

Sea Traffic Management - A Concept Creating the Need for New Maritime Information Standards and Software Solutions

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Abstract

This paper describes the concept Sea Traffic Management (STM). STM is information sharing in the whole maritime transport chain. We describe how STM will lead to safer transports, saving fuel and cost, while improving the environment simultaneously. We will present the first steps already achieved and the key enabling concepts and technologies.

1. Introduction

With today's navigational tools, every vessel know their own position and intentions. Other tools help finding out the positions of vessels in the vicinity. A technology standard developed lately is the AIS, which primarily was developed in order to see oncoming vessels "around the corner", which were undetected by radar. The AIS information has led to the development of new services, not foreseen while the concept was created.

There is however one piece of the puzzle still missing in order for the bridge to have a complete situational awareness; the intentions of oncoming vessels are unknown. The embryo of STM was the idea that we should know these intentions. Most ships have electronic charts where their route is entered. If this information was shared with all ships nearby, everybody would suddenly know all intentions instead of making assumptions. The design of the updated navigational knowledge in the charts is really important in order to assist the bridge officers instead of complicating the picture. The principle of communication and information sharing is thus a basis for improving the safety at sea.

Well if this information is shared between ships it could be shared with shore as well. And the possibilities to add service from the shore side were investigated in the MONALISA project. By sharing route information with shore centres giving advices to the vessels based on local knowledge, vessels can realize huge savings in distance, time and fuel. Seasonal Environmentally Sensitive Areas can be avoided or not and thus the protection of marine wild life is improved. SAR operations can be made more efficient when search patterns in the form of suggested routes can be distributed. The route exchange was demonstrated in the MONALISA project 2010-2013, *NN (2014)*.

What about information outside the route? When discussing this concept all kinds of solutions and services were envisioned. For example the interface to the ports and enabling ports to plan more efficiently, and have that planning reflect in route suggestions to the approaching vessels or to have common goods information within the whole maritime logistics chain. And these are just speculations before the information has been made available. When new technology and new concepts arrive, there will be innovative people and companies building new and useful services that we cannot envision today.

The purpose of this paper is to describe the building blocks of the Sea Traffic Management concept and its generative properties to enable the innovation of third-party services.

2. The Sea Traffic Management Concept

The Sea Traffic Management (STM) concept is an information and communication centred approach, The concept aims at enabling the many players in the maritime arena to perform operations optimally, both for their own purpose but also for the sea traffic system as such. Sea Traffic Management is an

decentralised structure of governance where each actor makes his/her own decisions based on the situation awareness that the actor have. To share information becomes thereby an enabler to get something back. This is to be enabled by the SWIM concept enabling different systems being used by the different actors to channelize information that is to be shared by standardised interfaces between the systems. In the decentralised structure we also foresee modifications to most software involved in the transport chain, when new information streams will affect planning at all levels. We believe that the data in the SWIM, in the Cloud, can form a base for research based on Big Data, and a source for many new services.

The STM concepts matches very well the ambitions of the EU e-Maritime initiative. IMO and IALA are using e-navigation when discussing the development of the maritime sector. STM fits in with the Strategic Implementation Plan of IMO and the IALA definition. Korea is one leading nation in the area, and an open Memorandum of Understanding has been signed by Sweden, Denmark and Korea to promote international cooperation and global test beds for new solutions.

The benefits of the STM are so immediate that Australian and Alaskan authorities would like to apply the solutions even before they exist. The MONALISA 2.0-project are keeping close contact to these and many other initiatives in order to avoid double work and parallel solutions.

The efficiency for a chain of operations is never stronger than its weakest link. This means that there is a need to ensure a tight integration to different actors in a larger chain of operations than just the sea voyage. The sea voyage needs to become an integrated part of a larger multimodal chain and boundary objects (such as e.g. estimated time of arrival, estimated time of departure etc.) need to be acknowledged and utilized as a basis for enabling different actors to optimally plan upcoming operations and utilization of the common infrastructure. Ports, and shipping companies, are thus important actors to enable seamless and sustainable transports by connecting its operations to ground transporters, Fig 3. The different connection points depicted in the figure is a way to put focus upon states that are to be planned to reach by the involvement of multiple actors. Thereby fast turn-around processes (for ships and ground transporting vehicles) and efficient port operations could be addressed.

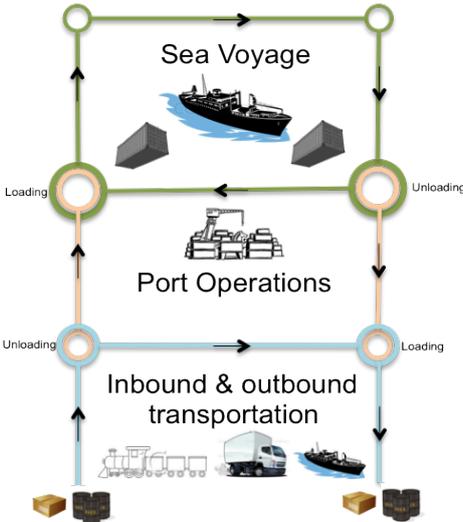


Fig. 3: The sea voyage as an integrated part of a larger transport chain, Lind (2014)

3. Benefits of Sea Traffic Management

Everyone involved in the maritime logistics chain can take advantage of more reliable information. This helps planning in advance, adjusting plans and lead to greater efficiency for every link in the chain. We have not identified any study quantifying the possible savings.

