MONALISA 2.0 PROJECT AND ITS DEPLOYMENT IN THE MARITIME SPATIAL PLANNING CONCEPT.

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ABSTRACT

The scope of MONALISA 2.0 project covers 10 EU countries and it is implemented by 39 entities representing public, private and academic sectors. Maritime Spatial Planning, Dynamic Route Planning, Route optimization, exchanging Information about Routes between ships and ships to shore, the possibility to have available a real time service for monitoring and coordinate sea traffic, are now a concept under the deployment of the different technologies applied. The improvement on ships performance and the response in case of accidents are other key elements introduced in Monalisa 2.0. This project is delivering new standards and protocols that will enable communicative machines in several levels, ship to ship, ship to shore and VTS to VTS, creating a comprehensive and interoperable network for a European Sea Traffic Management (STM) Service. STM means information sharing in the whole maritime transport chain. The partnership expects the transfer of STM information to happen in a System Wide Information Environment (SWIM) or what is understood is 'the maritime cloud'. This paper tries to link the Maritime Spatial Planning initiative and how to deploy in it the MONALISA concept, as a tool for a safer, environmental and more effective maritime transport in the Balearic Islands area.

Keywords
VTS, AIS, Route Planning and Exchange, Sea Traffic Management, SAR

1 INTRODUCTION

Sea transport is the most effective mode to move large quantities of cargo over long distances. In terms of passengers, it is also the mode of transport that can move more amount of people by trip. Main waterborne routes are performed in oceans, coasts, seas, lakes, rivers and channels, being the north hemisphere countries the most developed in the maritime transport industry. In shipping, passengers and freight used to share the same vessels and often the same terminals. Since the 1950s specialization has occurred, and the two are now quite distinct, except for ferries and some RORO services, making possible to create new business models based on passengers, cargo, and both.

"Sea transport services are essential for the European economy to compete globally. In 2011, the Commission adopted a White Paper for Transport". Following the previous edition in 2001 where a rebalancing among modes of transport was suggested. "It further specifies the orientations of the Maritime Transport Strategy until 2018: the ability to provide cost-efficient maritime transport services; the long-term competitiveness of the EU shipping sector; and the creation of seamless transport chains for passengers and cargo across transport modes. In 2011, the Commission proposed new guidelines for Trans-European Networks to broaden the role of the Motorways of the Sea as main European corridors. Through multi-annual calls, the

Commission is leading the way in reducing the environmental impact of transport and in increasing transport efficiency"[1]

With this scenario in mind, sea and maritime safety is a key factor to maintain a sustainable maritime industry growth. The demand on new and competitive transport services and the multimodality approach require the interoperability among different modes of transport and interfaces like ports and corridors. "Since 2009, the EU and its Member States have been at the forefront in improving maritime safety. The aim is to eliminate substandard shipping, increase the protection of passengers and crews, prevent accidents and reduce the risk of environmental pollution. The implementation of the 2009 Third Maritime Safety Package improves the quality of European flags, the work undertaken by classification societies, the inspection of vessels in ports, traffic monitoring, accident investigation, and victim protection".

In early 2010, Sweden and the Swedish Maritime Administration initiated a Motorways of the Sea project of wider benefit – MONALISA project (2010-EU-21109-S). MONALISA proceeds on the basis of the challenges facing the Baltic Sea region in the area of maritime transport, challenges that are outlined in the EU Strategy for the Baltic region. In 2013, MONALISA 2.0 took its point of departure in the results and experiences from the former MONALISA project, co-financed by TEN-T under the Motorways of the Sea Program. As a MONALISA project extension in terms of geographical and technical innovations, MONALISA 2.0 is reusing the results and experiences from the development within the aviation sector and its SESAR (Single European sky Air Traffic Management Research) program, which has been strongly supported by the European Union through the Framework Programs and TEN-T during the past decade, to improve maritime safety in a common framework in Europe through the Sea Traffic Management (STM) concept. The objective is to make maritime transport safer, environmentally sustainable and more efficient in terms of life, time and money savings.

2 MONALISA PROJECT – THE ORIGIN

MONALISA aimed at making a specific contribution to efficient, safe and environmentally friendly maritime transport. This has been done through the development, demonstration and dissemination of innovative e-navigation services to the shipping industry, which can lay the groundwork for future international deployment adopting improvements in standards.

