Ministry of Infrastructure and Water Management

IALA

ROTTERDAM. MARITIME CAPITAL OF EUROPE.

14th IALA SYMPOSIUM REPORT

This page left intentionally blank.

EXECUTIVE SUMMARY

The 14th International VTS Symposium – 'Enhanced Maritime Safety and Efficiency by Connectivity' was held from 12 – 16 April 2021 in Rotterdam, The Netherlands. The Symposium was attended by 230 delegates. The delegates represented 37 countries, of which 33 were IALA National members. The associated exhibition attracted 12 Industrial members, displaying the latest developments in VTS and e-Navigation. A series of 34 presentations were given under 12 broad headings and resulted in the following:

Highlights

1 VTS will be essential for digital information exchange and therefore central to the successful digital transformation within the maritime world.

2 Maritime connectivity is paramount for progressing e-Navigation. It is time to settle on the standards for the first generation of a worldwide connectivity and data communication solutions so industry can move forward with innovative solutions.

3 VDES R-Mode can act as terrestrial backup for GNSS by using time synchronised ranging information. VDES also provides improved communication capabilities.

4 Advanced decision support systems will assist both VTS operators' and navigators' situational awareness, facilitate risk assessment and improve the safety and efficiency of navigation.

5 The provision of S-100 digital maritime services is a key enabler for e-navigation. Global harmonization of standards is required for a successful implementation of the ambitious digital maritime agenda.

6 Successful VTS training is a crucial factor for delivering VTS in a professional and harmonized way. New skill sets for VTS personnel to meet changing demands will be essential and should be taken into account by relevant authorities.

7 VTS will be fundamental in implementing harmonized digital data to prepare for management of mixed traffic areas with both conventional and autonomous vessels.

8 Autonomous systems, driven by a business case with defined user needs and requirements, are becoming operational and stakeholders need to be prepared. Standardisation, harmonization and definition of responsibilities is required to guide current and future activities.

Table of Contents

14TH IALA symposium

Enhanced Maritime Safety and Efficiency by Connectivity

1. INTRODUCTION

The 14th International VTS Symposium – 'Enhanced Maritime Safety and Efficiency by Connectivity' was held from 12 – 16 April 2021 in Rotterdam, The Netherlands. The Symposium was attended by 230 delegates. The delegates represented 37 countries, of which 33 were IALA National members. The associated exhibition attracted 12 Industrial members, displaying the latest developments in VTS and e-Navigation. A series of 34 presentations were given under 12 broad headings:

- Opportunities in a Digital World
- Developing VTS
- Managing risk
- Anomaly detection and decision support
- Embracing ENAV
- Connectivity and resilient PNT
- Digital communication
- Navigation safety
- Transport chain efficiency
- Safety and security in a connected world
- VTS training and certification
- MASS challenges

A list of participants can be found in annex A.

1.1. OPENING OF THE SYMPOSIUM

Pauline de Wilde, the Symposium Moderator, opened the proceedings. She was accompanied by Brigit Gijsbers, IALA Councillor for the Netherlands and Director for Maritime Affairs at the Ministry of Infrastructure and the Environment. She commented that the programme with 35 presentations promised to be very rich and exciting.

2. WELCOME ADDRESS

Facilitated by Pauline de Wilde, Symposium Moderator.

2.1. Welcome by Cora van Neuwenhuizen, Minister of Infrastructure and Water Management

The Minister started her welcome address by expressing her regrets that the Symposium could not be held physically due to the pandemic. She reminded the audience of the importance of safety in maritime shipping. As the volume of shipping is growing and getting busier, there is a need to develop technology and improve safety. The development of Maritime Autonomous Surface Shipping (MASS) for example is an important step. Technology changes the maritime sector. She was proud that the Netherlands, a nation of seafarers was hosting this major event. She wished for a successful Symposium for participants from all over the world.

2.2. Welcome address from Arjan van Gils Vice Mayor for Finance, Organization, Port and Large Projects

The Vice-Mayor also expressed his regrets that the Symposium could not be hosted physically in the beautiful city of Rotterdam as planned but he emphasized how important this type of event is for developing and sharing experience and expertise. He also underlined the necessity for developing standards which can be used world-wide for the harmonization of aids to navigation and so governments and manufacturers can work towards common objectives. He saluted the great cooperation between countries which have agreed to work on the topic of MASS.

2.3. Francis Zachariae – Secretary-General of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)

Mr Zachariae stated that it was a pleasure to welcome everyone to this 14th Symposium on Vessel Traffic Services and e-Navigation in Rotterdam, the largest port and maritime hub in Europe.

As a maritime nation The Netherlands has gained knowledge and experience in shipping transport logistics, port development, mariners' skills and the advancement of safety of navigation over many centuries. Furthermore, as a vulnerable coastal State bordering one of the most extensively used sea areas in the world, the country is a world leader in marine spatial planning for the benefit of protection of the environment and the harmonious and expeditious conduct of multiple activities at sea. These are all aspects that combine VTS and e-Navigation. They are closely connected and in IALA we consider VTS as the front office of e-Navigation in many aspects.

The Netherlands can be truly proud of its efforts to host this Symposium at such a high standard of pre-planning, organizational logistics and especially flexibility in this very challenging situation. He said on behalf of himself and the IALA Secretariat, that he was truly grateful to the Ministry of Infrastructure and Water Management for the excellent and generous support with regard to the wide array of practical matters involved in organizing an international event of this size during a pandemic.

He specifically mentioned the hard work done by Mr. Maarten Berrevoets and his team, with strong support from the IALA Council member and Director for Maritime Affairs, Deputy Director-General Brigit Gijbers.

He also thanked the Steering Group and especially the Chairs of the VTS and ENAV Committee Ms. Monica Sundklev and Cmdr. Hideki Noguchi for their support and hard work.

Mr Zachariae said that IALA took the difficult decision to postpone the Symposium for one year to be sure that it could be a physical one and that we could all meet face-to-face here in Rotterdam. But, one year later, – we are still all living with the restrictions of the pandemic. For IALA this has been a challenge. Each of the four IALA Committees have met remotely once again, during March and April, in accordance with established procedures. These innovative working arrangements have proved remarkably effective and more than 550 attendees from 35 countries and sister organizations have logged on to our virtual platform.

This success was a great tribute to the flexibility of the IALA membership, and he thanked everyone for their tremendous efforts and work in the well-known spirit of IALA. This spirit would also ensure the success of this first ever virtual Symposium. He was pleased that the popular Industrial exhibition was taking place virtually and thanked all the exhibitors and Industrial members for their support and splendid efforts to bring such a good show to Rotterdam. He encouraged everybody to take full advantage of the opportunity to visit the exhibition on their screens and see first-hand what world leaders in research and technology development and manufacturers of equipment have achieved in the VTS end ENAV arena.

He said that the Symposium's chosen theme of "Enhanced Maritime Safety and Efficiency by Connectivity" appropriately addresses the importance of maritime digital transformation for the future efficiency and safety of navigation and that this was indeed reflected in the decision to hold a combined VTS-ENAV Symposium. As VTS centres draw increasingly on the capabilities of e-Navigation, this development is driving ongoing work within IALA, in close coordination with the International Maritime Organization, the International Hydrographic Organization and others, on the shore-based maritime services in the context of e-Navigation and its global and harmonized implementation.

Mr Zachariae commented that the Symposium's carefully selected technical programme focused on the increasing availability and use of new information and communication technologies and the unprecedented opportunities these technologies provide for enhanced, real-time interaction and information sharing between ships and shore-based authorities.

Together with the associated Industrial exhibition, he stated that the Symposium provides an ideal, global forum for review and discussion among peers of ongoing research and development, lessons learned from the implementation of test beds, practical technology applications and their training implications, as well as evolving Aids to Navigation and VTS developments in different parts of the world.

The benefits of so many different interest groups in an international context and with a cooperative spirit is all the more significant if we consider that promoting vessel traffic services (VTSs) serves our common interest and common goal of streamlining standards and harmonizing practices. This can only be good for the principal users of VTSs, the mariners, as represented by the multi-national and multi-cultural crews working in the service of ocean transportation. Seafarers need a harmonized approach to VTS standards and practices and increasingly also of e-Navigation.

