

# Report



# e-Navigation Underway

## 2019 / International



## **e-NAVIGATION UNDERWAY INTERNATIONAL 2019 CONFERENCE REPORT**

### **Executive Summary**

The ninth e-Navigation Underway International conference was held from 6<sup>th</sup> to 8<sup>th</sup> February 2019 on board the DFDS ferry M/S Pearl Seaways, during which time she sailed from Copenhagen to Oslo before returning to Copenhagen. The theme for the conference was *Benefits and Barriers when Implementing New Technologies*.

Welcoming remarks were given by the conference facilitator, Astrid Haug, and opening addresses from Andreas Nordseth- Director General of the Danish Maritime Authority, Francis Zachariae- Secretary-General of IALA, Mr. Kitack Lim, Secretary General of IMO, and Annette Dybdal Fenger- Director Danish Maritime Authority.

A series of 21 presentations were given under the broad themes of The Industry Perspective - Benefits and Barriers when being a first mover, Regulation and Standards, The Port and Coastal State and Cyber Security. This was followed by a signing ceremony that established the Maritime Connectivity Platform Consortium (MCC) as a neutral and independent group of interested parties that will coordinate the provision of guidelines and standards to maritime navigation and transportation systems.

The Conference generated six highlights:

1. The need for standards persists and all stakeholders, including industry, should continue to bring harmonized standards forward.
2. Current and future technology should increase the potential of humans to work with technology to improve safety.
3. It is important to share data with as little restriction as possible.
4. Consideration of cyber security must be an integral part of technological developments and implementation.
5. VDES is important and SAT downlink is essential to improve global connectivity. All ITU Member States are encouraged to provide support at WRC19.
6. The European Maritime Simulation Network has been proven useful in identifying unforeseen consequences of new technologies and such initiatives should be sustained.

An invitation was issued to the e-Navigation Underway – Asia-Pacific 2019 conference to be held in Seoul, Republic of Korea, September 2019.

The presentations from the sessions are provided on the IALA website at <https://www.iala-aism.org/news-events/e-nav-underway/e-nav-underway-international-2019/>.



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# e-NAVIGATION UNDERWAY INTERNATIONAL 2019

## Paving the way for a Digital Maritime World – focusing on the benefits and barriers when implementing e-Navigation technologies

### 1 INTRODUCTION

The ninth e-Navigation Underway International conference was held from 6<sup>th</sup> to 8<sup>th</sup> February 2019 on board the DFDS ferry M/S Pearl Seaways, during which time she sailed from Copenhagen to Oslo and then returned to Copenhagen. The theme for the conference was *Benefits and Barriers when Implementing New Technologies*.

The presentations from the sessions are provided on the IALA web site at <https://www.iala-aism.org/news-events/e-nav-underway/e-nav-underway-international-2019/>.



A list of participants is at Annex A.

### 2 WELCOME ADDRESS

Astrid Haug, Conference Moderator, welcomed all delegates to Denmark and e-Navigation Underway 2019 International. She went on to introduce the themes of the conference – the industry - barriers and benefits when being a first mover, regulation and standards, the port and coastal state and cyber security.

### 3 OPENING OF THE CONFERENCE

Facilitated by Astrid Haug, Conference Moderator.

### **3.1 Welcome by Director General Andreas Nordseth - Danish Maritime Authority**

Andreas Nordseth, Director General DMA, welcomed participants to Denmark and to this year's e-Navigation Underway International conference. The suitability of the location, onboard the PEARL SEAWAYS, to discuss digitalization in the maritime sector was observed.

Secretary-General, Kitack Lim, was thanked and it was noted that his attendance set the scene at an interesting time for the e-navigation underway international conference. The cooperation between IALA and the DMA was hailed for being a fruitful partnership.

The address went on to observe that digitalization is one of the big opportunities for the maritime world and standards and regulations are key elements in ensuring success. IALA would take a leading role in the development of standards with the IMO. Technological development will become a game changer for shipping, as the possibility to be online everywhere, all the time, combined with the huge amounts of maritime data collected around the clock enabling the automatization of processes, and the way the maritime world works. Currently, we are experiencing a growing demand for the development of data.

The importance of making a difference in the everyday life of the maritime world was emphasised. In the digital world everything is connected and we need to think of digitalization in a broader perspective. A close collaboration between authorities, organizations and private actors in the maritime world is needed. All of these stakeholders were urged to share their data.