Table I: Examples of STM benefits

| Party | Benefits |
|-------------------------|--|
| Cargo Owner | Cost reduction: Lower rates Service improvement: Accurate real-time goods information to customers |
| Ship owner | Cost reduction: Fuel savings – shorter distance, slow-steaming/just in time arrivals, shorter port turnaround time Cost reduction: Lower insurance – when accident rates fall Service improvement: Accurate info to goods owners |
| Ship Operator | See Ship Owner |
| Port Authorities | Service improvement: More efficient planning. Manual communication only needed as an exception. Safety: Possibility to check pilot exemptions on line. |
| Terminals | Better planning due to common port information and goods information |
| Port services | More reliable plans, due to more accurate and up to date data. |
| Crew | Safety: Fewer accidents due to improved situational awareness Less administration: simplified procedures and automation of data collection |
| Ship brokers and agents | Improved services with up to date info. Better focus on value-add services. |
| Pilots | Better planning due to more reliable up to date information. |
| Passengers | Safety: Fewer accidents, improved SAR operations. |
| Customs | Better planning, due to earlier heads up on arrivals. |
| Coast Guard | Improved focus on suspicious vessels avoiding STM |
| Locks and Bridges | Improved Just-in time planning and passages |
| Insurance | Fewer accidents – less cost. |
| General public | Safety: Fewer accidents – possible growth of cruise industry. Lower societal cost for cleaning. Environment: More CO2 efficient transport |
| Atmosphere | Less CO2 per transported goods. (and other pollutants) |
| Marine life | Less emission! Less oil spill due to fewer accidents. Proactive route advice for Environmentally Sensitive Areas, e.g. the Great Barrier Reef. Advice regarding seasonal Environmentally Sensitive Areas, e.g. seabirds in the Baltic, whales outside L.A. |
| Other marine industry | Safety: reduced risk for accidents: less direct damages to wind farms, less oil spill disturbing farming |

However, John van Breugel, representative of Maersk Line in Rotterdam, believes that the turnaround time could be reduced by 30%, saving some energy in the port, but foremost making goods delivery more efficient. As part of the efforts in MONALISA 2.0 stakeholder specific business cases for different areas of interest (KPAs) will be developed (see Table I as the point of departure for this work).

Some of the concrete savings reduce the burning of fuel, thus lowering the cost and lowering the environmental impact simultaneously. *Andersson (2013)* show that for every 1% shorter routes for all vessels in the Baltic Sea due to dynamic route-planning, society would gain 100 million EUR per year. The gains split almost in half between reduced costs for the shipping companies and for emissions. The same study also estimates that further 60 million EUR could be saved annually by making anchoring ship slow-steam the last 4 hours before anchoring. The investments to realize this are around 20 million EUR.

How much shorter distance is realistic? A study by SSPA, *Johansson (2012)*, regarding traffic in the Kattegat analysed the AIS tracks of all large vessels during one month. SSPA then used their optimization tool on each vessel to calculate the fuel optimised route. Figs. 3 and 4 show the difference. Some of the optimal routes were not taken, mostly due to old habits. For example, the approach to the Sound from the North, the easterly passage at the bottom of the map, has an accented “elbow” in Fig. 3. instead of being a straight line, as in Fig. 4. The route with the “elbow” was the first to be cleared of mines after World War II. It was the safest route 1946, and still a majority of mariners follow it, even though there are more efficient routes.

