch	Lunch
12:30 – 14:00	Task specific familiarization. Operators learn the use of nav. equipment and controls. Supervisors learn the communications and operations control center	**Exercise 2**:
14:00 – 15:30	Test scenario demonstration and internal communications check	**Exercise 3**:
15:30 – 16:00	(Optional: Second scenario demonstration)	Common debriefing and feedback

Figure 3. Draft of the two (2) day simulator training programme (schedule).

As the development of the training programme outline was advancing the discussion was moving more to the development of the individual scenarios. Xamk specialist team had already some experience in creating oil spill simulator training from earlier projects (e.g. Halonen & Lanki 2018, 49-58), while AMSUMIS had only recently acquired the oil spill functionality to their simulators. Therefore, it was decided to arrange a demonstration event online where some tried and tested practices can be transferred, capabilities showed and the efficiency of the development increased. The simulator as a piece of technology always has some technical limitations and features which are difficult to describe in any other way than concretely showing it as the system runs.

Oil spill and maritime simulator demonstration event was organized in Novemer 12th 2021 in Kotka and was streamed online to the AMSUMIS (and other) project partners via Microsoft Teams. The event was also an online workshop and Q&A session. Xamk specialists prepared and demonstrated specific capabilities and limitations of the oil spill functionality used in both partner centers (Wartsila NTPro). The demonstration had four (4) working demo's which could also be used as exercise (scenario) ideas and templates. The demonstration themes were:

1. Oil Objects and Reconnaissance
2. Obstacle Course ("augmented objects")
3. Oil spill Object and Wind interaction
4. Two-ship seining Operation

Each of the demonstrations presented different technical and practical aspects which could be further developed in to the actual exercises. Also, it is important to demonstrate some of the specific technical limitations of the software to avoid any obvious mistakes and difficulties in the actual training (e.g. limited size of the interactive oil spill object, features of the ship-models and connections to other objects using lines etc.). After the demonstrations the assosiated system files (*.nti) were sent to AMSUMIS partners for further testing.

6. Developing specific scenarios and exercises

Last step of the development (step 4) was the creation of the individual exercises (scenarios) which was done in online working sessions during late 2021 and early 2022. Scenario planning is especially difficult when local face-to-face meetings are not possible. The optimal way of planning maritime simulator scenarios is when the specialists gather around the same table with physical maps and materials. This kind of planning requires drawing, sketching, and measuring of distances, positions and angles. As this was still not possible (Covid-19) all of this had to be done online. The team used tools and platforms such as: Teams, Powerpoint, Paint and online nautical chart materials (e.g. openseamap.org).

At this stage the common log -procedure was obsolete and the teams started drafting the documents needed in conducting a real joint simulator training. The documents were:

A. Checklist for creating Simulator training scenarios (process description)
B. Joint Cross-Border Oil Spill Response Simulator Training using EMSN (Details & Specifications Document)

The checklist (A.) was created by Xamk and sent to partner's specialists in September 2021 before agreeing on the scenario development workshop schedules. The checklist describes the process of any simulator scenario creation and works as guide for planning. The planning and creation process is listed in items step-by-step with descriptions and recommended methods. The items are:

0. Selecting the THEME and OBJECTIVE
1. Select the SCOPE of exercise
2. Selecting the AREA
3. Selecting the SHIP(S)
4. Selecting the OBJECTS
5. Creating the exercise file in NTPro
6. Perform first test on file
7. Modify and adjust Ships / Objects in file
8. Select and modify time of day & environmental conditions
9. Perform second test(s) on file
10. Make final adjustments & save
11. Take backup of file for sharing

12. Document the scenario
13. Additional EMSN tests and validations

Following the items of the checklists is repeated for any created single exercise scenario. Thus the checklist was also the 'agenda' of the following scenario planning (online) workshops. Item 12 (documentation) refers to the written Joint training details and specifications document (B.) which is the main document used when running the joint exercise. It describes all the details and specifications which are needed for the actual execution of the simulator training. This document is the simulator instructors guidebook and reference for all the details related to the whole training programme (and all the exercises it contains). The main parts of the document are:

- Project information and objectives
- Educational framework (pedagogy)
- Connected centers and the contact persons
- Instructor(s) and participants (learners)
- Communication channels and methods
- Schedule
- Exercise details and specifications

The joint document is attached to this report (see: Appendix 1) as well as the detailed checklist for creation of simulator scenarios (see: Appendix 1.1 in the joint document).