The future will arrive no matter what, but if we want to reap the benefits, we need both an ambitious private sector, an adaptable regulatory framework and - perhaps most importantly - shared standards across borders and across different systems. All of this will be essential if we are to make digitalization truly work for industry, authorities and mariners alike.

The Director General then introduced the #DigitalMaritime\_LetsMove hashtag and encouraged participants to use it throughout the conference.

He urged the Conference to move together in order to create the way forward in the digitalization of the maritime sector and concluded by again welcoming participants to the 9th edition of the e-Navigation Underway International Conference.

### **3.2 Mr Francis Zachariae – Secretary-General of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)**

Mr Zachariae stated that he was very pleased to see that so many e-Navigation colleagues and friends from all around the world were again present at the ninth International e-Navigation Underway International Conference. He added that e-navigation Underway is now established as a worldwide brand; the North American e-Navigation Underway Conference was successfully conducted in San Francisco in November last year and the next is scheduled in the fall of this year. The second e-Navigation Underway Asia-Pacific Conference took place in Seoul in June last year and the third is scheduled later this year.

The address went on to affirm that the e-Navigation Underway initiative complements the work carried out by the International Maritime Organization, supported by a wide range of stakeholders with the IMO acting as the leading coordinator to ensure a global approach to e-navigation developments.

Mr Zachariae stated that the important topic of benefits and barriers when implementing e-Navigation technologies is a key aspect and something that should have been focused upon earlier.

He highlighted key points that he believed participants should focus upon:

- Back to basics - return to the simple and most important things we must implement - digitalisation for safety of navigation.
- Find the business case
- Look through the Hype – e-Navigation is now approaching implementation and has passed through its conceptual stages.



Mr Zachariae then invited participants to take part in frank debate in an informal atmosphere, to help promote understanding to stimulate cooperation in test beds and in the verification of emerging e-navigation concepts and technologies, and generally to progress discussions on the future of e-navigation and related strategy and policy aspects.

He assured the Conference that IALA would take the outcomes of the Conference forward in its technical work and in the activities of the World-Wide Academy.

He concluded by thanking the Danish Maritime Authority for organizing the event in particular Linda Assel Hald, the sister organizations in the e-Navigation Underway Steering Committee and the participants.

### **3.3 Key-note speech: Kitack Lim, Secretary General, IMO**

IMO Secretary General, Kitack Lim, congratulated participants on a successful start to the e-Nav Underway International Conference in the maritime city of Copenhagen. He was glad to see the experts on this subject gathered together. As the shipping industry runs on into the future e-Navigation is expected to provide digital information and the infrastructure for the safety, security and protection of the marine environment and reduce the administrative burden and increase efficiency of the shipping industry. These words are from the IMO's e-Navigation strategy which explains the excitement around e-Navigation.

Mr Lim went on to state that e-navigation has been 'the future' for a long time now recognising that the process for a regulatory framework was first agreed in 2006. The building blocks for e-Navigation are already in place, the IMO e-Navigation strategy is about harmonizing, standardising and integrating information is shared and presented ashore and at sea. The question is how can this be turned into an advantage for shipping? It is widely believed that autonomous shipping will arrive very soon, artificial intelligence and the internet of things will have a big impact on shipping and the wider logistical chain and IMO are preparing for this. The aim is to complete a scoping exercise by 2020 and develop guidelines for the trial of autonomous vessels to embrace this new world. IMO is leading the global coordination on this subject. New players like Google and Rolls Royce are getting involved in the smart ship concept. It is an exciting time to be involved in shipping and logistics. Whatever shape the future takes it must be at least as safe and environmentally friendly as it is now.

Shipping is entering a new era but it should not be driven by technology but by users and customers. IMO has been concentrating on many environmental issues and all of these changes together are having a big impact on the maritime industry. In order to meet the changes, the industry has to invest a lot more to meet these new developments and Mr Lim extended his thanks to them.

In order to ensure that the full benefit of e-Navigation is realised it requires full collaboration from stakeholders, this is achieved through events such as e-Navigation Underway. E-Navigation is the core heart of autonomous ships and all information sharing. The next step is to focus upon the connection between ships and shoreside logistics. The development of e-Navigation is moving in the right way and contributing to the work of IMO and this work supports the change in the global supply chain. The DMA and IALA are to be commended for organising this event and have helped chart the course for the shipping industry. The Secretary General looked forward to a productive outcome of the conference.

### **3.4 Setting the scene – Anette Dybdal Fenger, Danish Maritime Authority, Denmark**

Anette Dybdal Fenger welcomed participants to the 9th edition of the e-Navigation Underway International Conference.