He wished everyone a fruitful, successful and enjoyable Symposium.

2.4. Key Note Speech: Mathias Jonas, Secretary-General, International Hydrogrpahic Organization

Mathias Jonas, Secretary-General of the International Hydrographic Organization Mr. Jonas stated that IMO's official definition of e-Navigation clearly defines two partnered areas. The harmonized collection, integration, exchange, presentation and analysis of marine information both onboard and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and the protection of the marine environment.

The Symposium is a good example that e-Navigation is more and more reality in shipping.

Mr. Jonas sees more and more regional testbeds. In a way this is a good first step. But it is time for global solutions.

In the world of the Hydrographics autonomous vessels are very common. They are being used for analyzing seabed assets, to provide accumulate and detailed information, for seabed search, salvage and sub-sea security and for detailed survey and mapping of the sea-floor. It provides efficient operations in dull, dangerous and dirty areas. And it extended survey coverage, it is faster and cheaper with swam survey.

Mr. Jonas got 5 thesis on the quality and the state of being connected: His first thesis is that the internet at sea will never be as stable as ashore. It remains a decentralized concept of local data replications at the vessel to give decision support. The second one is that VTS will play an emerging role in remote decision support towards a model known from aviation in congested situations. His third one is that broadband data exchange is also a gateway to manipulation of critical technical components, data security and that prevention of cyber threat casual is. The fourth one is that bridge equipment is often a collection of poorly integrated single devices delivered by different manufacturers and maintained with varying quality. His last thesis is that higher integration and consistency on onboard navigation landscape is a precondition to elevate ship and shore interaction to the next level.

Mr. Jonas has also seven ideas to act. For the IALA domain these are the adoption of best practices of existing local solutions in collaborative VTS, Vessel traffic management of global solutions, and anticipation of the update of mixed traffic situations with autonomous shipping to enable VTS for their surveillance.

In his view therefore it needed mandatory regulations for a software maintenance regime for navigation and utility equipment and strict type-approval procedures for onboard navigation-equipment.

And of course global standardization of data model and distribution formats for dispatch of marine data.

It is all about connectivity. It must be user-friendly and the mariner at sea must see the benefits. And last, but not least: a worldwide harmonization is needed.

3. THEMED SESSIONS

The themed sessions comprised of 34 presentations:

3.1. Session 1 – Opportunities in a digital world

This session was chaired by Hideki Noguchi, Japan Coast Guard who expressed his appreciation to the organizers and in particular the Netherlands government for their hospitality and support.

3.1.1. *Future VTS – Embracing opportunities in a digital world* – Neil Trainor, Australian Maritime Safety Authority (AMSA)

The presentation focused on the opportunities for VTS in a digital world including maritime services in the context of e-navigation. It examined trends that will impact on how “Future VTS” can contribute to enhancing maritime

logistics, communication and standards and the potential for changes and challenges in the role, function and operation of VTS. There was discussion about the implications of MASS from a VTS perspective including potential issues of intervention in developing unsafe situations. The presentation concluded that it was necessary for IMO instruments and an IALA generated framework for standardization to influence and inform the strategic planning required by the introduction of MASS vessels. The concluding message was to treat this topic as a change management project, to embrace the change and actively influence and manage the future outcomes.

3.1.2. *Whenever e-navigation lost its holistic edge – the challenges for international Organizations to deal with holistic concepts and a proposed way forward* – Jan-Hendrik Oltmann, German Federal Waterways and Shipping Administration (WSV)

The presentation introduced the proposal of a "hyper strategy" called a Maritime Digital Package. This solution seeks to address the issues of international harmonization of e-Navigation by means of international coordination and agreement which would define the specific contribution of international organizations to achieve truly holistic e-Navigation. The presentation referred to the original vision for e-Navigation captured in 2007 and highlighted how the detail of models and guidelines had been developed in the intervening years by the IMO, HO and IALA. The need to now stand back and view the big picture once more now knowing the detail was expressed and included recommendations for how to achieve coordination and implementation of Maritime Digital Packages.

The chair thanked the presenters and acknowledged the message that we are entering a new era for VTS. He also noted Jan-Hendrik Oltmann's look back to the history of e-navigation development and the need to regain a holistic view.

In response to a question regarding how manned and MASS vessels may interact going forward, Neil Trainor responded that there are still unknowns surrounding this but with the ongoing work of the relevant committees, there would be a better understanding of what the implications could be, even by the end of 2021.

3.2. Session 2 – Developing VTS

The session was chaired by Monica Sundklev, Swedish Transport Agency.

3.2.1. *Introduction on China's VTS management and future development* – Shengji Jin, China Maritime Safety Administration

The presentation introduced the distribution, construction and vessel traffic situation of the VTS in China, as well as the management of VTS personnel and the construction of a VTS personnel training system which has been certificated by IALA. Secondly, by analysing the roles of VTS has been playing in ensuring safety and efficiency of navigation, the presentation sums up the experience and problems in China VTS operation management. Finally, the lecture combined the development of E-NAV and puts forward the basic principles and planning vision for the future development of China VTS, with a view to sharing with VTS and related experts from all over the world.

3.2.2. *VTS of Columbia* – Juan Carlos Ospina Arias, Servicio Nacional de Aprendizaje

The presentation gave an overview of the first investigation in Colombia to determine the maritime traffic management model, characterize the infrastructure and technology of the main port areas of the country, carried out in 2015. The qualitative, descriptive method was used, benchmarking with the VTS of the ports from Hamburg and Bremen. Colombia has 14 maritime port captaincies to manage an average arrival of 33,647 motorboats per year, of which approximately 30% corresponds to international traffic.

It is concluded that the Maritime Traffic Control System in Colombia benefits from its professionalization and standardization, with the implementation of modern technologies. The National Sub-Grade School "ARC Barranquilla" is the training centre for the personnel that administers the VTS. A special model for evaluating areas and facilities designed for maritime traffic management is designed, in a City-Port context, which can serve as a reference for the construction of an IALA framework document. The study also considers a SWOT analysis to the DIMAR, as maritime authority, which aims to renew and update it. Auditing the State's investments is not only the task of DIMAR, as the executing agency, but also of all citizens and researchers interested in the professionalization and competitiveness of the country's maritime transport.

3.2.3. *Development of effective calculation formula for calculating adequate number of VTS operators* – Byung-Woo Jeong, Korea Coast Guard

The presentation examined the development of effective calculation formula for calculating an adequate number of VTS operators. In most countries providing a vessel traffic service, VTSs are operated through shifts of VTS operators 24/7. A VTS centre should have a sufficient number of VTS operators to ensure that the VTS operations can be carried out efficiently and safely under all conditions, with due regard to the safety of navigation within the VTS area. It is not possible to monitor the vessel's movement and to provide proper information just in time in case of lack of VTS operator. Also, excessive overtime will result in fatigue, difficulty in concentrating and have consequent implications for human errors. Fatigue in VTS disrupts cognitive ability and flexibility and impairs attention, decision making and overall performance. The fact remains however, it is still difficult to calculate the adequate number of VTS operator objectively and quantitatively to reduce fatigue and excessive overtime for VTS operational area.

Following the presentations discussions highlighted that:

- The challenges of the future are not just limited to technology but also involve the requirements for people working within VTS. Training remains extremely important especially in areas such as communication.
- Technologies such as satellite AIS for long range monitoring are being increasingly adopted by some countries. Sharing the data from these sensors remains integral for many reasons especially the prevention of marine incidents.

3.3. Session 3 – Managing risk

The session was chaired by Trond Ski, Norwegian Coastal Administration.

3.3.1. *Analyses of AIS data for real time risk detection in maritime traffic* – Takeharu Kato, Japan Coast Guard

The presentation gave an overview of the development of technologies to automatically detect potential risks of maritime accidents in a timely manner from shore stations. This is based on AIS data that Japan Coast Guard (JCG) has accumulated in the last 10 years relating to collision and anchor dragging.

Of the two scopes of developments, the risk identification of dragging anchor is the main focus because frequent damages are caused by typhoons in Japan, with the potential to affect the Japanese economy; an accident caused by a cargo ship's dragging anchor in October 2018, interrupted the operation of the sea-based airport for 14 days. The JCG has found that anchor dragging can be detected by the combination of vessel movement patterns, which are modelled by means of pattern recognition based on AIS data analyses. The result of the evaluation shows that the proposed method could detect the possible anchor dragging earlier than VTS operators with high accuracy.