Quality assurance of hydrographic data for the major navigational areas in Swedish and Finnish waters in the Baltic Sea is expected to contribute to improving the safety and optimization of shipping routes from the results obtained in the project.

MONALISA project was divided into four activities, all of which contribute to the achievement of objectives as follows: Dynamic and proactive route planning – "Green Routes"; Verification System for officer certification; Quality assurance of hydrographic data, and Global sharing of maritime information.

2.1 Dynamic and proactive route planning[2]

Some 80 000 ships passed in and out of the Baltic Sea during 2012 many of them tankers with dangerous cargo. In order to strengthen the safety of shipping in the area, tests with

[1] Progress of the EU's Integrated Maritime Policy; Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions COM(2012) 491 final. http://ec.europa.eu/maritimeaffairs/documentation/publications/documents/imp-progress-report_en.pdf

[2] e-Navigation.net portal: http://www.e-navigation.net/index.php?page=monalisa-1

dynamic and proactive route planning has been done within the first MONALISA project (test is continued in the MONALISA 2 project until end of 2015).

The test bed includes a shore-based Ship Traffic Coordination Centre (STCC) and the ability of ship to exchange voyage plans from test bed ECDIS platforms (SAAB, and DMA's e-Navigation Prototype Display - in MONALISA 2.0, Transas is involved).

The system is intended to be advisory and the process is as follows. A vessel approaching the MONALISA area will send its voyage plan to the STCC. STCC will validate it for under keel clearance and NoGo areas (and in MONALISA 2 also for separation to other ships). The voyage is then "agreed" by the captain and the ship is expected to follow its green corridor (except for obvious deviation due to traffic). Progress is then monitored from shore and route advice may be communicated to the ship. If there are any changes a new route request is made either from ship or from shore.

The intention is that the MONALISA functionality should be integrated in ordinary ECDIS systems based on a new standard and using the proprietary systems own functionality. Until that is possible prototype lab platforms has been used for testing.

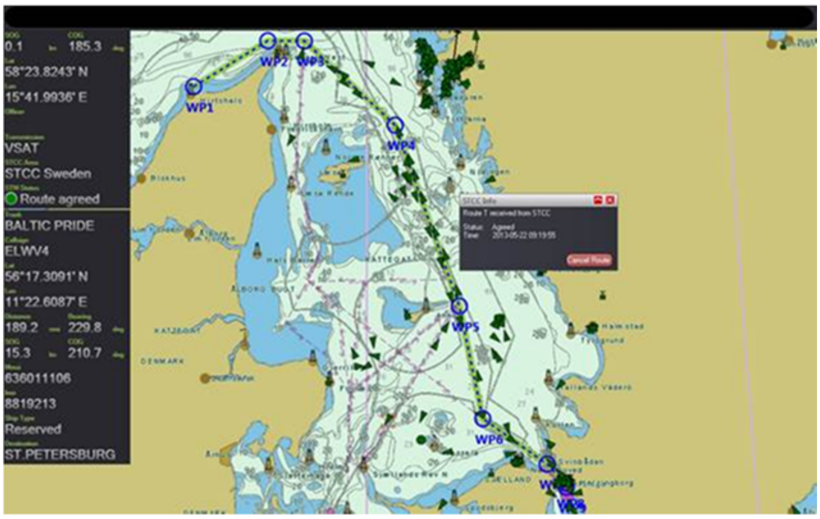

Figure 1: A "green" agreed route between the shore traffic control and the vessel in the MONALISA system, here in the SAAB prototype platform
Source: MONALISA Project reports

2.2 Global sharing of maritime information

The aim of this activity has been to develop a functionally demonstrative system defined both technically and procedurally; the final objective being to extend the sharing of maritime information on to a global scale and also to expanding the scope of maritime information shared between maritime authorities which shall be consistent with their specific needs. It is contemplated that the activity must have been based on experiences gained from HELCOM AIS, Safe Sea Net and IALA Net. As a result, the extended application of Global Sharing of Maritime Information is one of the pillars to be reinforced within MONALISA 2.0 after the first tests under MONALISA project.