The formula of the conference was explained to participants – a mix of presentations and networking. The forthcoming days would highlight the development in standardised digital solutions for the maritime sector but also provide a broader perspective this year. There would be an added focus on regulation, which was emphasized by the participation of the IMO.

It was noted that many of the technologies that were visualized theoretically have actually been achieved. Real world solutions are present and being tested, but there might still be various obstacles that prevent them from being fully adopted. Therefore, this years conference will focus on how to pave the way for a

digital maritime world - concentrating on barriers and benefits when implementing new technologies and e-navigation solutions.

The future points towards large leaps of development as we move into the age of digitalisation and science is really changing the way things work, onboard ships and around a sea voyage.

Today we can no longer continue making things work in isolation, everything is becoming connected and interconnectivity is essential to maximise profits. Because of this development, we have to look at e-Navigation in a broad context - connected to other types of technologies, that are used in the digital world of global shipping.

Communication is a main focus area and we have to think about how ships can communicate to shore, and to other ships, but also about how different IT-systems can communicate.

Shipping is global, and in the new and digitalized world, data sharing is necessary. It is vital that we collaborate and agree to cooperate in order to create common standards, and to drive forward the agenda around digitalization and e-navigation in relation to standards. Governments are obvious players in pushing the standardization agenda and in creating a level playing field for those industrial players that are eager to drive the technical IT-development of digitalisation of the maritime industry towards increased efficiency and profit. And of course governments should make an effort to reduce regulatory barriers and forward the acceptance of digital solutions. In taking on a facilitating role, they can bring together both private and public efforts to push forward the agenda on e-Navigation and digitalization, as for instance it has been the case in ensuring test-areas for autonomous ships.

As new solutions such as drone technology and autonomous ships emerge, technologies will need to interact with their surroundings and we have to take this interaction into consideration. However, we also have to regard the interaction to less technical aspects such as the human factor, habits, cultural differences and regulations. Some claim that these new technologies make the maritime sector more vulnerable to cyber threats, but others claim that we also might find solutions to issues such as cyber security in some of those new

To conclude Anette Dybdal Fenger stated the conference would focus on the barriers and benefits of first movers who are implementing e-navigation solutions, how new solutions affect international standards and regulations and finally cybersecurity.

The Conference Facilitator, Astrid Haug, then invited participants to vote in an online interactive poll on the following questions:

- In one word - what do you see as the greatest benefits when implementing e-Navigation solutions?  
Result – Safety
- In one word - what you see as the biggest barriers when implementing e-Navigation solutions?  
Result – Harmonisation, Standards, Costs, Complexity and Resistance to Change

The full results are available at IALA website at <https://www.iala-aism.org/news-events/e-nav-underway/e-nav-underway-international-2019/>.

## Themed Sessions

The themed sessions comprised of 21 presentations and 2 group sessions that considered the barriers and benefits to e-nav implementation. All presentations will be available on the IALA website following the conference at <https://www.iala-aism.org/news-events/e-nav-underway/e-nav-underway-international-2019/>

### **4 SESSION 1 – THE INDUSTRY PERSPECTIVE - BENEFITS AND BARRIERS WHEN BEING A FIRST MOVER**

This session was introduced by Astrid Haug, Conference Facilitator.



## 4.1 New Technologies – New Opportunities

### 4.1.1 Presenter and author

Anne H. Steffensen, Director General and CEO, Danish Shipping.

### 4.1.2 Abstract

Anne Steffenson gave a short introduction to Danish Shipping and shipping's importance for Denmark. Denmark is the 6<sup>th</sup> largest shipping nation and was the fastest growing flag state in 2018. Her presentation then highlighted two new technologies impacting shipping now and will continue to do so in the years to come:

- Land based technologies - Digitalization of global trade

By reducing barriers we could increase trade by 15%. Huge potential to simplify shipping processes. Only companies investing in digitalisation will be able to compete going forward.

- Sea based technology - Levels of autonomous vessels

We owe to our seafarers and the environment to make the most of new technology. Autonomous vessels does not mean widespread unmanned ships, it is there to help the crew in their daily work and to increase safety and lower emissions.

She observed that these technologies will impact upon the commercial side of shipping and on the future of navigation with potential benefits to increased safety and optimization of vessels transits. The presenter stated that we tend to overestimate change that will occur in two years and underestimate the change over ten years. Regulation and competition drives innovation and change.