During the online workshops in January – February 2022 the first exercise (Locating and Reporting the Oil Spill) was planned according to the process described in the checklist (A.) and the file shared between Xamk and AMSUMIS for the first tests. The selected area was in the Eastern Gulf of Finland in the fairway-crossing near the island of Sommers. The area is one of the traffic 'hot-spots' also backed up by the research made by Aalto. A picture was drawn in the planning workshop and is seen below (see: Fig. 4)

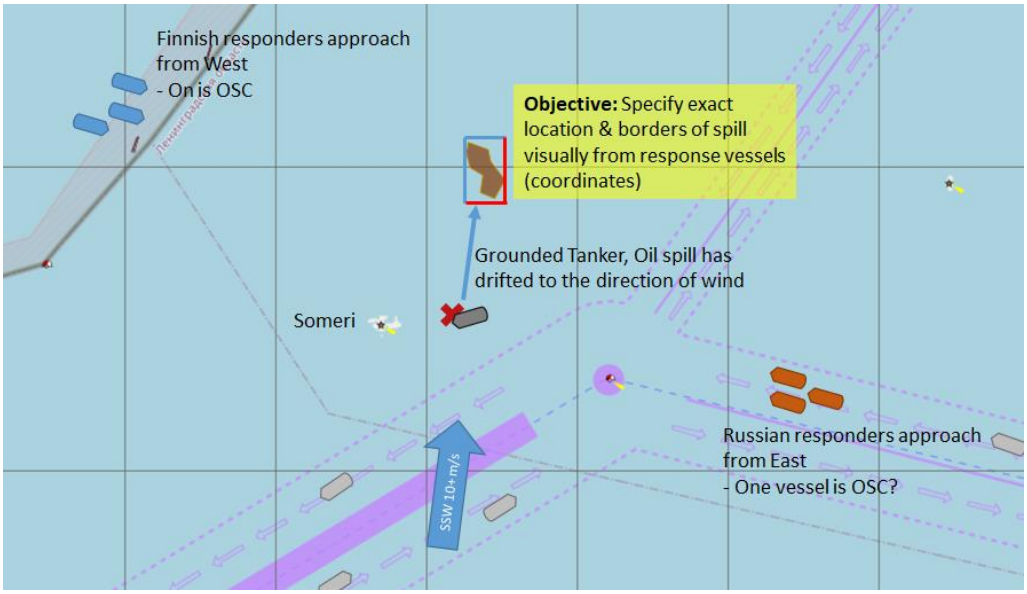

Figure 4. Picture of Exercise 1 drawn in the joint scenario planning sessions.

The setting is that a laden tanker has grounded to the shallow water and the hull is breached leaking crude oil to the sea. The wind is from the South-West and the spill is drifting windwards. Near the scene there are three (3) Finnish response vessels approaching at the National Sea-border and three (3) Russian response vessels approaching from the St. Petersburg direction. The Russian authorities (e.g. the VTS) have alerted and requested international assistance from the Finnish authorities (as per Helcom protocols). The objective of the exercise is that the two (2) command centers supervisors (in Xamk / AMSUMIS) create a common situational awareness of the exact position and size of the spill using the agreed communication methods (mainly VHF radio). The main objective is from the educational function: F.2 Communication & Coordination. So, in laymen's terms: *"Draw the exact form and image of the oil spill area on the map based on the descriptions of the on-scene vessels (without seeing it yourself)".* The details are found in the joint document (Annex 1, chapter 5).