Additionally, the JCG also found that the proposed collision prediction algorithm, which considers relative motions of two vessels, i.e., their distance, speed and direction, could produce higher accuracy compared to the conventional CPA/TCPA methods; the proposed method could reduce false alerts in current VTS system(s).

3.3.2. *Artificial intelligence to predict long term collision risk* – Jordi Daniels, Saab Technologies BV

This presentation highlighted that maritime traffic is getting ever busier and consequently the risk of collisions is constantly rising. Vessel traffic service operators play an essential role in increasing efficiency while maintaining safety. To ensure maximum safety, the operator should be assisted in times of increased traffic density. It is not a matter of whether collisions occur, but when and with what impact. Research is undertaken to predict collision risk over a larger time horizon by using machine learning algorithms, part of a larger artificial intelligence theme. Advanced ETA calculations are performed by creating routes based on historical data and plotting vessels on these routes using the Known Nearest-Neighbour-algorithm. Using the speed and course of a vessel, the predictive model is able to know where vessels will be and at what time. Collisions can be detected pre-emptively by combining the individual predictions for multiple vessels and cross-checking the data of these vessels.

3.3.3. *Risk management in XiaZhiMen channel* – Ranxuan Ke, Navigation Institute of Jimei University

The presentation focuses upon XiaZhiMen as a gateway channel that is an important access to Ningbo-Zhoushan port, whose throughput capacity has been No.1 worldwide for ten years (2009-2018). The traffic flow of this gateway channel is very complicated because there are East-West bound big vessels and North-South bound fishery ships. This paper investigates risk management of this channel, using the IALA Risk Management Toolbox. One method applied is IWRAP using AIS data, the other is PAWSA with detailed observations from experts with suggestions.

The data and report could provide VTS more support during daily work and when decision making is needed, which improve the vessel traffic service level and promote harmonious relationshisp among stakeholders. After analysis, the paper would offer potential solutions to reduce the administrative burden ashore.

3.4. Session 4 - Anomaly detection and decision support

The session was chaired by Jorge Arroyo, US Coast Guard.

3.4.1. *VTS intelligent technology* – Lina Li, School of Navigation, Jimei University

The presentation related to the application of intelligent collision avoidance technology in the context of the coastal waters of the China Sea. It presented a method based on the Personifying Intelligent Decision-making for Vessel Collision and Obstacle Avoidance (PIDVCA) system and discussed the implications for MASS and remote control vessels. The presentation demonstrated an intelligent early warning system that improves the accuracy of early warning and has the potential for application in a wide range of circumstances. Future work recommended includes construction of a control parameter database to improve the early warning accuracy.

3.4.2. *Development and trial of the concept of new generation decision support system in VTS* – Dmitry Rostophsin, Wärtisilä

The presentation demonstrated the research results in developing a new generation of active decision support systems for undesired vessel scenarios and their potential solutions. The details of the AIM system validation in real and simulated traffic conditions and geographical areas were presented. The system has the potential to address decision making issues related to the ability to monitor high traffic and large geographical areas, to reduce the number of false alarms, to reduce the time for decision making for skilled VTS operators and help where there is a lack of adequate training. The AIM system is still in development but has been subject to positive feedback from test users. It has been developed in accordance with IALA Guideline *G1110 Use of Decision Support Tools for VTS Personnel* and requires further testing with volunteer organizations.

3.4.3. *Analysis paralysis: breaking free from traditional decision making in the VTS environment* – Ernest Batty, IMIS Global Limited

The presentation addressed the potential issue of losing focus when presented with large amounts of data provided by modern digital communications. It considered three key elements of process, procedures and people and the implications for maritime organisation and authorities. It presented a gap analysis of current and future requirements to ensure a safe, efficient and pollution free operational environment. It concluded that data needs to be in a simple format so that the user does not become overwhelmed and then hesitates to make necessary decisions. It was recommended that data should not be listed in tables but in dashboards without the need for over analysis. It should also be clean and validated presented in user friendly tools and reports.

The chair noted how well the three presentations of this novel and unique session meshed together. They covered theoretical development, commercial application and the operator's implementation view of new and exciting tools for improved decision making. The chair commented how it will be interesting to see if decision support tools and the use of AI will be standardized or developed as individual supplier tools and commented on the interesting decade that lies ahead for this subject.

3.5. Session 5 - Embracing ENAV

Mahes Alimanchi (AMSA) chaired the session on Embracing ENAV. He first highlighted the IMO e-navigation implementation plan, last update on 2018, identifies five navigation solutions, three of these dealing with the efficient exchange of information between ship and shore. Maritime services were also identified, electronically and in a harmonized manner.

3.5.1. *A lay-person's description of e-Navigation* – Axel Hahn, OFFIS e.V

The presentation started with a practical and easily understandable analogy with the delivery of pizza to explain the provision of Maritime Services in the context of e-Navigation. It presented examples of Maritime services (MS) and how the technical service of each MS was technically realised such as server/client data standardization, seeking for interoperability, data retrieving, technology, different designs. It suggested that these are typically in the scope of IT teams. The Data model is the recipe involving the structure of specific types of data being the inputs for the machine processing. IHO S-100 standard is used to define data models for MS. The MS can use different sources to retrieve information for a better quality of the data provided through the MS.

3.5.2. *Advances of the Maritime Connectivity Platform* – Thomas Christensen, Maritime Connectivity Platform Consortium

The presentation promoted the use of IALA documents when establishing maritime services, including Guideline *G1128 The Specification of e-Navigation Technical Services* and the complementary Guideline *G1157 Web Service Based S-100 Data Exchange* to facilitate the exchange of information in the maritime domain. The aim is also that other organisations use also these guidelines when setting up other maritime services.

The Maritime Connectivity Platform (MCP) includes service registry for technical e-navigation services providing the user reliable information, secure exchange and identity of the source of the information. The core components of the MCP include an identity registry, a service registry and a messaging service.

The services are harmonized by the MCP consortium inspired by the world-wide-web consortium facilitating connectivity and trusted information across the maritime stakeholders. The Consortium involves 24 members with operational instances in Korea managed by the Ministry of Ocean and Fishery, Sweden and soon to be established in Finland.

3.5.3. *Canada's e-Navigation architecture and the place for VTS* – Jean-Francois Coutu, Canadian Coast Guard

The presentation examined e-Navigation architecture and VTS with a focus on technologies creating a single architecture to streamline and/or automate the processing of vessel reports, improve grounding, collision and strike avoidance, automate information exchange and enable an integrated waterway information image. The first step to understand when defining the architecture is to consider the different stakeholders being part and interacting with e-Navigation including their tools and needs. From the shore authority perspective, in order to cope with the expectations, connectivity and needs from these clients and partners, it is needed to identify the maritime services. The shore authority recognizes different types of digital communications for e-Navigation: some digital communications are general and others are dedicated to maritime.

The presentation described how the maritime services standards (based on S-100 and S-200 series) are then needed providing a harmonized and compatible format to distribute the situational awareness from shore to ships in their waters. The single window is viewed as a more collaborative component of e-Navigation providing voyage information, ship reporting and route plan; thus it is foreseen that the SW will be consolidated as the information hub and being synchronized about the route plan, ETA, reporting of the ship voyaging in the shore authority waters. Providing the SW and situational awareness, VTS can compare this information (route plan) with their own sources of data (AIS, radar…) which will help operators to manage the surveyance, monitoring and assistance of the VTS area. With this route comparison, collision risks could be avoid leveraging the decision support tools. All of these inputs could apply on the route calculation giving the most realistic and accurate shipping route optimization.

The roadmap of the Canadian e-Navigation implementation was also presented.

Following the discussion, a question was raised concerning what upcoming technology could have a big impact in e-Navigation. Satellite, low orbit constellation (LEO) providing high connectivity communication with very affordable prices and globally even at the poles was discussed and it was also considered to have possible implementation for MASS. There was also consideration if MCP is a sufficiently robust organization to deliver a global maritime communication framework. It was considered that the instances used by the MCP would never disappear even if the consortium ceased to exist. The MCP permits the development of specifications to support e-Navigation and maritime digitalization.