Cyber security should be considered at all levels of companies and the shipping community as a whole. Citing the cyber-attack on Maersk in 2017 – research has shown that 69% of Danish shipping companies have been attacked in the past year, therefore we must be able to protect the digital operations of our ships against this global threat.

Regulation can be a driver for innovation as demonstrated by the regulations around greenhouse gasses and the innovation shown to meet these targets. There is a need for updated IMO regulation to support the development of new technologies

We don't know where we are going but there will be winners and losers. Danish shipping strives to engage in new responsible regulation in order to create the future.

### 4.1.3 Discussion

Discussions highlighted the following:

The need to change culture as we can't rest on the past and we must stay ahead of the curve before change affects business adversely.

That the industry has become cost focussed that there is a danger that we will forget about investing in the future.

There is a need to encourage sharing data between companies.

## 4.2 Enhanced Operational Awareness and Remote Pilotage

### 4.2.1 Presenter and author

Peter Holm, European Director, Sea Machines Robotics

### 4.2.2 Abstract

Peter Holm introduced Sea Machines current projects. Sensor fusion is currently carried out by the human and 75% of maritime accidents are caused by human error. The goal of Sea Machines 400 is enhanced situational awareness. The project retrofitted a vessel with the equipment to merge sensors together, through this the crew will be able to see a centralised display. The project also examines remote pilotage.

The Pilot does not board the vessel but is fed data from the ship, including cameras and radar sensors that utilise the 4G network. This will be tested in March or April this year.

The benefits of enhanced operational awareness are:

- Reduced transit risk
- Enhanced productivity
- Increased operational data

This work is currently a proof of concept project and notes that not every ship can be retrofitted with this technology.

A key aspect of the project is crew culture - worries included job losses and information overload. Peter Holm affirmed that the projects aim was to make the crews job easier and not to lose personnel. As well as cyber security – sensor security must be considered to include threats such as GPS spoofing.

#### 4.2.3 Discussion

Discussions highlighted the following:

- That sensors will cross reference between each other in order to make an intelligent interpretation of a congested area.
- There is a need to keep the equipment system simple to reduce the risk of confusion to the mariner.
- There is the potential of the systems having need of maintenance but redundancy is built in through duplication of sensors.
- The system has the ability to track small debris through the use of LiDAR
- The system will be made intelligent to check historical position data as well as verification of surrounding vessel targets to prevent threats such as GPS spoofing.
- Complacency is a possible downside to crew interaction with the system.

### 4.3 Making STM a global standard

#### 4.3.1 Presenter and author

Tina Dejan and Erik Daren, COMBITECH

#### 4.3.2 Abstract

STM projects have run for a number of years and established a powerful digital maritime infrastructure

Authorities and institutions have recognised the work and their need at the IMO in November 2018. Many industry actors have recognised the benefits. The technology and infrastructure exists and has been tested but an owner needs to be identified to govern and drive it. Business partners and authorities are required to adopt, implement technologies need and endorse the project.

In order to fulfil the vision and become a global standard governance organisation needs to be established.

The industry group is quite mature and now vital questions need to be addressed by the whole industry to agree on the benefits and future use of STM.

STM has been created it needs to be picked up, governed and monitored. Industry must see if it can implement it. There is a team of industry players that need support from wider stakeholders.

### 4.4 Implementing of e-navigation and operator workload

#### 4.4.1 Presenter and author

Todd Schuett, Innovations Project Manager, Kongsberg NORCONTROL AS, Norway.

#### 4.4.2 Abstract

SESAME Solution II is an e-navigation testbed project that builds on the strong foundation laid by SESAME Straits. With an expanded consortium and loftier ambitions, SESAME II aims to create the most complete ship traffic management system possible, which we hope will be ready for the market by 2021.

Human factors research is a high priority in the project. This will include how can system design promote trust. One of the key research questions in SESAME II concerns how the introduction of e-navigation technologies will impact workload, both on ships and ashore. It has been found that there is a difference between workload and burden.

Testbed locations include three VTS centres in Norway, the Singapore MPA port operations control centre, the Channel Navigation Information Centre at Dover UK, and the port of Southampton.

Technologies to be developed and tested include automated electronic ship reporting, just in time arrival coordinated with port services, and a variety of e-navigation services, such as recommended/pilot route, route monitoring and cross-check, route optimization, weather optimization, MSI, and others.

e-navigation services are assumed to increase safety, reduce risk, improve efficiency and reduce pollution. Another assumption has been that certain services, such as automating the mandatory reporting that is required of class A vessels, will reduce administrative burdens, allowing the bridge team to focus on their most important job, namely to safely navigate the ship. VTS and SRS centres also anticipate a reduction in their administrative burden. However, this anticipated reduction in workload is an assumption that is untested and therefore cannot be assumed.