The Costa Concordia disaster gave impetus to the process of sharpening e-navigation generally; if a master changes course, as apparently occurred in that incident, the STCC must be informed, and in that case the STCC may have asked why the master was deviating from his passage plan. The ship sank after it capsized at Isola dei Giglio, Tuscany, on 13 January 2012 accident, 32 people died.

The South Korean ferry Sewol that sank off the South Korean coast on 15th April 2014, with the likely loss of more than 300 passengers, was being steered by an inexperienced young officer who was navigating the area, which is notorious for its fast currents, for the first time.

The revelation lends weight to the theory that a series of errors by senior crew members caused the Sewol to list and capsize, prompting a major rescue operation and questions about safety measures as South Korea struggled to with one of the worst maritime disasters in its history

The crew appeared underprepared to deal with a serious incident at sea amid reports that the vessel's owner, Chonghaejin, had not given them guidance in how to execute a swift evacuation.[3]

Figure 2: The South Korean ferry Sewol sank
Source: Internet picture galleries

3 MONALISA 2.0 – THE PRESENT AND A STEP FORWARD TO THE FUTURE OF MARITIME SAFETY

Both accidents recently happened demonstrate the existing gaps and fails in maritime transport safety, from the ordinary navigation watch keeping and navigational tasks, to the safety management after an accident occurs. Even the technology available is highly developed in terms of equipment, manning, communications, etc., its misuse, the lack in the decision making processes supported by proper risk assessment tools, the crisis management deficiencies from the ship side and the difficulties in coordinating the response actions between the Coast Guard services and the crew, reinforce the idea that something goes wrong. Human factor is still being the main incidents cause against the safer and more developed ships and equipment today.

More than three years after the Costa Concordia disaster, improving passenger ship safety continues to be a priority with a particular focus on services where quality standards can be an issue. An increasingly difficult operating climate for ship operators has forced a number of innovations, including larger ship sizes to capitalize on economies of scale and the use of alternative fuels. Such scenarios present new risks and challenges, particularly around crew safety and training – it has been estimated that 80% of marine casualties are down to human error and lack of skilled workforce is still an issue. The claims arising out of maritime emergencies of “mega ships” can be huge, such as if an accident was to block entrance to a port.[4]

MONALISA 2.0 project takes the results from MONALISA project and is aimed to extend them in the way that several safety and operational aspects of the current Maritime

[3] Justin McCurry, The Observer, Sunday 20 April 2014
[4] Safety and Shipping Review 2014, Allianz Global Corporate & Specialty; www.agcs.allianz.com; March 2014

Transport Industry may be improved dismissing or eliminating sever accidents like the mentioned above.

"MONALISA 2.0 will also make use of relevant results from earlier Motorways of the Sea projects, maritime R&D projects and re-use best practices from other areas in an effort to bring these further towards deployment in the maritime sector. The goal is that this will foster innovations and deployment of new technologies and systems to increase efficiency, safety, effectiveness and environmental sustainability of Motorways of the Sea and its integration in the Trans-European Transport Network. In MONALISA 2.0, the demonstrated results of Sea Traffic Management from MONALISA 2.0 will be taken a step further towards deployment through:

- testing of specific applications and services which would allow rapid commercial deployment.
- integration of route planning tools with additional environmental information and maritime spatial planning for the purpose of improving maritime safety and environmental protection;
- joint private-public action to elaborate better standards for route information exchange through a common interface and common data format allowing equipment from all manufacturers be used for Sea Traffic management;
- demonstrating concrete/hands-on services using new technology to enhance maritime safety, making Search and Rescue and mass-evacuations more efficient than today and by addressing the urgent issue of safety in ports;
- re-using results of previous EU investments in Air Traffic Management as well as from other sectors and their application into the maritime domain."[5]