ENAV Committee supports the development of technologies such as VDES, Maritime Resources Names, etc with the number of experts involved in the technical Committees.

3.6. Session 6 - Connectivity and resilient PNT

The session was chaired by Michael Hoppe who presented the two components of the on-going digitalization of shipping and automatization, i.e., VDES for connectivity and navigation allowed by the increasing of the bandwidth. VDES R-mode provides terrestrial radio navigation with the potential use of the ranging information.

3.6.1. *VDES developments with a focus on R-Mode* – Jan Safar, General Lighthouse Authorities of the UK and Ireland

The presentation described development in VDES with a focus on R-Mode. The main characteristics of VDES are to safeguard AIS, provide enhanced data exchange (increasing data performances, integrity, authenticity, confidentiality, harmonized), modernising the GMDSS and effectively using the maritime mobile VHF band. VDES consists of of several subsystems such as AIS, ASM, VDE-TER (VHF range), VDE-SAT (global coverage) and the frequencies planned for VDES as agreed on the world radio communication conferences were presented. It illustrated that the VDE subsystem uses up to 6 times more bandwidth than either the ASM or AIS providing higher data rates and higher accuracy on navigation ranging. The high level scheme of the VDES digital communication system developed by IALA and ITU (supported by IMO and IEC) were also presented.

A number of documents from IALA, IMO, IEC and ITU describe the international developments and standardization of VDES. The concept of Ranging Mode (R-Mode) was explained and how this could mitigate the impact of GNSS service disruptions on maritime navigation as a GNSS back-up at least on coastal areas. The VDES architecture and broadcast types of the VDES R mode were described and the results of measurement trials in the Baltic Sea were presented. A coverage and performance modelling tool has been developed to optimise the density and location of shore based infrastructure. Finally the presentation focused on the work to be done in ITU-R including an update of ITU-R M.2092 to accommodate the R-Mode air interface and an ITU-R report on VDES R-Mode to support Radionavigation service allocation at WRC-23 or 27. Jan asked participants to provide their ITU representative with the latest updates on VDES.

Tomoya Nakajima (Japan Coast Guard) took the floor to give an overview on a demonstration experiment for the practical implementation of VDES with the main goal of evaluating VDES application in a real environment.

The area and route covered in the trials included two ships and a coastal station in Japan. A dedicated software was built with a chart and messaging functions including the attachment of files (meteorological information, MSI) and history of communications. The tests examined the number and rate of successful communications and the rate of the receiving slots for chat, chart data and images data. The tests also resulted in observation of interference by AIS waves from the ships, the need to improve the quality of the application software and a need to improve the cause identification rate for communication error.

3.6.2. *R-Mode Baltic – Testbed for safe navigation art the Baltic Sea* – Dr Stefan Gewies, German Aerospace Center

The presentation highlighted the strong dependence on GNSS as a primary source of for PNT information in the maritime environment, being the primary input to several navigation and communication systems. Unintentional and intentional interferences are highly documented. The sources of ranging signals focus on in this presentation were the MF radio beacons and the ranging signal coming from the VDES base station using the VHF signals, as noted in the previous presentation.

The presentation described the parameters and service levels of a minimum two hour duration GNSS contingency system, based on the IALA Recommendation 129. The system requirements were defined including the independence to GNSS, use of existing infrastructure, no disruption or degradation of the legacy service, unlimited user capacity and integrity warning. The MF R-Mode signal characterization was presented for the infrastructure of marine radio beacons providing DGNSS corrections in a service area of 250 km The accuracy performances during the day and during the night (with a significant degradation of the accuracy), nevertheless, for coastal navigation, are within the performances limits as depicted in R-129. Trials and testbeds are being scheduled in Southern Baltic area using 4 or 7 MF R-Mode sites and showing the following results (in line with theorical results performed during the coverage prediction study):

- Mean error 5.2 metres and 95% accuracy 12 metres (day-time)
- Mean error 30 metres and 95% accuracy 64 metres (night-time)

The architecture proposed for the retrofitting of legacy maritime radio beacons was described and some challenges and areas of potential improvement were presented. The number of ships potentially taking advantage of MF R-Mode capabilities (dependable of the signal availability), based on the IALA list of radio beacons 2019 was suggested. The R-mode Baltic team stated it would provide its project results virtually on 18 May 2021.

3.7. Session 7 - Digital communication

The session was chaired by Jin Park, KRISO

3.7.1. *Developments in maritime radio communication – Outcome of the World Radiocommunication Conference 2019* - Stefan Bober, German Federal Waterways and Shipping Administration

The availability of appropriate maritime radio communication systems is essential for the introduction of e-Navigation and the digitisation of shipping. IALA has been always involved in the development and the introduction of digital maritime radio communication systems. Prominent examples are the introduction of AIS in the 2000's and the ongoing work on VDES, where IALA is the focal point of the process. IALA publishes the Maritime Radio Communication Plan (MRCP), which provides an overview of systems in the maritime mobile radio communication service and their mode of operation.

New developments in digital radio communication systems will bring more dynamism to the application of e-Navigation solutions and new digital applications for the maritime industry. Topics on the agenda of the World Radiocommunication Conference 2019 (WRC-19) include a satellite component of the VHF Date Exchange System (VDE-SAT), Autonomous Maritime Radio Device (AMRD), Navigational Data System on HF for broadcasting maritime safety and security related information (NAVDAT), digital voice service on maritime VHF and R-Mode applications in the marine VHF band.

The paper will present the outcome of the WRC-19 and its consequences for the work at IALA and other international standardisation bodies for the development of digital maritime radio communication systems.

3.7.2. *Camera based location detection of non-AIS vessels* – Kazuhiko Nakamura, Japan Coast Guard

Abstract not available

3.7.3. *Internet AIS of e-Navigation background* – Yalei Ren and Sihui Hu, Yangshangang Maritime Safety Administration

Abstract not available

3.8. Session 8 - Navigation safety

3.8.1. *VTS and e-Navigation: Traffic organization by moving haven* – Thomas Porathe, Norwegian University of Science and Technology

In November 2018, a Norwegian warship collided with a tanker leaving birth at a West Norwegian oil terminal. The accident happened in an area surveyed by VTS. Luckily there was only material damage and no lives were spilled. However, the frigate involved became a total loss. This accident raises some interesting questions regarding VTS and whether innovations in resent e-Navigation testbeds can be used to enhance the traffic organization service (TOS) and make vessel movements in congested areas safer.

Route Exchange is a means by which voyage plans can be exchanged between ships and between ships and shore. In the recent e-Navigation projects EfficienSea, MONALISA and ACCSES route exchange was investigated and tested with end-users both at sea (in Korea) and in simulators (in Sweden and Germany). The methods allow for routes to be sent from pilots or VTS directly to a ship's ECDIS. As a result of tests in these projects the new route plan exchange format – RTZ - was published by the IEC in 2015. The format allows voyage planes to be time coordinated.

Such coordination can be done by Moving Havens which is a visualisation method used by submarines to ensure that they do not collide under water. The presentation proposed to use an adapted version of Moving Havens to organize vessel traffic in an e-Navigation context. For VTS Moving Havens can be interesting in these two cases:

1. To see ships intentions and potential future loss of separation.
2. To exercise NAS and TOS by sending time-synchronized voyage plans to ships.
3. In very busy waters a "conveyor belt" of traffic separated Moving Havens can be used where ships catch an empty slot.

For this to work the time dimension must be added to ECDIS, e.g. through a "time slider".

More details can be found on: https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2732157

3.8.2. *Smart Shipping and the impact on port authority* – Harmen Van Dorsser, Port of Rotterdam

The presentation showed technological developments in shipping giving opportunities and challenges to Port Authorities; research from an established vision to monitoring, data sharing and decision making.

3.8.3. *Technology psychology – looking at the skill set for VTS personnel in a changing maritime environment* – Jillian Carson-Jackson, The Nautical Institute

Technology is changing at a breakneck pace, but what is the impact on the person working with the technology? As the technology in VTS evolves, what about the VTS Operator? There is opportunity to share and learn about the role of technology in VTS now, and in the future through analysis of existing skill sets within a 'future mindset'.

