Activity 1 - MONALISA 2.0

Sea Traffic Management
Operations and tools
Sea Traffic Management Operations and tools

The purpose of this activity is to provide the maritime world with new tools and processes that will increase safety and efficiency. It all boils down to an entirely new way of sharing and transferring information, allowing the maritime world to make better decisions. Having access to the right information makes it possible for the vessels to optimise their routes, and for the ports to make a just in time delivery.

Maritime traffic information is currently shared between vessels and ports on a one-to-one, and need to know basis. MONALISA 2.0 aims to achieve a maritime information environment similar to that of air traffic control - minus the control element. New technology, and information sharing, opens up for a wide range of new applications. This activity zooms in on the specifics of what is needed in order for all actors to collaborate in an effective manor.
Sea Traffic Management looks at the entire nautical voyage and all of the processes that take place, from the moment the journey is initiated until all is settled in the port of final destination. Information exchange is at the heart of the concept.

“When all actors contribute with information a more complete picture of reality is painted. Vessels that have a better understanding of their current context can make better and safer decisions, and land-based support that understand the vessel’s intention can be of better service”, says Mikael Hägg, Head of Maritime Operations at Chalmers University of Technology.

Human Machine Interface
In order for the information exchange systems to be effective they must have an optimal human machine interface. This activity considers the technology from the users’ perspective: How human beings interact with the systems.

“All the systems that we are testing are developed in liaison with the users. We evaluate if the users feel that they are getting enough information and that they are able to assimilate it”, says Mikael Hägg.

“Among other things, the new technology has enabled the land-based support to send a new route to the vessel that instantly appears on their electronic nautical chart. Our tests have confirmed the thesis that visual instructions in some cases are more effective than voice communication.”

Standard Operating procedures
Rules and regulations stipulate how to navigate a vessel and how communication between land-based actors and vessels is conducted.

“As new information and technology becomes available it is important to consider the full impact and whether standard operating procedures will have to be changed. We have found that some new guidelines and rules will have to be implemented, but that they only will generate very slight alterations to how we work today”, says Mikael Hägg.

STM Voyage exchange format and architecture
“Today all actors have their own picture of reality and that may cause misunderstandings and incidents. With route exchange in place we will for the first time in history move from ‘individual situational awareness’, beyond ‘enhanced situational awareness’ to something completely new. Once we have achieved ‘common situational awareness’ all parties that are involved in an action will share the exact same picture of the course of events. This is a paradigm shift”, says Ulf Svedberg, Senior Innovation Coordinator at the Swedish Maritime Administration.

About eight years ago, Ulf Svedberg and his colleague Fredrik Karlsson were discussing the future needs of the maritime industry. The idea of vessels being able to share data between them in new ways came up in the conversation.

“We realised that it would be great if vessels could communicate with each other in spite of them having navigational systems from different suppliers. That would allow them to share information about their intended routes, and even to have them presented visually on their own screens. Seconds later it dawned on us that it also would open up for the possibility of vessels sharing information with land-based actors. We realised that there basically was no limit to the benefits it could generate”, says Ulf.
At maritime conferences around the world, Ulf Svedberg started talking about the possibility of sharing information between proprietary systems.

“Every time I talked about this idea people from suppliers of navigational and communication equipment would come up to me afterwards. They all thought it sounded interesting and expressed that they wanted to be a part of the solution”, says Ulf.

In 2012, Ulf Svedberg invited all of those who had approached him to a meeting at the Danish Maritime Administration in Copenhagen.

“25 people from 15 different companies showed up at the meeting. At lunchtime people were already discussing what a technical solution could look like. And keep in mind; the ones who were discussing a common platform were the same people that normally consider themselves fierce competitors. At the end of the meeting all were in agreement that we needed a common format that would enable communication between navigational equipment of different brands and that we had to work together to achieve it”, says Ulf.

A few months later the Route Exchange Protocol (REX) had been developed within the technical requirements specified by the International Electrotechnical Committee. The International Maritime Organisation had specified the requirements from the users’ perspective. In August 2015 the REX was adopted in IEC (61174 ed 4).