The next step was to perform a validation check and technical EMSN connection tests and then continue with planning the scenarios 2 and 3. In the final workshop on February 18th 2022 the teams started Preliminary planning of scenarios 2 and 3 (see: Fig. 5)

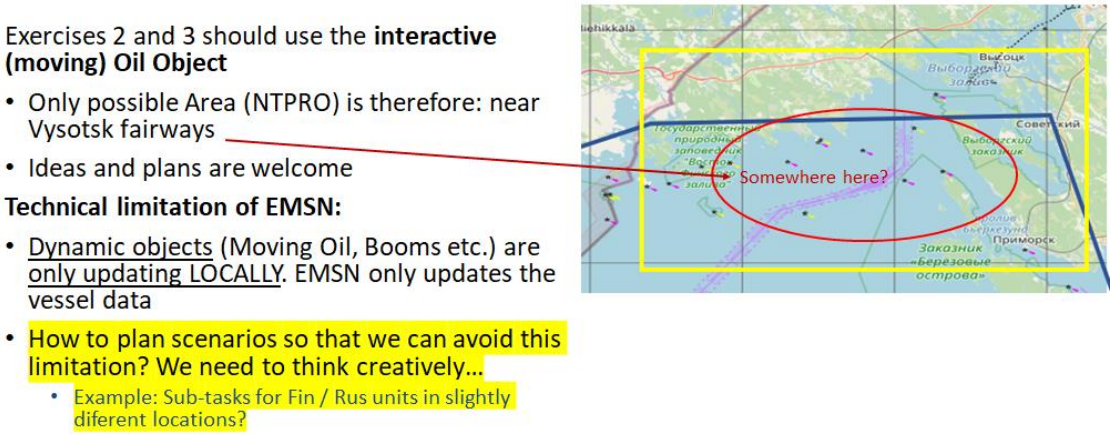

Figure 5. Preliminary planning notes for scenarios 2 & 3 from the last joint workshop session (18.02.2022)

In February 2022 the international situation (Ukraine crisis) changed the plans and no further workshop sessions were conducted as per instructions from the funding authority.

7. Changing situation and final National exercise

In February 2022 the international situation (Ukraine crisis) changed the initial plans. Xamk decided to change the last outputs of the WP3. After consultation with the funding authority, it was decided to proceed with the last outputs on a National (Finnish) level.

The initial working plan was to start the physical connection tests of the (Xamk & AMSUMIS) simulator centers and to conduct a unique cross-border training session with Finnish and Russian oil spill response specialists. Due to the changes in the European security situation the last phase (i.e. the 'pilot exercise') was decided to be changed to a National (Finnish) training and stakeholder event without utilizing the EMSN connectivity. One important reason for this is the fact that EMSN infrastructure exists in other (EU) countries simulator centers and the extensive work should not go to "waste". Xamk project team feels it is important to reach out to stakeholders in the oil spill response field and demonstrate the feasibility and capability of the training model for future development.

In relatively short time and project end day approaching the planning for a changed final output ('Pilot exercise') commenced. Based on all the previous development (learning objectives, simulator training framework, planned scenarios etc.) a training and stakeholder day was planned for May 2022. The core idea was to demonstrate the concepts, functionalities and the potential of simulation based learning in oil spill response training and it's future possibilities.

Oil Spill Simulator Exercise and Stakeholder Day May 12th, 2022 ("National Exercise") in Kotka Maritime Simulation Center

09:00	**Welcome** - Introducing and experimenting with simulators functionalities
09:30	**EXERCISE 1: Reconnaissance mission near island Sommers** Objective: The command center will determine an accurate picture of the spill, its location and size, based on the information provided by the vessels.
12:00	Lunch (Local restaurant)
13:00	**DEMO EXERCISE 2: Oil spill response vessel in spring ice** **DEMO EXERCISE 3: Seining with 2 vessels and the boom-oil interaction** **DEMO EXERCISE 4: Booming around a grounded ship**
15:00	**Conclusions & Discussion**

Figure 6. Schedule of the oil spill simulator and stakeholder event in Kotka Maritime Centre (12.5.2022)

The national oil spill simulator and stakeholder event was organized in Kotka, Finland May 12th, 2022. The invitations were sent to all the relevant parties, including Simrec project partners, oil spill authorities and research contacts. The event was also video recorded, and an edited video will be available as one of the project outputs during 2022.