The presentation reviewed the impact of technology on different transport modes, analysed the current and evolving role of VTS in port operations, presented possible future skill sets for VTS personnel and identified options for a transition strategy to address this human aspect of digital transformation in the maritime environment.

3.9. Session 9 - Transport chain efficiency

The session as chaired by Mr Dirk Eckhoff, Federal Waterways & Shipping Administration.

3.9.1. *The changing world of VTS – From analog binoculars to digital decisions, increasing capacity and accuracy* – Anders Johansen, Swedish Maritime Administration

The presentation considered technological advances that facilitate improved vessel monitoring and hazardous situation avoidance. The presentation examined the scope and outcomes of four research projects; two artificial intelligence, one based on the air traffic control operator experience and one concerning the sea traffic management (STM) project. A particular area of interest was the use of eye tracking and biometric sensors on VTS

operators. There was optimism of the application of this technology to effectively provide the operator with a "virtual colleague" to reduce human errors and to influence future training. Specific areas of interest from the research were what the operator looks at when a vessel interacts with the VTS and the operator's attention during the handover phase. The presentation concluded with a description of the STM Balt safe project which developed a simulator package and associated training.

3.9.2. *The PortCDM (Port Collaborative Decision Making) Concept* – Michael Bergmann, International PortCDM Council, RISE

The presentation discussed the role of digitization and how connectivity and data exchange are paramount to harmonization of standards. Caution was advised as with multiple new data streams there is the potential to make data more confusing and it can impact situational awareness. GIS visualisation was presented as a good example of the conversion of data into information. The presentation described the Maritime Connectivity Platform and how it is being used in Korea and Europe and also covered the relevant Maritime Service Portfolios (MSPs). These included VTS related MSPs 1 to 3 but also MSP4, the Local port Service. The presentation concluded with the role of the PortCDM (Port Collaborative Decision Making) concept and its role in enabling harmonization in global shipping.

3.9.3. *The progress and prospect on e-Navigation of China MSA* – Luo Ziwen, China Maritime Safety Administration

The presentation focused on the formulation by the China Maritime Safety Authority (MSA) of a detailed plan for the implementation of e-Navigation. The presentation discussed the plan framework and presented the e-Navigation project of the Yangtze River estuary as an example of the plan in practice. A route information service and an AtoN service were developed for the test bed area, resulting in an improved two way vessel routing in the restricted channel. It also discussed potential problems and solutions for the implementation of e-Navigation in China. The presentation concluded by stating how the China Maritime Safety Administration were keen to work closely with global partners to develop maritime solutions.

The chair commented that it was possible to see the puzzle of harmonization coming together and whilst there were challenges and opportunities there was the technology to adapt to operational and training needs. There was also a suggestion that it may be an opportune time to review the division of the 16 IMO Maritime Service Portfolios. There was agreement among the speakers that the use of artificial intelligence including eye tracker systems was a way of complementing, rather than replacing the operator's training and provide a useful system support tool.

3.10. Session 10 - Safety and security in a connected world

The session was chaired by Mr Neil Trainor, AMSA.

3.10.1. *"5G" for e-Navigation and VTS?* – Jan Hendrik Oltmann, Federal Waterways and Shipping Administration

The presentation discussed '5G' as the buzz word presently in telecommunications creating the impression that with its advent all communication dreams will come true. But what is the real potential of '5G' for the maritime domain, including e-navigation and VTS, when considering all relevant aspects?

'5G' is not only sophisticated and bandwidth-wise cutting edge radio communications technology – thus incurring certain inherent physical limitations; but also cloud computing – thus incurring certain IT-related constraints, such as cyber-security and data privacy considerations. Also, it is not big industry consortia's playing ground alone but also highly internationally harmonized and regulated.: At the ITU, '5G' is called IMT-2020, and there exists an elaborate international regulation and standardization framework.

This latter aspect is of particular relevance for the topic under consideration. E-navigation and VTS are both demanding and also driving international harmonization and standardization in their respective, partially overlapping domains, too.

Having thus established the capabilities and limitations of '5G' somewhat more realistically than at buzz word level, potential applications in the maritime domains of e-navigation and VTS were addressed. Fields were pointed out

where '5G' may add specific value to those domains and may thus contribute to the development of those fields in the future.

3.10.2. *A tale of 5 ships* – Todd Schuett, Sesame Solution II Project

This presentation tells the tale of five ships in the SESAME Solution II testbed, each equipped with technology developed in the project, operating in a VTS area, and using e-navigation services provided by the VTS in varying ways to achieve their objectives. While all vessels have the same e-navigation-enabled equipment, namely a Planning Station and ECDIS, some vessels will subscribe to only MSI data, others to ship reporting services, and still others will use the technology to plan all aspects of their voyage, subscribing to several e-navigation services along their route (MSI alerts, route optimization, pilot route, and others), receiving a slot for a just-in-time arrival service, and electronically report to a maritime single window as well as mandatory reporting points, such as BAREP and CALDOVREP. The presentation communicated the preliminary results of the SESAME II testbed and described in how VTS centres (and vessels) can exploit e-navigation services and technologies in different ways to achieve their safety objectives.

SESAME Solution II is an innovation project partly funded by the Research Council of Norway. Partners include Kongsberg Norcontrol, Kongsberg Maritime, Kongsberg Seatex, Navtor, the University of South East Norway, the Western Norway University of Applied Sciences, the Norwegian University of Science and Technology, SINTEF Ocean, and supported by the Norwegian Coastal Administration, the Norwegian Maritime Authority, and the Maritime and Port Authority of Singapore.

3.10.3. *Cyber security in VTS* – Martijn Ebben, Port of Rotterdam

The presentation focused on cybercrime as a growing issue in today's world and it is becoming more advanced by the day. This applies as much to systems used in the maritime community as it does for IT systems. VTS systems and vessels are more and more connected to utilize Maritime Services in the Context of e-Navigation. This causes major cyber security risks as many of these systems were never designed to be connected to external services and to the internet.

One of today's greatest risks is awareness. Users often do not realize that a ship can be hacked as well and that VTS systems are not intended to browse the internet with. On the other hand, VTS systems have always been designed for functionality, not for cyber resiliency. This has only started to change in the recent years.

The presentation discussed hat if a VTS is compromised or held ransom for bitcoins and what that could mean for the maritime safety and the continuity of the dependent logistics chains. It also highlighted which technical measures could be applied and how your users can help in preventing cyber incidents.

3.11. Session 11 - VTS training and certification

The session was chaired by Els Bogaert, Agency for Maritime and Coastal Services.

3.11.1. *Making the Grade? An overview of (experience gained in auditing) VTS training* – Jillian Carson-Jackson, The Nautical Institute

The presentation described how, in 2017, the Nautical Institute carried out a survey of its membership on the effectiveness of aids to navigation, including VTS. The results were presented at the IALA Conference in Incheon, South Korea in 2018. The results highlight significant concern regarding the standardisation of training of VTS personnel, leading to concern on the consistency of service provision. Of particular interest from the survey was that despite all the work of IALA and its member authorities, 40% of mariners claimed that they were 'not confident' in the services provided.

In Q2 of 2019 the Nautical Institute implemented an audit process to assist Competent Authorities in accrediting VTS Training Facilities and approving VTS training courses. Results of the survey were presented along with results of VTS training audits completed. The presentation included lessons learned and proposed next steps to continue to promote professional, consistent and effective VTS on a global basis.

Discussion highlighted that feedback from the VTS sector with respect to training needs, especially after the new IMO VTS Guidelines are approved, may be beneficial to ensure VTS training meets operational needs. A lot of development in VTS training policy us underway and the next two years will be an interesting time for the sector,

3.11.2. *Designing simulation exercises for recruitment of future VTS operators* – Carlos Salinas, Spanish Maritime Safety and Rescue Agency

The presentation explained the work undertaken over three years by the Spanish Maritime Safety and Rescue Agency, in its procedure for recruitment of new VTS operators using a VTS simulator in an innovative way. In previous recruitment processes it was detected that some candidates were suitable from a theoretical point of view. However, despite having a good knowledge of the legal framework, high command in English, and even having passed a psychological assessment, when facing real VTS operations some of them were unable to carry out their tasks efficiently. This was with reference to lack of specific skills such as combining auditory and visual information, being proactive or carrying out several tasks simultaneously, among others. For this reason, in the new recruitment procedure an individual assessment was included where the candidate has to deal with a simulated situation.