During the SESAME Straits project, we hypothesized that workload would actually increase during the early days of e-navigation implementation as not all vessels would implement e-navigation technology all at once. This hypothesis also needs to be tested.

SESAME Solution II seeks to address this issue by first studying the workload of ship and shore operators to understand the impact e-navigation services has on workload. If the impact on workload is known, it can be planned for.

We also aim to develop as many automated solutions as possible, meaning that many of the services will require very little human operator intervention. However, automation introduces additional issues, especially around human trust in the technology. Therefore, another research issue to address concerns how the SESAME technology can be implemented in such a way that trust in automation improves.

#### 4.4.3 Discussions

Discussion highlighted the following:

- SESAME Solutions II wants visual presentation of issues rather than text in order to combat overload of alarms.

### 4.5 The reality and future of e-Navigation: Data exchange and collaboration - inspired by aviation

#### 4.5.1 Presenter and author

Michael Bergmann, Senior Advisor, RISE – Research Institutes of Sweden

#### 4.5.2 Abstract

The presentation focused on two questions:

How are similar industries benefiting for digitalization and what can we learn?

How will new technologies impact the maritime industry 10 years from now?

The presentation highlighted the current status and future implementation of e-Navigation concepts, standards in process or already approved, existing implementation of e-Navigation concepts and those in final stages.

Mr Bergmann went on to focus upon digitization and data exchange. In particular it looked into aspects of e-certificates and the benefits derived from exchanging trusted and verified data between the different stakeholders.

He linked the status quo to mid-term expectations, explaining the lessons learned in aviation on data sharing and collaboration. Information was shared on how collaborative decision making in aviation has proven to increase reliability and efficiency of aviation transport and how it reduced the environmental footprint of this mode of transportation.

The presentation went on to say that there is a need for standardisation in areas such as VDES, data and information citing S-200 as an example. It is imperative that you must trust the data that you are receiving. Aviation does this through a standard that checks seven areas to verify quality.

Mr Bergmann further explained how test beds and e-Navigation projects have taken these lessons into account and that new concepts were being developed by using the inspiration of aviation, but still focused upon the specific needs and circumstances in the maritime transport ecosystem.

With results from experience in this process the presentation looked into the future and finished with next steps that are necessary in order to gain the intended benefits.

Key points highlighted were:

1. E-navigation is already a reality
2. The e-Navigation journey needs to continue
3. Developments in aviation can provide inspiration for the maritime sector
4. Data exchange and collaborative decision making is paramount for an efficient and effective maritime transport domain

#### **4.6 Time for e-Navigation to deliver: research has produced; implementation is lagging and in the meantime accidents happen.**

##### **4.6.1 Presenter and author**

Thomas Porathe, Norwegian University of Science and Technology

##### **4.6.2 Abstract**

The presentation focused on two questions:

- What is required from authorities when implementing new navigational technologies and how can authorities make use of and implement services?
- What is required to prepare for a future with autonomous and smart shipping?
- How do we ensure that safety is obtained and risks

The speed of implementation of e-navigation is not in line with produced research results. In the meantime, accidents keep happening.

We have come some way in researching the collection, integration, exchange, presentation and analysis of marine information on board and ashore. Results have been produced in projects like the EfficienSea, MONALISA, ACCSEAS, SESAME and STM, to just name a few. Services like the display of route intentions, route suggestions, maritime safety information, dynamic no-go areas, are just some of the research areas investigated during the last six or seven years. None of which have yet reached an implementation stage. A service like route exchange has, for instance, been investigated rather thoroughly in a number of these research projects, and together with a visualisation service like the Moving Haven, there is potentially a mitigating effect on some types of accidents. Two recent examples, that potentially could have been avoided,

are the grounding of a car carrier in Sweden in July 2018 and the collision between a warship and a tanker in Norway in November 2018.

The presentation asked why this is still the case, and urged for forward motion. The human-machine interaction processes of decision-making/decision support was used as examples. Implementation is currently lagging. The future offers no suspension – shipping must meet the challenges of today such as the marine special planning and increased competition for ocean space.

Key points highlighted were:

1. Research has produced e-Navigation results
2. There is a need for the implementation process to move forward
3. Presentation of examples of how e-Navigation research findings can add to maritime resilience

## **5 SESSION 2 - REGULATION AND STANDARDS**

The Session was introduced by Astrid Haug, Conference Facilitator.