The first exercise was an objective oriented training based on the developed exercise 1 (see: Appendix 1, chapt. 5.1). The target group of the training was four (4) Rescue Service oil spill responders (Kympe). Other event participants and project partners observed the exercise. After the lunch the exercises were more demonstrational showing different capabilities and functionalities of the simulators. One (1) bridge was dedicated to ice module -functionality and participants could try and operate a vessel in a fairway with drifting ice floes. On the other bridges the Rescue Service responders demonstrated multi-vessel operation and coordination seining interactive oil with oil booms attached to both vessels. Technically the training was implemented as planned and was very illustrative and close to real-life circumstances, providing command bridges with all the technical supply and on the other hand imitating extreme conditions like strong wind, ice, fog and waves at sea. After the exercises and demonstrations there was an open debriefing and discussion section. The discussion was active and open minded and the general attitude positive. The partners of UH (University of Helsinki) were taking notes and conducting their research related to their activity in Simrec (work package 4).

8. Results and Discussion

Main task of Xamk was to plan and develop joint maritime oil spill simulator training in cooperation with our Baltic partner's. Simulator training is practical and comprehensive method of learning complex situations which may be expensive or difficult to train in real-life. The setting should resemble actual real-life events and situations. We have based the training on three stages of an actual oil spill which are: reconnaissance, immediate action and continued operation.

To find the best educational objectives we conducted a survey and based on the results we established the three main functions of learning: Controlling and navigating the vessel, Communication & coordination and

Response tactics. These functions contain the specific objectives on two levels of responsibility: the supervisors and the operators.

In order to determine the limits and values of extreme environmental conditions we analysed meteorological data (from coastal measuring stations) and operational limits of the actual response fleet. Based on this we developed a table of limit values, for wind, waves, visibility – which is used when creating the simulated exercise environment.

Main challenge to the development was the COVID-19 pandemic which caused significant challenges to development workshops and overall delays and also internation situation has changed significantly. Both factors have noticable impact to the overall working process and results accordingly. Anyway we have explained the needs and scenarios which we made and final session was successfully organized to local (Finnish) oil spill response officials.

Due to the EMSN-system there is a wide spectrum of possibilities to be connected to the other training centers worldwide and train oil spill skills simultaneosly and organize other Maritime trainings internationally.

Communication and quick decision making could be practices better in the international level of participants then there are more response groups. With participant of different countries Simulators provide wide scope of trainings in both communicating and in booming and waste removing experience.

It is important to make the location of oil spill and response boats easier and more accurate in process of training. In a training process coordinating should be connected to the map or AIS-system automatically.

In implementing training there was successfully demonstrated vessel driving in a spring ice. In future it can be taken in account that also ice conditions can chance and have affect to response operations. Perhaps later the ice model and oil spill response model can work simultaneously in NTPro- programs.

The final training was implemented successfully. The training was tested by the national Finnish responders because of the common international situation. Anyway, it was noticed that this kind of training is very useful and resembles natural conditions a lot by the comments of responders. There was commented, that the common information and commands are very important, and it was noticed that in case of international response groups it will be even more challenging to use exact right terms, so that they are understood by both sides correctly. This should be developed in future by creating a list of command sentences. Also,

decision making is important to supervise the responder groups effectively. In extreme conditions the oil spill response work has to be implemented very carefully and consistently.

Taking into account large liquid bulk traffic in Gulf of Finland and narrow sea area as far as limited channels it is important to develop common trainings of oil spill response to provide safe traffic in Baltic Sea.

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APPENDIX 1

Joint Cross-Border Oil Spill Response Simulator Training using EMSN (Details & Specifications Document)

1. Overview

This Simulator Training document describes the methods and practices of joint cross-border oil spill response simulator training between Xamk (South-Eastern University of Applied Sciences) and AMSUMIS (Admiral Makarov State University of Maritime and Inland Shipping) using EMSN as part of Simrec Task 3.4: Pilot exercise. This document is the “instructor’s manuscript and guide“ for conducting an EMSN exercise.

2. Project information and objectives

Simrec project Work Package 3: Simulator based approaches for developing joint cross-border practices is a joint development done by Xamk and AMSUMIS specialists. The work package consists of four (4) tasks. First the common training needs were studied (survey). Secondly the joint training model was developed incorporating the applicable outputs from other work packages and tasks. Then the training scenarios were developed and created using Wartsila NTPro simulator system. This document contains the information for implementing the final pilot exercise with real oil-spill responders and authorities from Finland and Russia.

2.1. Educational Framework

The joint Oil-spill response Simulator Training is based on three (3) stages of Oil-spill response, three (3) Educational functions (i.e Main topics of learning) and two (2) levels of responsibility (i.e. the operators and supervisors) as seen in table 1.