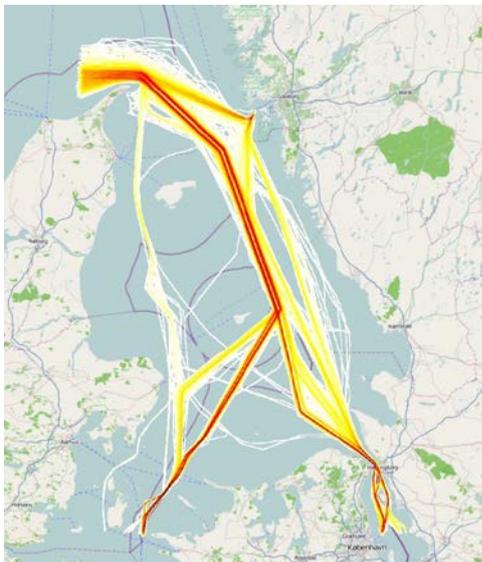


Fig 3. Actual AIS traces

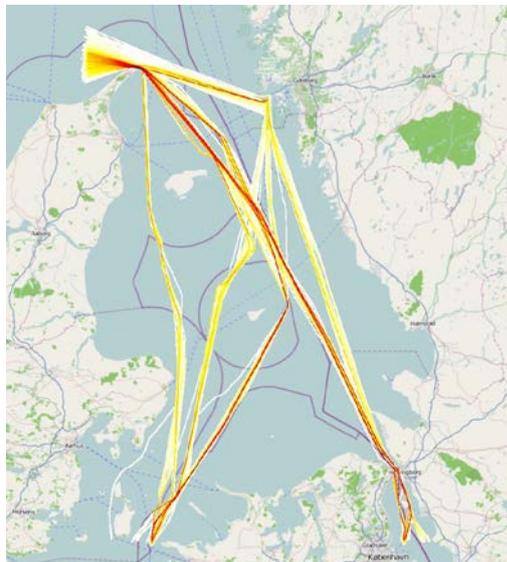


Fig. 4. Optimised routes by SSPA

The distance savings have been subject to a couple of studies, but there are more areas which would be interesting to try to quantify.

4. Dynamic Route Exchange

In order for Dynamic Route Exchange to be possible there is a need for a common format. It can be used for:

- On-board for save navigation (ECDIS etc.)
- On-board for route-, schedule- and speed optimization
- By service provider for route optimization services
- A shore for and Deep Sea Pilotage

- A shore by stake holders who have an interest in the vessels route and schedule Vetting, Ships-operator, Port Authorities among others.

The route format should be open and aligned with International Standard. It should allow easy customization so that project goals can be achieved as well as easy and safe exchange of routes between ship and shore.

In the Sea Traffic Management concept where dynamic routing is supposed to be used and supported, more information related to the route needs to be shared compare to what traditional is included in a route plan used in electronic systems on-board vessels and ashore. This information can be divided in four groups:

- General Route Information and vessel static data
- Route geometry and waypoint data
- Schedule and environmental data
- STM Information – Voyage Information

Today there is no international standard available for Route exchange format. What exist is low level information i.e. Way Point data used for peer to peer communication between different systems on the vessel but those formats will not cover the needs in this project.

The industry of navigational equipment is supporting the new standard format. A large majority of the industry is part of a Technical Advisory Group which has ratified the suggested format being developed under the lead of Transas. A united industry will help in taking usable solutions to users on board and a shore within a short time span.

The timing of the work on the route format in the MONALISA 2.0-project, matched the IEC work on the standards for maritime navigation. The format is now a suggested to be included in the next version of the standard; IEC 61174 ed4 Route exchange format general description. *Rydlinger (2013)*

The IEC prepares suggestion for new IMO standards. In parallel the route format has also been presented in a paper to IHO as an input to the S-100 format, *Olsen et al. (2014)*.

5. Conclusion

This paper has described the concept Sea Traffic Management (STM). Sea Traffic Management is the sharing of information to all relevant parties in the whole maritime logistics chain.

The initial approach, Dynamic Route Exchange, was conceived in order to increase the situational awareness on the bridge and thus further improve safety. This approach turned out to be a fertile ground for the bigger STM concept acknowledging the sea voyage as part of the larger multi-modal chain.

We have shown the work on including Route Exchange information in the IMO and IHO standards, and the benefits that would bring.

We believe this is the first brick in building the holistic standard for the whole maritime transport chain. A new key contributor introduced in the standard is the unique identifier voyage number. Inspiration comes from the air industry where flight numbers + date make up a unique identifier that can be used for short and long term planning as well as for operational purposes. Since there will be so much more information waiting to be transferred, there will also be a need for more standards to be developed. Possibly these new standards will be more de facto standards since some of them are affecting

players belonging to different standardisation spheres: ships, ports, other logistic players. These standards are to be used in the different concepts being proposed within STM and enabled by the SWIM concept. These concepts are:

- Flow Management for enabling efficient utilization of the infrastructure
- Strategic voyage management
- Tactical route management
- Port CDM (Collaborative Decision Making) for enabling relevant content to be shared and agreed upon

We expect the transfer of STM information to happen in a System Wide Information Environment, which some believe will be realised in 'the maritime cloud'.

By introducing STM, the processes in the transport chain will be transformed. Some parties may disappear, and new functions may emerge. All this change needs to be supported by new and/or modified software and IT infrastructure.

Why will STM happen and change the industry? The benefits for all involved parties in the maritime logistics chain are huge. The improved services for the customers will strengthen the maritime transport alternative and the environment is improved by less emission, fewer accidents and avoidance of Environmentally Sensitive Areas. The ship owners, goods operators, politicians, and the public in form of environmental opinion and passengers will all benefit, and thus the industry has all the motivation to make it come true.

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