“Technological advances are often harnessed quickly by the industry if a business opportunity has been identified, and after just a short period of time we had a solution: REX, a common language for the maritime industry”, says Ulf.

On a conceptual level REX can be compared to the Bluetooth format in the telecom industry. It was developed by three mobile phone manufacturers and accepted as a standard by the industry.

“We know that as soon as the shipping companies understand the massive benefits that information exchange can generate they will, so to speak, join the movement. But as they are under no obligation, it is our task to convince them”, says Ulf.

The new functionality is implemented directly in the ECDIS software and the visualization of the new Voyage Exchange Format, approved by IEC, will be implemented in new bridge equipment. It provides the officer on watch with greater situational awareness and also provides new means to communicate intentions and other data with stakeholders.

“Today, vessels normally move between ports at full speed, not considering if it is the optimal speed given the situation at the next port of call. Linköping University made calculations that indicated that the savings, as a result of optimized speeds, would be astonishing. No other mode of transport can be optimised as much as seaborne transports”, says Ulf Svedberg.
Extended test bed

Virtual environment
In order to test the impact of the concepts that have been created as a part of MONALISA 2.0, the world’s first civilian simulator network was developed.

“We realised that it would be impossible to evaluate and test some of the tools and concepts in reality. Even if we could get vessels to participate, and to share data with us, we still would not be able to get them to move as we would want them to. Simulations are commonly used in the maritime industry and our need for testing complex traffic situations gave us the idea of connecting a number of different European test centres”, says Fredrik Karlsson, Innovation Coordinator at the Swedish Maritime Administration.

Collaborative effort
Fredrik Karlsson and his colleagues reached out to the simulator suppliers. The goal was to get the companies, who are usually in fierce competition with each other, to collaborate to develop a protocol that would allow multi vendor communication.

“In the beginning there was some hesitation from the suppliers, but all of them worked well together and we ended up with a non-proprietary solution that would not exclude any simulator brand”, says Fredrik.

In the near future an even greater number of simulator centres will join the extended test bed. The greater the number of connected centres, the greater the relevance of this piece of new technology and the STM-concept.

“We have a momentum, customers are demanding that the simulators they purchase can be connected to the network, and hopefully that makes it good business for the suppliers to join us”, says Fredrik.

Baseline- and final simulations
Six simulator centres, four navigational schools, three simulator manufacturers, three research institutes and 18 manned virtual vessels participated in three large-scale simulations of complex traffic patterns in the Belt area. All of the 200 people, who in one way or another participated in the exercises, have a close relation to shipping and make decisions similar to those in the simulation on a daily basis.

“A majority said that the simulations felt very real. The fact that the exercise indeed is very similar to reality contributes to the participants acting as they would in reality. As a result of our extended test bed we have been able to accurately study the full impact of every move and to consider the second and third hand effects of them.”

The final simulation in MONALISA 2.0 is scheduled to mid November 2015. All centres will be connected, tools and equipment that have been developed as part of the project will be used at their full potential, and the results will be compared with the baseline simulations in order to evaluate the concept.

Different perspectives
During the simulations, engineers have observed the equipment from a product development perspective and Machine Interface specialists have looked at how the people interacted with the tools. Since the simulations included people from different parts of Europe, interacting in realistic traffic scenarios, it was also possible for HR representatives to observe cultural differences and psychological effects.

“We are all aware of the fact that people from different parts of the world behave differently. The simulations provide us with the opportunity to study them and to help us identify, illustrate and hamper the cultural differences”, says Fredrik.
Extended test bed participants

- Swedish Maritime Administration, Sweden
- Novia, Finland
- Fraunhofer CLM, Germany
- Chalmers University of Technology, Sweden
- National Technical University of Athens, Greece
- Carnival Cooperation, Germany
- VeMarS, Italy
- Kongsberg, Norway
- SSPA, Sweden
- TRANSAS, Sweden
- Rheinmetall, Germany
- SASEMAR, Spain
- Polytechnic University of Catalonia UPC, Spain

Results from these simulations and other findings in MONALISA 2.0 will be posted on the MONALISA 2.0 webpage when they become available and will be communicated at a large number of conferences. The results will also be used in the upcoming continuation of the project, the Sea Traffic Management – Validation Project.