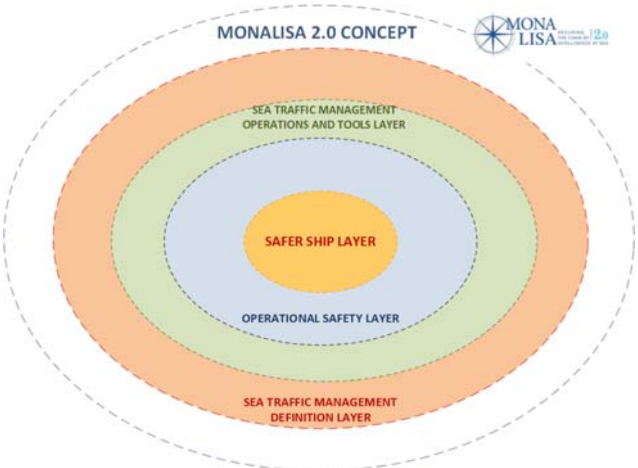

Figure 3: Multilayer Approach of MONALISA 2.0 project
Source: Own development

[5] Geir Lyngheim Olsen (Jeppesen), Eivind Mong (Jeppesen), Anders Rydlingen (Transas International), Konstantin Ivanov (Transas International), Jonas Palson (World Maritime University), Hans Engberg (Swedish Maritime Administration); Information paper on the ongoing work in the MONALISA 2.0 project. Information paper prepared for the IHO TRANSFER STANDARD MAINTENANCE AND APPLICATIONS DEVELOPMENT WORKING GROUP (TSMAD).

To reach these objectives, the MONALISA 2.0 project has been defined according four complementary activities that will be implemented until 31st December 2015. These activities are:

Act. 1 **–** Sea Traffic Management Operations and Tools

Act. 2 **–** Sea Traffic Management Definition Phase Study

Act. 3 **–** Safer Ships

Act. 4 **–** Operational Safety

3.1 Sea traffic management operations and tools

The aim of this activity is to verify and further develop operational and technical aspects that support the Sea Traffic Management concept of ship monitoring and coordination through, for example, route exchange between ships and shore centers, dynamic separation schemes and time slot allocation in congested waters.

This will be achieved through establishing a virtual Sea Traffic Coordination Centre (STCC) and engaging several European maritime simulator facilities that will be interconnected in macro simulations using a large number of simulated ships. Simulating an entire traffic environment in selected test areas makes it possible to study the effects on navigational behavior, safety and efficiency, thereby identifying needs for further development before the STM concept becomes operational.

The concept will take a considerable leap forward towards deployment, as many of the manufacturers of navigational equipment have joined forces in MONALISA 2.0 in order to develop a route exchange format and architecture that allows route/voyage plan files to be seamlessly exchanged irrespective of the equipment brand.

A major share of maritime manufacturers is participating in the technical advisory group. Standard Operating Procedures will be further developed in order to foster safe and efficient deployment.

There are several Decision Support Tools available for route exchange and route optimization. In an effort to enhance concept efficiency, a number of Decision Support Tools will be integrated into the system. A dynamic Maritime Spatial Planning tool will be integrated.

Different Applications and Services for STM will be tested and commercially validated and a Formal Safety Assessment (FSA) will be conducted. Also comprehensive conceptual tests and demonstration of STM from a navigational viewpoint will be carried out.

3.2 Sea traffic management definition phase study[6]

Development towards increased safety, sustainable environment, and higher profits within shipping cannot be enabled without Sea Traffic Management (STM). Reaching full effects of STM requires engagement from all actors operating within the maritime domain. Important enablers are increased degree of connectivity, increased possibilities of digital collaboration, seamless interoperability between systems, and highly distributed coordination

[6] Mikael Lind (facilitator), Viktoria Swedish ICT, et al: MARSEC-XL, Chalmers University of Technology, Swedish Maritime Administration; Sea Traffic Management in MONALISA 2.0. 2014-02-28

(i.e. each actor taking responsibility for his/her own actions) in sea transportation. This concept represents an opportunity to move away from a traditional approach to Sea Traffic Management (the final goal for STM is to be self-sequential without central governance. Sea Traffic Management (2.0) will involve and engage multiple actors on multiple levels and will require new procedures for information sharing in a distributed manner within each engaged actor's action scope.

