THE PURPOSE OF VTS

EFFICIENCY, SAFETY AND ENVIRONMENTAL PROTECTION

SWEDISH MARITIME ADMINISTRATION

Anders Johannesson, VTS Training, Senior Advisor, Research and Innovation, Swedish Maritime Association, Sweden; Katie Aylward, PhD student, Maritime Human Factors Unit at Chalmers University, Gothenburg, Sweden

READ MORE ABOUT SWEDEN'S MARITIME INDUSTRY

After World War II, the rebuilding of Europe led to rapid developments in shipping. There were increasing industrial demands for raw materials and pressure on the supply chains to be more efficient and reliable. In navigation, one of the most difficult obstacles to overcome is fog. Traditionally, navigation in and out of ports was suspended in heavy fog conditions and vessels had to anchor nearby until visibility improved. This often led to congested logistic chains. Experts decided the most reasonable solution was radar.

However, the cost of radar was a major issue for shipping companies. Therefore, it was decided to place the burden on the shore side. The ports provided their pilots with radar stations that could be used to pilot all vessels calling at the particular port. This concept was successfully tested with one pilot aboard the vessel and one ashore giving directions using radar. This resulted in the first goal of VTS being fulfilled: Efficiency.

With the shore-based radar system in place, concerns were raised about safety. Did navigating under radar surveillance in adverse conditions cause more accidents than before? On the contrary, the vessel traffic was clearly increasing, yet the rate of accidents diminished. The second goal of VTS- Safety- seemed to be fulfilled.

During post-war decades, the demand for oil rapidly grew and the world witnessed disastrous tanker accidents. Again, the nautical expertise turned to shore-based radar, which meant a vessel going astray could be detected and warned before it grounded or collided. The third goal - Environmental Protection – was also being achieved.

There are many milestones in VTS history. In the 1940s, the first milestone was that radar told the operator that something was coming, and if this something was either coming the right way or the wrong way. The next milestone was AIS (Automatic Identification System) in the 1990s, which told the VTS Operator who was coming. The third milestone, currently being implemented, is STM (Sea Traffic Management) which indicates the intentions of the incoming vessel. This article is about STM, the third milestone, and the possibilities and potential impact this will have within the VTS.

A PROACTIVE VTS

As previously described, the key goals of VTS are Efficiency, Safety and Environmental Protection. Most VTS personnel including; operators, supervisors, and managers, agree that these goals cannot be achieved without a proactive approach from the VTS. Possible incidents or accidents must be predicted and prevented (i.e. a warning or alert must be issued to a vessel in danger). The core working procedure for VTS operators can be summarized by the following points:

- The VTS Operator discovers a potentially dangerous situation, or a vessel acting in an unusual way (e.g. a vessel navigating in the wrong side (port side) of the channel). Depending on the

surrounding traffic, this might be a risky situation.

- The VTS Operator will then (usually by VHF radio) call the vessel to alert it about the situation and provide assistance out of the troublesome situation. Depending on the severity of the scenario, simple advice to keep to the starboard side of the channel might be enough.
- After providing advice to the vessel about how to avoid the danger, the VTS Operator will ensure that the suggested solution is carried out and provide further advice and instructions if deemed necessary.

Naturally, the faster, clearer, and more accurate the action of the VTS Operator, the higher the probability that the potential accident will be avoided. Prior to STM, the VTS Software System to discover dangerous situations used 'dead reckoning' and assumed that vessels would retain course and speed, thus calculating upcoming positions. This requires a significant level of human involvement, which has advantages and disadvantages. There is a clear need for proactive work from the VTS. There must be enough time to alert and inform the vessel, and its´ crew must have time to react, respond and take proper action. In general, if you have a sensible plan you are likely to have a good outcome. If you share your plan with experienced, objective and trustworthy people who can provide feedback, success is more likely. Then, if you share your plans with all other involved parties, the risk of misunderstandings is minimized. The STM technology and infrastructure enhances these proactive features.

STM FUNCTIONALITY

The STM concept is based on information sharing and interoperability between various software systems. The primary information to be shared is the vessels voyage plan. Sharing this information with all actors could lead to a common situation overview and help promote proactive work. However, STM offers many more

Ship to shore route exchange	There are two situations when this feature can be used: in the planning phase of the vessel´s voyage to show the VTS its intentions or
Route cross check	sending the route that they are monitoring during the voyage. In both cases the vessel submits its plan which shows its intentions to the VTS.
Chat	The VTS can review a route received from a vessel.
Sending routes shore to ship	Similar to Skype, but it is carried out by the means of ECDIS or a VTS software system.
Route based prediction tool	The VTS Operator can either edit the vessel´s route, make a new route or retrieve a route from a database and send it to the vessel. The route will automatically be presented as a suggestion on their ECDIS.
Enhanced monitoring	The VTS can use this feature to predict congestions and hazards. These calculations are based on the submitted voyage plans rather than dead reckoning.
Sending S-124 areas	If the vessel deviates from the monitored route, the VTS Operator is alerted by the VTS system.
	THE VTS OPERATOR CAN SEND AN AREA THAT WILL BE DISPLAYED ON THE VESSEL´S ECDIS. THE INFORMATION COULD INCLUDE RESTRICTED AREAS, SEARCH AND RESCUE OPERATIONS, ETC.

possibilities for information sharing. Listed below are the features developed within STM which can enhance efficiency, safety and environmental protection.