Table 1. Educational Framework of Cross-border joint oil-spill response simulator training.

Stages of Oil-spill response:	**1.Reconnaissance and Planning**	**2.Immediate Response Operation**	**3.Continued Operation**
Educational Functions:		Supervisors	Operators
F1.Controlling the vessel		Fleet level control, Strategic understanding: Manage reasonable convoy speeds	Single vessel control, Navigation, Practical skills: Maintain reasonable unit speed
F2.Communication & Coordination		Strategic cross-border and internal communication (leadership): Transmitting effectively	Operational communication with units in vicinity (understanding): Receiving/ relaying correctly
F3.Response Tactics		Fleet level awareness and management: Coordinate multi-vessel operations and formations	Single vessel operation: Understand own position and actions in relation to other units

3. Connected centers

Simulator centres from Kotka, Finland and St. Petersburg, Russia will be connected via EMSN. In Finland the KMC (Kotka Maritime Centre) has three (3) Navigational bridges one (1) Instructor station and one (1)

Briefing & Operations Control Center. In Russia the AMSUMIS has 3 Navigational bridges 1 instructor station(s) and (1) Briefing & Operations Control Center. Contact persons information is seen in table 2. The personnel (instructors and facilitators) and participants (OSR supervisors and OSR operators) are distributed in training facilities as seen in tables 3.1 and 3.2.

3.1. Contact persons

Table 2. Contact persons

Centre	Person	E-Mail	Other (Tel.)
KMC/ XAMK (Kotka Maritime Centre)			
AMSUMIS ()			

3.2. Instructors and Participants

Table 3.1. List of participants and instructors per centre

Centre: KMC / XAMK				
Teaching Facility	Instructors	Supervisors	Operators	Name(s)
Instructor Station	1 – 2			Instructor 1 (Maritime)
				Instructor 2 (Maritime, GMDSS)
Operations Control / Briefing class	1	2 – 3		Instructor 3 (Oil Spill specialist)
				OSR supervisor 1 [enter name here]
				OSR supervisor 2
				OSR supervisor 3
Navigational Bridge 1			2 – 3	*OSR operator 1*
				OSR operator 2

				OSR operator 3
Navigational Bridge 2			2 – 3	*OSR operator 4*
				OSR operator 5
				OSR operator 6
Navigational Bridge 3			2 – 3	*OSR operator 7*
				OSR operator 8
				OSR operator 9
Total:	2 – 3	2 – 3	6 – 9	*2 – 3 instructors + (6)/ 8 – 12 OSR participants*

Table 3.2. List of participants and instructors per centre

Centre: AMSUMIS				
Teaching Facility	Instructors	Supervisors	Operators	Name(s)
Instructor Station	1 – 2			Instructor 1 (Maritime)
				Instructor 2 (Maritime, GMDSS)
Operations Control / Briefing class	1	2 – 3		Instructor 3 (Oil Spill specialist)
				OSR supervisor 1 [enter name here]
				OSR supervisor 2
				OSR supervisor 3
Navigational Bridge 1			2 – 3	*OSR operator 1*
				OSR operator 2
				OSR operator 3
Navigational Bridge 2			2 – 3	*OSR operator 4*
				OSR operator 5
				OSR operator 6
Navigational Bridge 3			2 – 3	*OSR operator 7*
				OSR operator 8
				OSR operator 9
Total:	2 – 3	2 – 3	6 – 9	*2 – 3 instructors + (6)/ 8 – 12 OSR participants*

3.3. Communication channels and methods

During the exercise(s) the communication and coordination takes place using Teams (or similar VoIP), simulated VHF (TeamSpeak), handheld short-range radios (UHF, “walkie-talkies“) and verbally (locally at the centres). The trainees i.e. real responders are encouraged to use any other means of communication which would be in use during a real response operation (e.g. Finnish authorities Virve -system).