Various operational (acting) units, i.e. key actors, are engaged in sea transportation, where all operations highly influence the performance of the eco-system as a whole. Each operational unit is to be seen as a "point of interest" collecting several actors acting on behalf of this "point of interest". Examples of "point of interests" related to sea traffic management are ships, ports, authorities and ship-owners. These points of interests involve numerous actors that provide and utilize information to perform their tasks. Optimally each operational unit manages information sharing between different actors by collecting information from information providers (through their sources) and enabling information utilizers to access the information for its operations supported by an information hub. This means that e.g. ships would collect all relevant information from different sources on-board (e.g. the engine, the bridge etc.), refine that, and distribute it to different utilizers on-board the ship as well as to other operational units. The same applies to the other "points of interest" gathering numerous actors, where the collaborative ability including information sharing is one essential key success factor. Ecosystems where the performance relies on integrated performance of different organizational units requires that information is exchanged between these units efficiently and seamlessly.

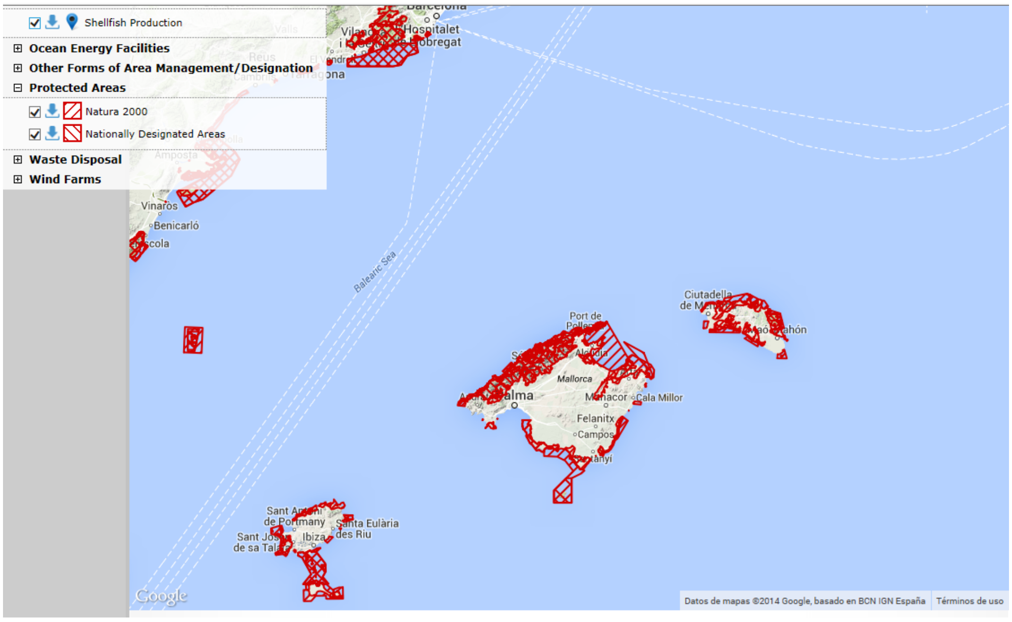

Figure 4: Marine protected areas showed by the maritime affairs atlas. EU Commission, updated to 2012. http://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/#lang=EN;p=w;pos=2.509:40.122:8;bkgd=5:1;gra=0;mode=1;theme=2:0.75:1:1,78:1:1:0,85:1:1:0,43:1:1:0,88:1:1:1,89:1:1:1,80:1:1:0,16:0.8:1:1;time=2012
Source: European Maritime Atlas

Sea Traffic Management (STM) is a concept encompassing all actors, actions, and systems (infrastructure) assisting maritime transport from port to port. STM is a part of the multimodal logistics chain, encompassing sea as well as shore based operations. STM is a network-based approach for optimal Intermodal Sea Transport. STM is performed on multiple actor levels, where each engaged actor co-produces traffic management.

3.3 Delimitation of STM area in the Mediterranean Sea. UPC responsibility

For the Monalisa 2.0 purposes, Technical University of Catalonia is focused on the Spanish part of the Balearic Sea. The boundaries are shown on the map in the following point and the coordinates pointed out.

The area to be covered by the UPC in the Mediterranean Sea, is the one covering the approaches to Barcelona Port approaches together with the Balearic Archipelago including the area of connection between both of them.

The criterion used has been in a first instance to cover Balearic Islands due to the number of protected area not only from the government side but also from Natura 2000 network. In this way, we attach an image of the mentioned protected areas around the Balearic Islands coasts.