The session lasts approximately twenty minutes and has ten different variations. Along the session, two assessors and one psychologist analyse the behaviour of the candidate following a rubric designed for this purpose. The VTS competent authority and unions are quite satisfied with the results and to date no candidate has raised an official complaint. It is considered that this new recruitment procedure as one of the most relevant innovations in Spanish vessel traffic service.

Discussion highlighted that it was important for the IALA training standards to be continuously reviewed and kept up to date, especially with respect to ensuring that existing VTS personnel remain current and up to date in terms of their knowledge and skill. Online training and e-learning present new opportunities for training to keep VTS personnel up to date.

3.12. Session 12 – MASS challenge

The MASS Challenges session was moderated by René Hogendoorn from Saab. René started recalling the difference between the levels of autonomous vessel defined by different organisations, being the four levels from IMO and applied in the regulatory scoping exercise the prevalent one.

3.12.1. *VTS and MASS – Responsibilities and consequences* – Pia Meling, Maasterly AS

The presentation discussed the three pillars of technological requirements that they are handling in common with Kongsberg:

- Vessel capabilities: operation, manoeuvrability, navigation, mission management, environmental and equipment analysis.
- Bidirectional secure connectivity.
- Remote operation centre.

Pia provide the view of the challenges that may arise between the remote operational centre (responsible for a fleet of ships) and the VTS. Firstly, the need to work together where software failures would have larger impact and the design of these system taking into consideration the cybersecurity risks to ensure an adequate emergency response, communication and provide back-up for the remote operational centre.

The opportunities for VTS with unmanned vessels were exposed highlighting the further, more relevant function of VTS to ensure safety operations. The presentation underlined the necessity to focus on the amount of data generated between all of the stakeholders connected to the ship and shore information. Such data will become big data and requires high level of data process. The speaker recognized the effort from an EU funded project, the VesselAI initiative to accelerate the implementation of big data processing in shipping.

3.12.2. *MASS for Aids to Navigation needs* – The Chilean approach – James Crawford, Chilean Navy Directemar

James Crawford (National Maritime Administration of Chile) provided an extremely visual video presentation dealing with the applicability of MASS for AtoN needs and requirements. Firstly, the video presented the enormous coast line where the Chilean AtoN network is deployed in varying weather conditions. In this sense, the Chilean AtoN service has invested devices to facilitate remote monitoring signal operation to avoid corrective actions.

The decision was made to invest on the development of MASS for maintenance, operation and monitoring the AtoN network and avoid therefore the deployment of larger ships to the network area or costly shore infrastructure, improving the efficiency of Chilean assets. Other applications are envisaged for MASS including:

- Portable hydrometeorological station to provide information in narrow strait areas where the deployment of shore infrastructure is costly. This collection of data is essential for the safety passage of ships across these narrow straits.
- Portable cameras for CCTV in VTS. Currently, installed cameras in VTS areas are not enough to cover the expectation when a decision making process is required.

3.12.3. *A decision support tool based on the collision avoidance algorithm for autonomous ships* – Koichi Nishimura, TST Corporation

The presentation described the VTS infrastructure in Japan and the role and tasks of the VTS. An extremely high number of required navigation assistance communications is observed in Tokyo Bay and there is an increasing need for a decision support tool. Koichi presented the methodology proposed for the development of the automatic collision avoidance and presented the results of tests on the automatic collision avoidance system.

The results of the DST Testbed in Osaka Bay illustrated the relative movements of ships that potentially could enter into the danger zone based on AIS information. The DST application for MASS could identify those ships entering in the danger zone and provide the automatic collision avoidance tool. This provides an improvement of the traditional CPA an TCPA warning alarms.

3.12.4. *Innovations needed for autonomous and sustainable shipping technology* – Harmen Van Dorsser, Port of Rotterdam

Th presentation summarized the highlights from the Symposium and highlighted the need for:

- Connectivity, a robust business case, user friendly systems and technological harmonization.
- Future VTS as a data hub, coordinating body or even a command centre but they should guarantee the information provided, validate and authenticate the participants in these VTS areas and monitor the agreement between them.

Scenarios presented during the week linked to the MASS type, operational aspects and services required. Smart shipping solutions in Norwegian waters, were also discussed.

The presentation also concluded that further development of aids to situational awareness are required by providing risk models, collision avoidance tools, AI systems etc. Equally, connectivity and communication systems to system need to be standardized and supported by technologies. The data coming from these system should be effectively used. Some challenges were raised, such as maintaining the holistic approach to MASS, the creation of valuable decision insights and the need to create a harmonized way forward and coordination to progress on this MASSive task. The common MASS task Group is led by The Netherlands and Singapore and the terms or reference of the MASS group was provided.

4. SYMPOSIUM HIGHLIGHTS

4.1. Symposium highlights

Monica Sundklev and Hideki Noguchi presented the highlights drawn from the presentations and discussions held during the online symposium.

1 VTS will be essential for digital information exchange and therefore central to the successful digital transformation within the maritime world.

2 Maritime connectivity is paramount for progressing e-Navigation. It is time to settle on the standards for the first generation of a worldwide connectivity and data communication solutions so industry can move forward with innovative solutions.

3 VDES R-Mode can act as terrestrial backup for GNSS by using time synchronised ranging information. VDES also provides improved communication capabilities.

4 Advanced decision support systems will assist both VTS operators' and navigators' situational awareness, facilitate risk assessment and improve the safety and efficiency of navigation.

5 The provision of S-100 digital maritime services is a key enabler for e-navigation. Global harmonization of standards is required for a successful implementation of the ambitious digital maritime agenda.

6 Successful VTS training is a crucial factor for delivering VTS in a professional and harmonized way. New skill sets for VTS personnel to meet changing demands will be essential and should be taken into account by relevant authorities.

7 VTS will be fundamental in implementing harmonized digital data to prepare for management of mixed traffic areas with both conventional and autonomous vessels.

8 Autonomous systems, driven by a business case with defined user needs and requirements, are becoming operational and stakeholders need to be prepared. Standardisation, harmonization and definition of responsibilities is required to guide current and future activities.

5. CLOSING OF THE SYMPOSIUM

Pauline de Wilde, moderator, and Brigit Gijsbers, IALA Councillor and Director of Maritime Affairs for the Netherlands closed the 14th IALA symposium. Mrs Gijsbers said how pleased she was with the high level of the presentations given during this virtual symposium. She was now looking forward to the future developments in technology and collaboration between many stakeholders in fields such as MASS or e-Navigation to name a few.

6. EXHIBITION

The 14th IALA Symposium was an online Symposium but despite this, 13 members of the IMC kindly sponsored the event. During a normal symposium there is an exhibition floor, where companies can show their latest products to the participants of the symposium. The NetwerkApp provided an alternative virtual platform for the 14th IALA Symposium.

An exhibition floor was also available in the NetwerkApp. By clicking on the logo of the exhibitor, you were able to enter their personal virtual room such that they could meet with potential clients and explain their products. During the live broadcast there was a presentation of this virtual room with the platinum sponsor, SAAB.

We thank all our sponsors for their contribution to this online event.

6.1. Exhibitors and Sponsors

Level of sponsorship	Sponsor name

Platinum	SAAB
Gold	Havelsan
	Leonardo
Silver	Elman
	Jotron
	Kongsberg Norcontrol
	Tokyo Keiki Inc.
	Vissim AS
	Wartsila Voyage
	In-innovative navigation GmbH
Bronze	ICS Technologies
	Norbit
	Terma

7. SOCIAL EVENTS

Because the 14th IALA Symposium was a virtual event and everyone joining the event was behind their computer screen, the social events were also virtual.

The NetwerkApp was a special place for the social events and included the video library. There were videos in the library to help virtual participants experience the Netherlands (like the Keukenhof) and take part in some technical tours. There were some examples of outstanding infrastructural achievements in the Netherlands in these technical tours, such as the new locks in IJmuiden en Terneuzen and the last part of the Delta works, the Maeslant flood barrier.