Shore Based Deep Sea Assistance

Compared to the air traffic industry, seaborne vessels receive very little land-based support. Shore based deep sea assistance is inspired by the air traffic control, but it will not go so far as to direct the vessels. Rather, it will offer guidance and coordination of traffic.

“Shore based deep sea assistance will, among other things, add to traditional sea pilot services in areas that are difficult to navigate, such as the inlet to the Baltic Sea. It will also provide vessels with information about the current situation, such as congestion or accidents, on their intended route”, says Mikael Hägg.

“Given that the land-based support shares information with all actors they can make suggestions regarding when it is optimal for a vessel to reach a particular waypoint in order to make a ‘just in time’ arrival to the port”, says Mikael.

Benefits of Shore Based Deep Sea Assistance

- Protect the flora and fauna by generating dynamic restrictions depending on current conditions or the time of the year.
- Icebreakers and ships in the Baltic Sea can share a common information environment.
- Increased efficiency leads to both speedier transports and optimized fuel efficiency.
- Access to updated traffic information allows the vessels to find a safe and optimal route.
- Access to local knowledge facilitates navigation through difficult passages.
- Vessels receive suggested schedules based on ‘just in time’-arrival to the port.

Etch bridge crew went through an EMSN 101 crash course to familiarise themselves with the new equipment that is being developed in the project. This is the small bridge at the Chalmers simulatorcentre that manned five bridges during the test campaigns.
Integration of Decision Support Tools

Bringing order to chaos
Today all vessels make their decisions independent of each other, such as when they leave the port and what route they are going to follow. The development and implementation of decision support tools is about bringing order to the chaos, and to minimise the environmental impact and the risk of accidents. This activity will provide a service oriented platform based on standards for distribution of Dynamic Routes, Weather Forecasts, Maritime Spatial Information and other related information provided by the partners.

“The Danish Meteorological Institute has played an important role in our compilation of weather data as they have supplied data covering a large geographical area”, says Lars Markström, project manager at SSPA.

The plan for the future is for all information to be geo-referenced and distributed via the geoportal developed by Carmenta. When this target is realised it will be presented on charts covering the Baltic and European waters.

Route optimisation and conflict solving
Data has been gathered via the AIS-system on vessels travelling the Swedish coast in order to map high-risk situations, and a number of simulations have also been run at SSPA in Gothenburg.

“The scenarios that we ran indicated that a vast majority of unplanned encounters could be resolved and that decision support tools also make it much less complex to solve potential conflicts and avoid collisions”, says Lars.

Planning encounters ahead of time, and having access to information about depth and weather conditions, also optimises fuel consumption.

“Our simulations indicated that average fuel consumption can be reduced by up to 10% for vessels joining the information exchange system and using decision support tools in order to optimise their routes.”

Scope
In MONALISA 2.0 the geographical scope of this activity was extended from Sweden to also cover the Baltics and other European waters. The tools platform was also enhanced with additional functionality to support service providers and service centres, including monitoring of ships, route optimisation and separation and prediction of arrival to port.

“Our goal is to provide the maritime industry with a limited number of comprehensive tools that will allow vessels to receive optimized routes and to become aware of potential risks in advance. As little as possible should come as a surprise at sea, such as when two vessels meet”.

Lars Markström
Project manager at SSPA
Decision Support Tools

Are you on the right track?
Navicon, specialised in maritime surveillance, is in the final stages of the development a Route Anomaly Detector and Classifier that monitors the vessel’s movements and automatically compares it to the planned route.

Minimising the risk and improving predictability
CIMNE is in the final stages of the development of an AI Decision Support Module that uses Artificial Intelligence in order to identify potential maritime safety risks.