Table 3.3. Methods and protocol of communication

Sender(s) <> Receiver(s)	Encounter / Type	Medium / Channel	Other
Main instructor 1 <> Main instructor 2 (inter-centre)	Exercise coordination and management	**Teams** (or similar video conferencing VoIP)	TeamSpeak (VHF) ch. 1 Direct telephony (as per contact list)
Instructors (intracentre)	Local exercise coordination	Verbal	Handheld radio (UHF or similar)
Instructor(s) <> Trainee supervisor (intracentre)	Guidance and additional information	Verbal	Handheld radio (UHF or similar)
Trainee supervisor 1 <> Trainee supervisor 2 (inter-centre)	Scenario coordination and task management	**TeamSpeak** (VHF) Ch. 16	TeamSpeak (jointly agreed working channel)
Trainee supervisor <> Trainee operator(s) (intra)	Operative coordination and command	Authorities telecomm. (e.g. Virve)	TeamSpeak (internally agreed working channel)
Trainee operator(s) 1 <> Trainee operator(s) 2	On Scene communication	**TeamSpeak** (VHF) jointly agreed working channel	**TeamSpeak** (VHF) Ch. 16

Trainee operator(s) internal	Response team communication	Verbal	Handheld radio (UHF or similar)

4. Schedule

The training will be conducted in two (2) days. First day is familiarizing the oil-spill responders and authorities to the simulated environment locally. Second day will be the full EMSN connected training with Finnish and Russian centres.

Table 4. Schedule of Training

Time	Day 1 *Local Familiarization*	Day 2 *Joint EMSN Training*
08:00 – 09:00	Technical set-up and preparations	Technical set-up and preparations
09:00 – 10:00	Introduction and tour of the simulation centre	Common briefing
10:00 – 11:30	Basic facilities and equipment demonstration	**Exercise 1**: Locating and reporting the oil-spill
11:30 – 12:30	Lunch	Lunch
12:30 – 14:00	Task specific familiarization. Operators learn the use of nav. equipment and controls. Supervisors learn the communications and operations control center	**Exercise 2**:
14:00 – 15:30	Test scenario demonstration and internal communications check	**Exercise 3**:
15:30 – 16:00	(Optional: Second scenario demonstration)	Common debriefing and feedback

5. Exercises

The Training consists of three (3) exercises (i.e. Scenarios). Every exercise is documented in tables:

- Scenario specifications and details
- Unit and Object specifications, EMSN data

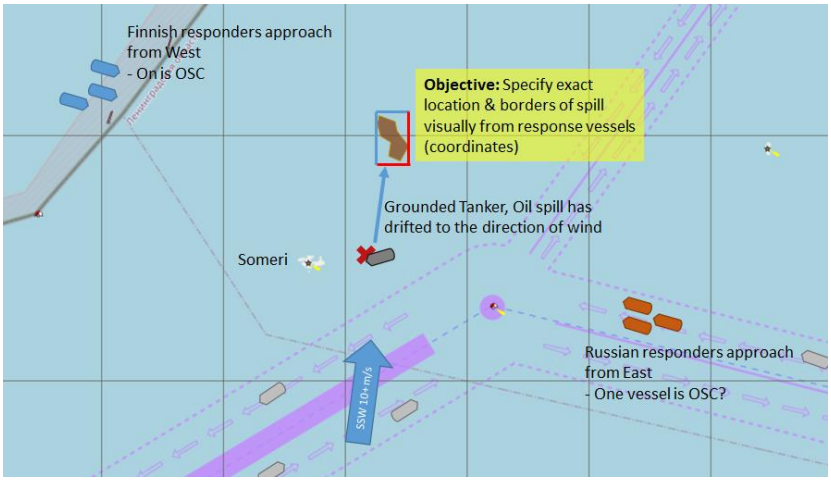
Note: Due to changes in the project (Feb. 2022) – only the first exercise is described in detail.

5.1. Exercise 1: details and specifications

1: Locating and reporting the Oil-spill

First exercise focusing on the reconnaissance and planning phase of an Oil Spill Accident.