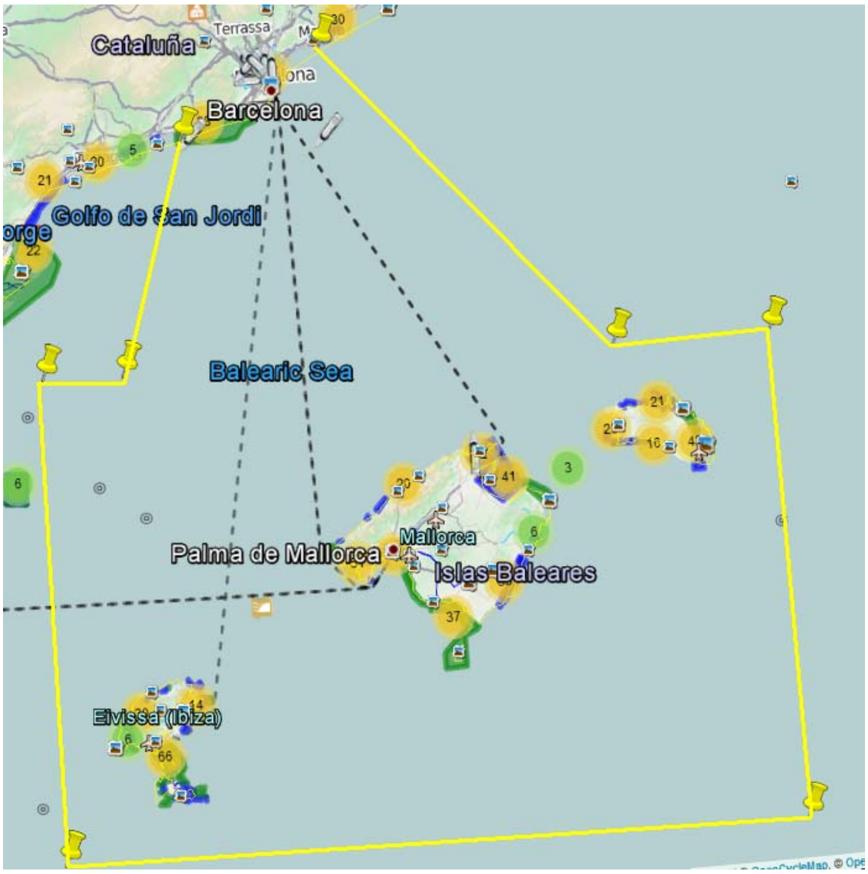

Figure 5: Picture taken from Google Earth, where the suggested area is signalled.
Source: Own over Google Earth layer

The data related to **Natura 2000** areas and **nationally designated areas** were collected through the European Marine Observation ad Data Network (EMODnet) portal – Human Activities - link: http://www.emodnet.eu/human-activities.

The area selected is the one covered by the following eight points:

1) l: 40,3ºN & L: 000,917ºE
2) l: 40,3ºN & L: 001,33ºE

3) l: 41,2ºN & L: 001,68ºE
4) l: 41,53ºN & L: 002,42ºE
5) l: 40,3ºN & L: 003,83ºE
6) l: 38,4ºN & L: 000,9ºE
7) l: 40,3ºN & L 004,65ºE
8) l 38,4ºN & L 004,65ºE

This distribution covers the area usually used for ships going from Barcelona port to different Balearic Islands ports, affording to divert the usual routes to maintain them apart from the natural protected areas.

3.4 Methodology for planning Green Routes

Maritime transport is, after road transport, the most important mode of transportation within the European transport system, being responsible for 36.8% of the intra-European transport in 2011.

In the last decades, based on a presumed environmentally friendly performance, intra-European maritime services, also known as SSS services, have been favoured by numerous supporting actions coming from both national governments and the European Union (EU): Marco Polo and Trans European Network of Transport (TEN-T) programmes the most relevant. However when comparing SSS with rail and road transport, its main competitors, several doubts arise with regards to its greener performance.

There is no doubt about maritime transport being the most energy efficient transport mode and therefore it is on average the transport alternative with lower CO2 emissions per transport work unit . But that doesn´t mean it is the greenest alternative in terms of air pollutants (NOx, VOCs, PM2.5, SO2, NH3) emissions, which are not solely dependent on fuel consumption. Aspects such as engine technologies, types of fuel, emissions abatement technologies, emission standards, logistical factors and sensitivity of concerned areas make all the difference in favour or against each mean of transportation.