The video library provides an overview of the 14th IALA Symposium, starting with the opening video and the opening session. All the sessions presentations are located in the library, which concludes with the Symposium closing session and the Aftermovie IALA 2021.

8. ACKNOWLEDGMENTS

The symposium acknowledged the Ministry of Infrastructure and Water Management, The Netherlands for the organization of the symposium.

The reporting of the technical sessions and the compilation of the report was undertaken by:

Jaime Alvarez

Kevin Gregory

Audrey Guinault

Minsu Jeon

Sarah Robinson

Thomas Southall

Thanks were also extended to those contributed to the drafting of the Symposium Highlights.

ANNEX A PARTICIPANTS LIST

Country	First name	Last name	Company/organization
Australia	Daniel	Christophersen	SAAB
Australia	Jillian	Carson-Jackson	The Nautical Institute
Australia	Kerrie	Abercrombie	Australian Maritime Safety Authority
Australia	Mahesh	Alimchandani	AMSA
Australia	Neil	Trainor	Australian Maritime Safety Authority
Australia	Nicholas	Bonser	Australian Maritime Safety Authority
Austria	Oener	Dabi	Frequentis
Austria	Patrick	Amici	Frequentis
Belgium	Els	Bogaert	Agency for Maritime and Coastal Services
Belgium	Nadia	Bos	Agency for Maritime and Coastal Services
Belgium	Rebecca	Andries	Agency for Maritime and Coastal Services
Belgium	Stefaan	Priem	Agency for Maritime and Coastal Services
Belgium	Wim	Smets	Agency for Maritime and Coastal Services
Belgium	Yves	Maekelberg	Agency for Maritime and Coastal Services
Brazil	Antonio	Oliveira	Aids to Navigation "Admiral Moraes Rego" Center
Brazil	Marcelo	Santiago Villas Boas	Companhia Docas Do Rio De Janeiro
Brunei Darussalam	Alvin Kang Loon	Wang	Marine and Port Department, Brunei
Bulgaria	Milen	Todorov	Bulgarian Ports Infrastructure Company
Cambodia	Kunthea	SEAN	Sihanoukville Autonomous Port of Cambodia
Cameroon	SALIHOU	Yacoubou	KRIBI PORT
Canada	Eivind	Mong	DFO/Canadian Coast Guard
Canada	Jean-Francois	Coutu	Canadian Coast Guard
Canada	Jean	Guèvremont	Canadian Coast Guard
Canada	Natacha	riendeau	DFO/Canadian Coast Guard
Canada	Simon	Pelletier	IMPA
Canada	Stéphane	Lessard	Canadian Coast Guard
China	Binsheng	Xu	China MSA
China	Shengli	Jin	China MSA
China	KOUKOU	LIU	saab
China	Lina	Li	Navigation Aids Technology Research Center of Jimei University
China	Yalei	Ren	China Maritime Safety Administration
China	YUANHANG	LI	CHINA MSA
China	Zhao	Jietong	HLJ
China	ZHOU	GUOXIANG	SHANGHAI MSA
Colombia	Jairo Eligio	Orobio Sanchez	Naval Academy "Almirante Padilla"
Colombia	ROBERTO	GRAELL	L,Nautica Ri Palenge - Sena Nautica
Cyprus	Neophytos	Vichas	Cyprus Ports Authority
Denmark	Dorte	Hansen	Navy Surveillance Center, DNK
Denmark	Christopher	Saarnak	Danish Maritime Authority
Denmark	Thomas	Christensen	DMC
Ecuador	Cesar	Mendoza Moyon	INOCAR
Ecuador	Jorge	Torres Olmedo	INOCAR
Ecuador	Santiago	Coral Carrillo	INOCAR

Country	First name	Last name	Company/organization
Egypt	Hisham	Mahmoud Kharashy	Egyptian Authority for Maritime Safety EAMS
Egypt	Wael	Aly	Egyptian authority for maritime safety
Egypt	Wael	Abd Elfattah Aly	Egyptian Authority for Maritime Safety EAMS
Finland	Dmitry	Rostopshin	Wärtsilä Voyage
Finland	Juho	Pitkänen	Fintraffic Vessel Traffic Services Ltd
Finland	Kaisu	Heikonen	Finnish Transport Infrastructure Agency
Finland	Maiju	Kaski	Fintraffic VTS
Finland	Mika	Nyrhilä	Fintraffic Vessel Traffic Services Ltd
Finland	Valtteri	Laine	Finnish Transport and Communications Agency
France	Audrey	Guinault	IALA
France	Christine	Philip	IALA
France	JEAN-LUC	FONTAN	IALA
France	Francis	Zachariae	IALA
France	Gerardine	Delanoye	IALA
France	Hervé	METAYER	Directorate for Maritime Affairs
France	Isabelle	Bracq	IALA
France	Jacques	MANCHARD	IALA
France	Kevin	Gregory	IALA
France	Lorraine	MBONG	IALA
France	Minsu	Jeon	IALA
France	Omar Frits	Eriksson	IALA
France	Pierre	Mingot	CEREMA
France	Steve	Guest	Kongsberg Norcontrol
France	Thomas	Southall	IALA
France	Virginia	Marshall	IALA
Gambia	ABAS	SAIDYKHAN	Gambia Maritime Administration
Germany	Axel	Hahn	OFFIS
Germany	Michael	Hoppe	Federal Waterways and Shipping Agency, Directorate General Shipping, Section National and International Stands Traffic Technologies
Germany	Dirk	Eckhoff	Federal Waterways and Shipping Agency Germany
Germany	Dominic	Plug	German Federal Maritime and Hydrographic Agency
Germany	Gero	Diezis	in - innovative navigation GmbH
Germany	Jan-Hendrik	Oltmann	Federal Waterways and Shipping Agency Germany
Germany	Jörn	Kirschstein	Federal Waterways and Shipping Agency Germany Maritime Traffic Technologies and Telematics Section
Germany	Marcus	Krol	in - innovative navigation GmbH
Germany	Mark	Thumann	Wasserstrassen- und Schifffahrtsamt Ostsee
Germany	Michael	Bergmann	International PortCDM Council

Country	First name	Last name	Company/organization
Germany	Stefan	Borowski	German Maritime Pilots Association
Germany	Sebastian	Wulf	DNV
Germany	Stefan	Bober	Federal Waterways and Shipping Agency Germany
Germany	Stefan	Gewies	German Aerospace Center (DLR)
Germany	Uwe	Voegele	in - innovative navigation GmbH
Hong Kong	Ophelia	Leung	Saab
India	Jinofer	Bhujwala	Aatash Norcontrol Ltd.
Indonesia	Nanditya	Darma Wardhana	Directorate General of Sea Transportation
Ireland	Ronan	Boyle	Commissioners of Irish Lights
Italy	Emanuele	Arcangeletti	Leonardo S.p.a.
Italy	Enrico	Deschner	ELMAN Srl
Italy	Francesco	Borghese	ELMAN S.r.l.
Italy	MARIO	SCANCARELLO	Leonardo SpA
Italy	Michele	Fiorini	Leonardo s.p.a.
Italy	michele	landi	Italian Coast Guard
Italy	Nadia	Panarese	Leonardo S.p.a,
Italy	Nazzareno	Romandini	ICS Technologies S.r.l.
Italy	Pierluigi	Fiori	ELMAN SRL
Italy	Piero	Pellizzari	Italian Coast Guard
Italy	Rosa Ana	Lopez Mazuelas	Leonardo
Italy	Stefano	Gelli	Leonardo
Japan	Hidenobu	Arai	Japan Radio Co., Ltd
Japan	Yoshihiro	Hata	Japan Radio Co., Ltd
Japan	Shunsuke	Yukimatsu	Japan Coast Guard
Japan	Takeharu	Kato	Japan Coast Guard
Japan	Tomoya	Nakajima	Japan Coast Guard
Japan	Kazuhiko	Nakamura	Japan Coast Guard
Japan	Hideki	Noguchi	Japan Coast Guard
Japan	Koichi	Nishimura	TST Corporation
Japan	Kazuhito	Madono	Japan Radio Co. Ltd.
Japan	Takuya	Fukuda	Tokyo Keiki Inc.
Japan	Akihiko	Takahashi	Japan Radio Co. Ltd.
Japan	Yasuko	Nakai	TST Corporation
Korea, Republic Of	Azeez	Sulaiman Agbenifola	Korea University
Korea, Republic Of	Jun-Hyeok	BYUN	Korea Coast Guard under MOF
Korea, Republic Of	Seung-Gi	Gug	Korea Maritime & Ocean University
Korea, Republic Of	Gyeongmin	JO	THE PROST
Korea, Republic Of	Hak-Sun	Hur	Korea Coast Guard under MOF
Korea, Republic Of	Hye-jin	KIM	KRISO
Korea, Republic Of	jeong	byungwoo	Korea coast guard
Korea, Republic Of	Jae Bong	Lee	GC Co. Ltd.
Korea, Republic Of	Sewoong	OH	KRISO
Korea, Republic Of	Seungweon	Yang	GMT
Malaysia	YBHG. DATO' HAJI BAHARIN	BIN DATO' ABDUL HAMID	Marine Department Malaysia
Malaysia	MR. ROSLEE BIN	MAT YUSOF	Marine Department Malaysia
Malaysia	Zulkifly	Ariffin	GreenFinder Sdn Bhd
Mexico	José luis	Vivar lo na	MARINA
Monaco	Mathias	Jonas	International Hydrographic Organization