Table 5.1.1. Scenario specifications

Name	01.Locate Oil in XXX region	**File (NTPro)**	1_simrec_locate-oil.nti
Description and Theme	Reconnaissance mission, arriving to an accident site. Three (3) Finnish units approach the scene from West and three (3) Russian units approach from East. Units will locate the spill and give situation reports to operation control. Operation control in Fin & Rus will communicate and share information to produce an accurate shared situational awareness.		
Objective	Main: F2. Communication and Coordination • On-scene Spill details communicated to scene command • Correct shared situational awareness achieved Other(s): F1 & F3		
Setting	NTPro Area: St. Petersburg and approaches 		

	NOTE: Oil Spill -object visual only						
Simulated conditions	Date	Time	Environmental conditions	Direction	Speed	Amount	Other
	01.05.2022	12:00 UTC	Wind	220 (SW)	12 m/s		
			Wave	220		1 m	
			Visibility			6 nm	cloudy
			Ice			N/A	
Maps and materials	Paper Chart No. FI 13 (Intl. 1245) Helcom Grid						

Table 5.1.2. Scenario unit and object specifications with EMSN data

Name	01.Locate Oil in XXX region							
Centre:	KMC		**Prefix:**	XA# (# = number)		**Site ID:**	Xamk 18	
DIS	Name	Call sign	(MMSI)?	Type of Ship	Flag	Start position	Start vector (Hdg / Spd)	Other
1-1-1-1	"Ariel"	OJAA	23000001	Oil skimmer	FIN	60N14,0' 027E35,5'	095 /5kn	
1-1-1-2	"Bertha"	OJAB	23000002	AHTS	FIN	60N13,8' 027E35,6'	095 /5kn	'OSC'
1-1-1-3	"Carolina"	OJAC	23000003	Oil Skimmer	FIN	60N13,6' 027E35,7'	095 /5kn	
Centre:	AMSUMIS		**Prefix:**	MA# (# = number)		**Site ID:**	?	
DIS	Name	Call sign	(MMSI)?	Type of Ship	Flag	Start position	Start vector (Head / Spd)	Other
1-1-2-1	"Name 1"	xxx?						

1-1-2-2								
1-1-2-3								

(APPENDIX 1.1)

CHECKLIST for creating Simulator training scenarios (process description)

item		Description	Notes
			for joint exercises planning:
0	Selecting the THEME and OBJECTIVE	Refer to the 'matrix' of competence - Phases / Main Functions	This makes the pedagogical basis and is agreed with partners
1	Select the SCOPE of exercise	How long will it be? What will happen in it? - general outline based on previous (item 0)	**Must be agreed collaboratively in workshop**
2	Selecting the AREA	Specific geographical location - must be inside an area covered by NTPro	**Must be agreed collaboratively in workshop**
3	Selecting the SHIP(S)	Specific units to be controlled by students - Starting pos. & vectors	**Must be agreed collaboratively in workshop**
4	Selecting the OBJECTS	Dynamic objects (= other ships etc.) Other objects (= ropes, anchors, scenic etc.) Camera objects	**Must be agreed collaboratively in workshop**
5	Creating the exercise file in NTPro	Insert items (2-4) to a new file	Can be done by 1 of the partners (then share), preferably during workshop
6	Perform first test on file	Load the file with all assigned (does it load up?)	Preferrably done in workshop
7	Modify Ships / Objects in file	Make 'fine tuning' to pos./ vectors etc.	Preferrably done in workshop
8	Select and modify time of day & environmental conditions	Create the desired weather effects, time of day etc.	Preferrably done in workshop
9	Perform tests	Load the file with all assigned + conditions Validate the run-time = Scope (item 1)	Preferrably done in workshop
10	Make final adjustments + save	Example: After full tests, the ship(s) take too long to arrive at the scene → move closer Example2: adjust the camera-objects (angle, tilt, height)	Preferrably done in workshop
11	Take backup of file for sharing	the *.nti file can be shared with other Wartsila centers (enables easier setup and identical object placements)	
12	Document the scenario	Fill the documentation form for the exercise	
	additionally with EMSN:		
A.	Perform tests in EMSN mode online	Make a joint test with other centre (both have same file loaded)	
B.	Validate DIS etc.	Example: centre1 sees all the objects of centre2	


XAMK


SIMREC

(APPENDIX 1.2)

TABLE of Simulated Environmental conditions (’Extreme limit’)

Variable	Lower limit	Notes
Wind speed : Waveheight	**10 m/s : < 1,5 m** (SW) **13 m/s : < 1,5 m** (S) **9 m/s : < 1,5 m** (SE) **10 m/s : < 1,5 m** (E)	when from SouthWest when from South when from SouthEast when from East
Visibility	**Night** **Visibility < 1,5 nm** (other causes)	i.e. times between nautical dusk to nautical dawn Fog, mist, precipitation etc.
Ice	**Any** fast ice **Any** float ice	Typically thickness < 40cm Typically compacted