SIMULATOR TESTS, THE EUROPEAN MARITIME SIMULATORS NETWORK (EMSN)

In general, testing new technology in a controlled and safe environment is preferred. In Europe, navigation bridge simulators are usually hosted by educational centers including merchant marine academies, research institutes, national maritime administrations etc. for training, research, and education. The European Maritime Simulator Network (EMSN) was developed, which consists of twelve simulator centers and has the capacity to host 30 manned bridges in the same simulator scenario, interacting with each other and with the VTS. Simulator scenarios were developed by subject matter experts, one with dense maritime traffic, and another with less traffic to assess the utility of the services in various traffic conditions. A VTS shore center was also established in the simulation set-up to function as a typical VTS center throughout the simulations.

Four weeks of simulation trials within the EMSN were conducted in the fall of 2018 and spring of 2019. The first two weeks were baseline tests in which no STM Technology was used (navigation as it is today). The last two weeks followed the exact same experimental design but instead used STM technology. The baseline and STM simulations were compared with each other.

The VTS Operators manning the VTS station were experienced but had no experience working in these particular VTS areas of the simulator scenarios. The data from the VTS was captured using two methods: observations of all interactions between the vessels and VTS (i.e. which STM services were used), and post-test questionnaires given to the VTS operators to obtain feedback related to the STM services. Results from the simulations showed interesting patterns in both the work flow of the VTS and the use and preference of the STM features.

RESULTS FROM THE SIMULATIONS:

The ship-to-shore route exchange service was used very frequently throughout the simulations and is thought to be one of the most useful features developed within the STM project. Once the route is shared, the VTS operators can review, edit and send back a route to the vessel. This feature is helpful as the route directly sent to a vessel´s ECDIS where the bridge team can easily review the route. This is a major change from today, in which the coordinates must be verbally transmitted over the VHF radio and must be manually plotted by the bridge team. Every time a route was sent from the VTS to a vessel, the proposed route was supplemented with a chat message. Chat was appreciated according to the post-test questionnaire. However, the introduction of the chat function, along with the route sharing features, led to a significant reduction of VHF communication. It was observed that VHF communication was reduced by approximately 40 %.

The route-based prediction and enhanced monitoring tools were the least used during the simulations, as both require a deeper understanding of the VTS system and the features of the new STM technology. Further testing is needed to understand the impact of these services. The S-124 feature allows the VTS Operator to send data directly to the vessels´ ECDIS screens. This is a significant change from today in which this information must be sent by Navtex or transmitted via VHF radio. This service was greatly appreciated by the navigation teams, as it reduced the manual workload on the bridge.

CHANGE IN INTERACTIONS BETWEEN SHIP AND SHORE

The current means of communication in shipping, VHF radio, is public, which means anyone can overhear the conversation between ships and the VTS or ship-to-ship. It is compulsory to continuously monitor the VTS working channel. This practice brings domain and situational awareness to all actors within the VTS area. Should a vessel enter the area, leave berth or drop their anchor they will communicate this to the VTS which will update on the traffic situation. However, the value of overhearing is disputed. In some ports the amount of VHF traffic makes it impossible to filter out the irrelevant information.

Based on the results from the simulations, the introduction of new communication/information sharing technologies will change the usage of VHF radio. In both baseline and STM trials the frequency and details of interactions between vessels and VTS were recorded. The results showed that the number of interactions increased in both traffic scenarios and approximately twice as many interactions were recorded during the STM trials. The interactions initiated by the VTS also approximately doubled, when the STM tools were introduced. Further studies and investigations are needed to assess how and when chatting is preferred to VHF and when VHF still must be compulsory.

These results also present a question of workload. Given the possibility to review, edit and send back the Voyage Plans of the vessels, will this be manageable tasks for the VTS? Will current manning requirements at VTS stations be sufficient, or should the manning requirements be re-assessed? These are questions which must be explored in further research.

WILL EFFICIENCY, SAFETY AND PROTECTION OF THE ENVIRONMENT BE ENHANCED BY USE OF THE STM TOOLS?

Although it is impossible to draw major conclusions from controlled simulation exercises, some preliminary observations can be made. The STM services promote a more pro-active and transparent approach to VTS work and foster more collaboration between ship and shore. The ability to make a plan and share it with others is an exciting aspect of STM, and if properly implemented has the opportunity to enhance efficiency, safety, and environmental protection. More research on work practices and procedures within the VTS, the effects of automation, cybersecurity, and other areas are needed to understand the full impact of the STM services within all aspects of the complex socio-technical system of shipping.

ABOUT THE AUTHOR

Anders Johannesson has 22 years in service at the Swedish Maritime Administration as VTS Operator and VTS Training Officer (responsible for national Swedish VTS training.) Since two years he is working as Senior Advisor at SMA´s Research and Innovation department.

Katie Aylward is a PhD student in the Maritime Human Factors Unit at Chalmers University in Gothenburg, Sweden. Her research focuses on the user experience of new technology implementation in both ship and shore-based applications. Prior to Chalmers, Katie worked as a Human Factors Specialist at the American Bureau of Shipping (ABS) in Houston, Texas.

ABOUT THE ORGANIZATION

The Swedish Maritime Administration (SMA) offers modern and safe shipping routes with 24 hour service. We take responsibility for the future of shipping. SMA is a governmental agency and enterprise within the transport sector and is responsible for maritime safety and availability.

ENQUIRIES

Contact: http://www.sjofartsverket.se/en/