### **5.1 Rules, Regulations, Guidelines, Standards and Reality. What does this all mean for Autonomous Vessels?**

#### **5.1.1 Presenter and author**

James Fanshawe, Chairman, Maritime Autonomous Systems, UK Marine Industries Alliance.

#### **5.1.2 Abstract**

The growth of autonomy continues to rise exponentially. New systems and concepts are being developed month by month and novel technologies are entering service in a variety of forms. These are not all to do with so-called unmanned vessels as there are some intriguing benefits being identified for conventional ships which should all contribute to a general rise in the levels of both safety and also efficiency particularly benefiting dangerous operations and adverse conditions at sea.

But the focus, when it comes to Standards and Regulation, tends to fall on the introduction and operation of more vessels that will not necessarily have personnel on the bridge. There is an industry working around the whole topic of definitions and terminology and this is tending to add to confusion, particularly amongst the maritime community who are not directly engaged with autonomy.

So where are we? IMO are fully engaged with their Regulatory Scoping Exercise for Maritime Autonomous Surface Ships (MASS) with ambitious targets and deadlines. It is vital that they are afforded the time to work this through and not to rush and potentially get it wrong. It is by no means clear what form their eventual output will take or indeed when this will happen.

Meanwhile, there are a variety of Rules and Guidelines which are in force and which are directly relevant to the design, build and operation of MASS. There are also many standards which can be directly applied to these vessels but there will be a need for some new ones. But the dichotomy is that the regulatory and standards work is bound to lag behind the reality of an ever increasing number of vessels which are operational. Whether these are truly autonomous or being monitored or operated from a remote station is not the key question. I suggest that the main point is that they must be seen to operating within every existing framework and doing so in the safest manner possible. The encouraging news is that this is happening, the UK has already established a policy in its strategy paper *Maritime 2050*. Building trust amongst all mariners is critical, as is the growth of the precedent law portfolio, and this process is well underway. The presentation looked at examples of codes that have been developed and recognised that industry had a role to play in developing these further as have classification societies. It was recognised that sub-SOLAS autonomous vessels are now able to get insurance and are operating in many fields such as scientific research and security.

Key points highlighted were:

- Safety must come first; humans are critical.

- There are sufficient guidelines and relevant standards for the autonomous industry to continue to grow.
- We must keep autonomy in perspective and not make assumptions which are not accurate.

### 5.1.3 Discussion

Discussion highlighted the following:

- That insurance premiums may reduce as autonomy may eliminate human liability.

## 5.2 STM and VDES are interlinked

### 5.2.1 Presenter and author

Peter Bergljung, Director of Strategy and Portfolio, Saab TransponderTech

### 5.2.2 Abstract

Peter Bergljung introduced the background to VDES and AIS. The next generation AIS – internationally called the VHF Data Exchange System (VDES) – will take into consideration the future requirements for more data exchange capabilities. Thereby, the AIS radio channels (VHF Data Link VDL) will be protected from overload as AIS populations increase. VDES gives up to 32 times more bandwidth compared to AIS and also unique satellite to ship communication. VDES main regulatory global challenge is Satellite VDES requirement for frequency allocation for downlink at WRC 19 in November 2019 and the speaker urged members of ITU to vote in favour of this allocation. VDES will be in initial operation from year 2020, and potentially in operation beyond year 2040.

STM is one of the new e-navigation applications that will benefit from VDES. This presentation described the background to the project and how VDES and STM are interlinked. With this combination safety, security and efficiency will be enhanced. VDES can be utilised in STM for route exchange as a result of increased bandwidth.

In order to make this operational STM Governance has to be in place after the project ends in 2019.

## 5.3 Harmonization is the key

### 5.3.1 Presenter and author

Omar Frits Eriksson, Deputy Secretary General & Dean IALA World-Wide Academy, IALA.

### 5.3.2 Abstract

Shipping is by its very nature mobile and global. Shipowners may be willing to equip their new-buildings with state-of-the-art technology to maximize their competitive advantage and operational safety, but they are reluctant to spend money on multiple sets of equipment just because different regions of the world have developed their own digital solutions which are incompatible with each other. Such incompatibility is a barrier to safe and sustainable global movement of vessels and will ultimately reduce the efficiency of the transport chain. If we don't harmonize local solutions will be developed that will be incompatible and e-navigation will then never happen.