SMHI is working on a tool, ETA Predictability, that will offer a more precise indication of when a vessel will be arriving to their destination.

Tools to analyse and provide means to deconflict whole traffic patterns have been developed. It is possible to send, receive and process routes via new approved standards, new HMI solutions and a new approach to ship-shore interaction.

Partners in developing Decision Support Tools are:
- SSPA, Sweden
- Carmenta, Sweden
- SMHI, Sweden
- DMI, Denmark
- Navicon, Denmark
- CIMNE, Spain
Integration of Maritime Spatial Planning

By 2021, all EU member states shall have a maritime spatial plan for their coastal areas, including the Territorial Sea and the Exclusive Economic Zone, and adjust their national legislation accordingly. The plan will include all of the human activities that occur in the area and will evaluate their impact on the marine environment and on each other. Maritime Spatial Planning is an on-going process since human activities in the marine areas vary in space and time.

Minimising the environmental impact
Within the framework of MONALISA 2.0 this activity has looked at the possibility to include the maritime traffic activities in the national maritime spatial plans with the perspective of an environmentally sustainable development. Economic evaluations, of the direct- and externality costs, have been performed via hypothetical scenarios in which vessels have been rerouted to minimise the impact on marine protected areas and marine organisms.

“One example of a rerouting scenario is in the Natura 2000 area of Hoburgs bank and the northern Midsjöbanken in the Baltic. During the winters the seabirds rest and feed in a protected area along one of the navigational routes and during the summers the codfish spawn along another. Seabirds are sensitive to oil spills and the codfish may be disturbed by the sound the vessels make”, says Lilitha Pongolini, research assistant at the World Maritime University.

Impact of “green routes”
Some areas have a more sensitive marine ecosystem than others, and the level of vulnerability may also vary over the course of the year. Marine spatial planning can be used to provide the maritime industry with information and to recommend so-called ‘green routes’ to minimise the impact on the environment.

This project intends to find a tool to measure the costs that the shipping industry will incur by taking the marine environment under consideration, for example by rerouting or slowing down the vessels in specific areas. Currently there is little scientific information about what impact the shipping activities have on the marine ecosystems and organisms. Further studies are needed to evaluate the consequences of green routes.
“Measuring the economic impact of rerouting or slowing vessels down is at the moment the most feasible way of quantifying the consequences of green routes. Direct costs, such as fuel consumption and labour costs, must be taken into consideration when calculating the economic impact. We also have to consider external costs, such as the social costs of the air pollution, and its effect on human health”, says Fabio Ballini, research associate at the World Maritime University.

“We need tools to evaluate the effect of the shipping industry in the interaction with other human activities as well as its impact on the environment and the marine ecosystem”, says Lilitha Pongolini.

Partners - Maritime Spatial Planning National Technical University of Athens has looked at the procedure and methods to perform economic impact assessment of green routes in the Mediterranean.

University of Genoa in Italy has worked with the planning and practical approach on the procedure to integrate the environmental aspects in route planning.

Polytechnic University of Catalonia has looked at the procedure of incorporating the shipping industry and route planning in the Maritime Spatial Planning process and provided information about the economic impact of route changes.

World Maritime University has looked at the Maritime Spatial Planning process in Sweden and in the Baltics. They have also looked at methods used to evaluate cumulative impact of human activities on the marine environment in the Baltic Sea. An economic assessment of a hypothetical green route has been made in the Baltics.
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Partners participating in Activity 1

- Swedish Maritime Administration
- Fraunhofer
- Chalmers University of Technology
- SSPA
- Sasemar
- National Technical University Athens
- CIMNE
- Italian Ministry of Infrastructure and Transport
- Polytechnic University of Catalonia
- Carnival
- Transas
- Swedish Meteorological and Hydrological Institute
- Carmenta
- Danish Meteorological Institute
- GateHouse
- World Maritime University
- Navicon
- Danish Maritime Authority
- Jeppesen
- Rheinmetall
- Marsec-XL
- Novia University of Applied Sciences