Country	First name	Last name	Company/organization
Morocco	Kabbab	Sara	Maritime
Netherlands	Adriaan	Zeillemaker	Ministerie IenW
Netherlands	Arnoud	Vernimmen	Saab
Netherlands	Anouk	van Helvert	City of Rotterdam
Netherlands	Brigit	Gijsbers	Ministry of Infrastructure and Water Management
Netherlands	Herman	Broers	Loodswezen
Netherlands	Cas	Willems	Smart Atlantis
Netherlands	Colin	Guiking	MARIN
Netherlands	Dimitry	Kovtunenko	Saab
Netherlands	Ed	Pardo	Saab
Netherlands	Harmen	Van Dorsser	Port of Rotterdam
Netherlands	Huub	van Roosmalen	Saab
Netherlands	Hans	Verra	Port Of Rotterdam
Netherlands	Jacqueline	van den Bosch	Rijkswaterstaat
Netherlands	Jan	Kool	Rijkswaterstaat Water, Transport and Environment
Netherlands	Jeffrey	van Gils	Rijkswaterstaat
Netherlands	Jordi	Daniëls	Saab
Netherlands	Jur	Janse	Ministry of Infrastructure and the Environment
Netherlands	Kitty	Tang	City of Rotterdam
Netherlands	Luc	De Nijs	Saab
Netherlands	Maarten	Berrevoets	Ministry of Infrastructure and water Management
Netherlands	Martijn	Drenth	Nederlandse loodsen corporatie
Netherlands	Zeevaartschool	Rotterdam	Hogeschool Rotterdam
Netherlands	Monique	Nelissen	Rijkswaterstaat
Netherlands	Pieter	Paap	Independant Maritime Consultant
Netherlands	Remi	Hoeve	Rijkswaterstaat
Netherlands	René	Hogendoorn	SAAB Technologies
Netherlands	Richard	Jonker	Saab
Netherlands	Rob	Gutteling	Port of Rotterdam
Norway	Espen	Fjellheim	Vissim AS
Norway	Halvard	Henriksen	Vissim AS
Norway	Håvard	Odden	Vissim AS
Norway	Lene	Vesterlund	Kongsberg Norcontrol
Norway	Malin	Dreijer	Norge
Norway	Morten	Gjersoe	Jotron as
Norway	Maxim	Semenov	Vissim AS
Norway	Peter	Eade	Vissim AS
Norway	Richard	Aase	Norwegian Coastal Administration
Norway	Roar	Flaatnes	JOTRON AS
Norway	Thomas	Porathe	NTNU, Norwegian University of Science and Technology
Norway	Todd	Schuett	Kongsberg Norcontrol
Norway	Tony	Haugen	Norbit Aptomar
Norway	Trond	Ski	Norwegian Coastal Administration
Panama	Jonathan	Guerini	Autoridad Maritima de Panama
Papua New Guinea	Dii	Thomas	PNG National Maritime Safety Authority

Country	First name	Last name	Company/organization
Papua New Guinea	Harvey	Lahani	National Maritime Safety Authority
Papua New Guinea	Jason	Klink	Papua New Guinea National Maritime Safety Authority
Papua New Guinea	Krzysztof	Orlowski	PNG National Maritime Safety Authority
Papua New Guinea	PAUL	UNAS	National Maritime Safety Authority
Philippines	Orly	Wong	Philippines Coast Guard
Portugal	Lukasz	Ziolkowski	European Maritime Safety Agency (EMSA)
Russian Federation	Dmitry	Sarychev	Kronshtadt Technologies, JSC
Singapore	Jeffrey	Chai Zhi Yang	Maritime and Port Authority of Singapore
Somalia	Sidow Sheikh	Ali Nur	Ministry of Ports and Marine Transport of FGS
South Africa	Bruce	Nell	Oynetec (Pty) Ltd
South Africa	David	Gordon	Transnet National ports authority
Spain	Juan Carlos	Fernández Salinas	Centro de Seguridad Marítima Integral Jovellanos
Spain	Francisco	Esteban Lefler	PIANC
Sweden	Anders	Johannesson	Swedish Maritime Administration
Sweden	Christian	Kark	Swedish maritime administration
Sweden	Fredrik	Karlsson	Swedish Maritime Administration
Sweden	Frida	Swahnberg	Swedish Transport Agency
Sweden	Johanna	Gustafsson	Saab
Sweden	Marco	Svantesson	Swedish maritime organisation
Sweden	Monica	Sundklev	Swedish Transport Agency
Taiwan	SHWU-JING	CHANG	National Taiwan Ocean University
Trinidad And Tobago	Dawn	Seepersad	Training & Education
Turkey	Berker Emre	Tok	Koç Bilgi ve Savunma Teknolojileri A.Ş.
Turkey	Deniz Remzi	Dumlu	Havelsan
Turkey	Levent	Kalfa	General Directorate Of Coastal Safety
Turkey	HAVELSAN	VTS	HAVELSAN
Turkey	Nezih	SISMAN	HAVELSAN Inc
Turkey	Ozgur	Cetin	HAVELSAN
United Kingdom	ALINE	DE BIEVRE	IALA
United Kingdom	Alan	Liversedge	AFS Consultants
United Kingdom	Barry	Goldman	International Harbour Masters' Association (IHMA)
United Kingdom	Bruce	Mills	Wärtsilä Voyage
United Kingdom	Charles	Wyng	Wärtsilä Voyage
United Kingdom	Ernest	Batty	IMIS Global Limited
United Kingdom	Frances	Baskerville	CIRM
United Kingdom	Garry	Shaw	Port of London Authority
United Kingdom	Heidi	Clevett	The Maritime & Coastguard Agency
United Kingdom	Jan	Safar	GRAD c/o Trinity House
United Kingdom	Moin	Ahmed	International Mobile Satellite Organisation
United Kingdom	Peter	Roelofs	Terma
United Kingdom	Paul	Ridgway	IALA
United Kingdom	Sarah	Robinson	Hawkshill Consulting Limited
United Kingdom	Nick	Cutmore	IMPA
United Kingdom	Simon	Gaskin	IAIN
United Kingdom	Simon	Gaskin	IAIN

Country	First name	Last name	Company/organization
United Kingdom	Simon	Phillips	Port of London Authority
United States	Christopher	Hill	United States Coast Guard
United States	Darin	Mathis	US Coast Guard
United States	Jorge	Arroyo	U.S. Coast Guard
United States	Robert	Lewald	U.S. Coast Guard
United States	Nienke	Huinink	Saab
United States	Peter	Kito	Japan Radio Co., Ltd.
Viet Nam	Minh Thuan	Tran	Southern Vietnam Maritime Safety Corporation
Yemen	Yeslem Mubark Salam	Bu-Amr	Maritime Affairs Authority (Mukalla Branch)