The presentation compared the journey of harmonizing the buoyage to the IALA Maritime Buoyage System.

The four steps to harmonization were:

- Define and publish the basic principles
- Provide guidance on how contemporary technology can be utilized to apply the principles
- Create a desire or an obligation to follow the principles.
- Publish how the principles have been implemented in any given geographical area.

This process was then compared to e-navigation. The five types of e-navigation specifications/descriptions were introduced and the related them to the equivalent stages with IALA maritime Buoyage Implementation.



E-Navigation has achieved 3 of the 4 principles of harmonization but must increase the desire or obligation to implement it fully. This may be achieved by defining a convincing business case.

For e-navigation there is a fifth stage 'secure and share of our natural resources' such as bandwidth. If it is not shared it is not e-navigation.

## **5.4 STM Testbed Results, Ongoing Work and Future Developments**

### **5.4.1 Presenter and author**

Per Setterberg, Operational Project Manager, STM Validation Project, Swedish Maritime Administration

### **5.4.2 Abstract**

Per Setterberg introduced the background of the Sea Traffic Management Project. The aim is to enable efficient exchange of information between maritime stakeholders through standards and decentralization. The project has had 39 partners from 13 countries and will continue until mid 2019. The project has proven its interoperability with many key actors adopting the technology. The presentation went on to explain some of the projects results.

### **5.4.3 Discussion**

Discussion highlighted the following:

- There is demand for a suite of documents for harmonization
- There was a call from participants to share results globally and forward them to relevant bodies such as IALA.
- IALA invited the e-navigation actors present to provide input to the 2020 IALA Symposium in order to facilitate closer collaboration with VTS.

## **5.5 Break Out Sessions**

The break out session was divided into two groups. Michael Bergmann facilitated the group considering barriers and Sunbae Hong facilitated the group considering the benefits of e-navigation implementation.

### **5.5.1 What are the barriers and potential solutions for an organization striving to be a 'first mover' when implementing new e-nav technologies?**

The group considered the barriers to e-navigation implementation, highlights included:

- Enhanced technology – e-navigation technology needs a certain amount of maturity in order to be implemented fully
- Budget - production costs need to be lower
- Culture – there is currently a reluctance to change and this needs to be addressed
- Clash with regulations – Authorities need to be able to keep up with developments and be flexible with regulatory solutions

The groups full findings can be found under Annex B.

### **5.5.2 What are the benefits and the business case for an organization to be a 'first mover' in implementing new e-nav technologies?**

The group considered the benefits to e-Navigation implementation, highlights included:

- First movers can have much more influence on the new market
- A solution to the communication gap between the ship and shore

It was agreed that these discussions are very timely because real e-navigation services may be implemented from next year and organisations need this business case to justify investment.

The groups full findings can be found under Annex B.

## 6 SESSION 3 – THE PORT AND COASTAL STATE

The Session was introduced by Astrid Haug, Conference Facilitator.

### 6.1 EMSA's challenges for implementing e-navigation with new technologies

#### 6.1.1 Presenters and authors

Leendert Bal, Head Of Department Operations, European Maritime Safety Agency (EMSA)

#### 6.1.2 Abstract

The presentation considered the following questions:

1. What is required from authorities when implementing new navigational technologies and how can authorities make use of and implement services?
2. What is required to prepare for a future with autonomous and smart shipping?

The presentation introduced the work in e-navigation by EMSA. It described SafeSeaNet (SSN) that collects around one-hundred million AIS messages per month, with departure and arrival information being exchanged. These AIS tracks can be monitored. This information supports the safety and efficiency of vessel movements. National single windows have been established that are linked to national and central SSN.

EMSA supports VDES and the increase of bandwidth. VDES-Sat may support the exchange of reporting formalities with ports. EMSA is considering other potential areas to use this 'reporting gateway'.

The European Commission has started to examine MASS. There will be guidelines produced but the interaction between autonomous and non-autonomous vessels must be considered further.

EMSA have developed Integrated Maritime Services (IMS) that brings together many sensors and information including AIS and meteorological data. This technology may be used for MASS in order to identify if a vessel is autonomous or not. Vessels could be alerted to this and the autonomous vessels route could be shared with them.

EMSA is also experimenting with the uses of drone technology in the maritime world. One such area could be emission monitoring.

A move to information management will bring more intelligence to the maritime picture, more services can be offered through the reporting gateway (VDES). Currently initiatives are fragmented.