The further development of the paper will bring some light to SSS´s environmental performance assessment in comparison with that of road transport and to lay foundations for future intervening actions. Therefore a computer model is built up characterizing the two transport chains under investigation. The model considers both local and rural externalities from direct emissions of air pollutants (NOx, VOCs, PM2.5, SO2, NH3) and the global impact of CO2 emissions. Only road transport and SSS are considered, as currently rail transport is not an actual alternative Europe-wise due to interoperability issues between countries.

There are a few reports (Fet A. M. et al. 2000 ; Essen H. et al. 2003 ; Boer E. et al. 2008 ; Delhaye E. et al. 2010 ; Boer E. et al. 2011 ; Hjelle H. M. et al. 2012), but not generalized simulation models, comparing SSS's environmental performance in comparison with other means of transport. The developed model presents several strengths and opportunities when comparing it with the aforementioned reports. In the following paragraphs these are highlighted.

A distinctive characteristic of the model is that the environmental performance is measured using the externalities produced by air pollutant and greenhouse gas (GHG) emissions, instead of by the amount of produced emissions. This is a significant issue as emission impacts depend on the sensitivity of the emission site and therefore same amounts of emissions do not necessarily present same impacts.

In this respect, the model is designed following a bottom up approach enabling spatially disaggregated emission inventories, which in the end allow geographically characterized impact valuations.

Moreover the ample range of logistical factors considered by the model, allow reproducing not only two transport chains but transport chains using different intermodal transport units (ITU): semi-trailers, car carrier trailers, TEUs and FEUs. This enables a more realistic reproduction of actual transport chains and to assess the impact of the use of different ITUs in the overall environmental performance of a transport chain.

The SSS fleet is not as homogenous as the European truck fleet. Depending on the type of main engine (ME), type of auxiliary engine (AE), engine power and engine load factor emission factors can differ substantially. Therefore it is critical a proper ship fleet characterization to obtain realistic results. Moreover not all ship types compete with road transport and hence only certain ship types are considered (Container, RoRo, RoPax, Car Carrier and ConRo ships). The developed model takes care of these aspects using a tailor made ship database. A review of this database allowed the identification of representative ships for each of the considered ship types. This fleet characterization process ended up with five different ship types divided into 8 subgroups representing the ship fleet engaged in SSS services in Europe.

On the other hand, sixteen different scenarios are considered for the simulation of the combined transport chain, road plus SSS, and four scenarios for unimodal transport chains, road only. These scenarios enable the user to assess the performance of transport chains using SSS and compare them with road transport not only in current scenarios but until 2020. As a result it is possible to assess, at an strategic level, the efficiency of scheduled policies for the prevention of air pollution from ships well in advance and in detail; permitting to take corrective measures if necessary. Even though in this first version the model contains a set of already scheduled scenarios, in case of having the necessary input data it also allows testing the efficiency of future policy measures before being adopted.

Finally, such a generalised model it also enables to carry out a sensitivity analysis of the modelled system if provided with a simple algorithm changing input data and saving results for each of the considered alternatives. In short a sensitivity analysis carried out using the model presents the following advantages when compared with individual reports:

- Increased understanding of the environmental performance of transport chains, by the identification of dominant input variables and relationships between input and output data;
- More credible, understandable, compelling or persuasive recommendations;
- Future model development and improvement, forcing the identification of errors or shortcomings.

4 CONCLUSION

This paper is showing the structure of MOANLISA 2.0 project, close to its ending. The main concept of the project is the Sea Traffic Management that now is being developed further in the continuation project called STM.

The participation of UPC was focused in the training activity but also in the Sea Traffic Management Operations and Tools definition. Specifically with the participation in the Mediterranean Sea, and in the Balearic Islands area due to its especially environmental sensitivity.

The different ferry lines, crossing that area several times per day, has been analyzed and some suggestion of changing in the approaching speed have been done.

Further development has been done in this sense whose results will be presented during the final conference for closing the project this next month of November 2015.

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