APPENDIX 2

COMMON LOG – Example pictures and descriptions of the working document (shared .xls) used in the joint SIMREC WP 2 & 3 development

SIMREC COMMON LOG

This is a common log for identifying mutual specifications and practices for developing cross-border oil spill response simulator training between XAMK and AMSUMIS

WP2: TECHNICAL DEVELOPMENT FOR CONNECTIVITY OF MARITIME SIMULATORS

WP2 plans of approach:	
Plan A1	Direct VPN connection between simulator centers with newer and updatable NTPro version (5.40.xxxx)
Plan A2	Direct VPN connection between simulator centers with older and fixed NTPro version (5.35.xxxx)
Plan A3	**EMSN connection between simulator centers with different NTPro versions**
Plan B	Cross-border joint training between simulator centers without direct VPN or EMSN connection

WP3: SIMULATORS BASED APPROACHES FOR DEVELOPING JOINT CROSS-BORDER PRACTICES

WP3 steps of development:	
Step 1	Target groups
Step 2	Educational objectives
Step 3	Framework and curriculum
Step 4	Scenarios and tasks

Figure 1. The front page of the 'COMMON LOG' online document containing the links to the different tabs and tables in Work Packages 2 and 3.

WP2: TECHNICAL DEVELOPMENT FOR CONNECTIVITY OF MARITIME SIMULATORS
Plan A3: EMSN connection between simulator centers with different NTPro versions
EMSN connection has been developed to connect simulator centers and it is recommended by the simulator provider
Selected plan

Specification	XAMK	AMSUMIS	Requirement
Established EMSN connection (Fraunhofer CML)	YES	NO	EMSN connection has to be established in both centers
Financing for EMSN connection	YES	NO	Financing is recommended for both centers
Ownership and control of NTPro simulators	PARTIAL	YES	Full ownership and control is recommended for both centers
Connectable NTPro simulators	3 BR + 8 WS	2 BR	Specify amount and type of simulators (BR = bridges, WS = workstations, VTS = vessel traffic service)
NTPro version	5.40.7018	5.35.xxxx	Versions can be different
TrnNetwork version	TO BE CHECKED	TO BE CHECKED	Versions can be different
NTPro Oil Spill Functionality Module	YES	TO BE PURCHASED	Module has to be installed in both centers
NTPro Ice Navigation and/or Operations Module	TO BE PURCHASED	NO	Module is recommended to be installed in both centers
NTPro exercise area(s)	TO BE PURCHASED	TO BE PURCHASED	Similar exercise area(s) has to be installed in both centers
NTPro ship models as ownships	TO BE COMPARED	TO BE COMPARED	Similar ship models as ownships have to be installed in both centers
Ownership and control of Internet connection	NO	YES	Full ownership and control is recommended for both centers
Normal Internet connection	50/10M	100/100M	Internet connection has to be at least 10/10M in both centers
VPN router and connection configuration	YES	POSSIBLE	VPN router has to be acquired and connection configured in both centers
Radio communication and connection configuration	YES	POSSIBLE	Radio communication has to be established through EMSN with TeamSpeak
Videoconferencing equipment and connection configuration	POSSIBLE	POSSIBLE	Videoconferencing equipment has to be acquired and connection configured in both centers
Risk of failure in establishing functional EMSN connection	LOW	MEDIUM	Risk of failure has to be low for both centers
Estimated probability for establishing EMSN connection	**75–100 %**	**50–75 %**	**Probability has to be 75–100 % for both centers**

Links to additional information about EMSN:
https://emsn.connect.fraunhofer.de/
https://www.cml.fraunhofer.de/content/dam/cml/de/documents/Produktblaetter/Produktblatt_EMSN_final-online.pdf
https://www.stmvalidation.eu/emsn-simulation-campaign/

Figure 2. The table in WP 2 – Plan A3 (EMSN). These kind of tables were used to log, note and agree on necessary steps and activities. Both partners (Xamk & AMSUMIS) had their own columns for writing.