#### 6.1.3 Discussion

Discussion highlighted the following:

- EMSA wishes to start early with MASS which is why they are developing guidelines to facilitate vessel traffic monitoring.
- The issue of VDES channel allocation that is to be discussed at ITU WRC19 is an EU shared competence.

### 6.2 Drones – an aid to increased situational awareness during traditional pilotage and future shorebased pilotage

#### 6.2.1 Presenter and author

Søren Westerskov, Chief Pilot, DANPILOT

#### 6.2.2 Abstract

The presentation addressed the following questions:

1. What is required from authorities when implementing new navigational technologies and how can authorities make use of and implement services?
2. What is required to prepare for a future with autonomous and smart shipping?

### 3. Do we need new competences onboard and ashore in the era of digitalization?

There are more than 20,000 annual pilotage operations in Danish waters and of them approx. 11,000 harbor pilotage operations, which emphasizes that the marine pilot work is an important part of the Danish maritime industry. This project introduces increased efficiency through shore and land based pilotage using drones and technology integration of existing systems performed by authorized and experienced marine pilots.

A report from COWI<sup>1</sup> in 2014 stated that there is a significant potential for increased efficiency and cost savings through shore based pilotage in specific Danish Waterways, though without highlighting harbour pilotage operations as an potential. Recent technical advances in drones and remote control have made it possible to supply necessary components for the individual ship and subsequently provide an overview which supposedly makes the harbor pilotage operation both faster and safer.

The necessary expertise is created through the joint venture company "VesCo Systems" with the three partners: DanPilot, Blue Ocean Robotics and Third Element Aviation supported by the Danish Maritime Fond.

Ultimately the purpose of the project is to develop a system of drones and technical equipment called "RemotePilot", which allows a harbor pilotage operation from ashore. The result will be increased safety, savings and efficiency in relation to the operation of pilot boats and better utilization of the pilot's time, which increases the capacity for pilotage and the market in general.

RemotePilot is based on a drone system facilitating interface/interlink between ship and shore. The situational awareness for the shore based pilot is insured by real time camera feed (bird eye overview) of the vessel and surrounding as well as visual support of the communication / commands between vessel and pilot.

The project has provided the pilot with a birds eye view of the vessel and also the capability to deliver equipment required on board to make remote pilotage possible. Controls to operate the drone have been integrated into the PPU. The project will continue to address questions such as legislation and whether or not ships would use the product.

A harbor pilotage operation is to be performed at least on the same level of quality as if the pilot were on board the vessel i.e. ensuring availability and reliable, efficient and safe pilotage operations.

The main results of the project are as follows:

- Using new technology in order to make harbor pilotage operations more efficient
- Increased safety for marine pilots when boarding or landing
- Making harbor pilotage available for more ships due lower cost
- At least the same quality level in RemotePilot compared with traditional pilotage.

#### 6.2.3 Discussion

Discussion highlighted the following:

- That drone technology could be utilized for many other purposes apart from pilotage such as ship inspections
- The vision is not to replace pilots

### 6.3 Strategies for establishment of a SMART Maritime Logistics System

#### 6.3.1 Presenter and author

Sunbae Hong, Director / Head Of E-Navigation Development Task Force

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<sup>1</sup> COWI, November 2014, DMA. Technological Assessment of the possibility of shore based pilotage in Danish Waters.

### 6.3.2 Abstract

The presentation addressed the following questions:

1. What is required from authorities when implementing new navigational technologies and how can authorities make use of and implement services?
2. What is required to prepare for a future with autonomous and smart shipping?

The digitalization in maritime sectors would be an unavoidable trend in terms of its effectiveness and evolving ICT technologies, and it might include e-Navigation, smart port/shipping and autonomous ships. It is clear that digitalization provides many kinds of benefit to the world maritime communities, including authorities, shipping, port, crews on board the ship, relevant IGOs/NGOs and even relevant industries in terms of safety, efficiency, marine environment and climate change.

There might not be any difficulties in digitalizing maritime sectors in terms of necessary technologies, but many challenges are there to be solved at the level of authorities and between the relevant stakeholders over the world in terms of standardization of element factors, legal schemes, sharing data and information and the sustainable world cooperation scheme. In order to solve such challenges and achieve the world's common goal of sustainable shared growth through digitalization, it is important for us to identify challenges and find the solutions on how to digitalize maritime sectors in the most beneficial way to all relevant stakeholders over the world.

As a case study for these questions, Sunbae Hong presented Korea's strategic implementation plan (SIP) of SMART Maritime Logistics, including the development and implementation of e-Navigation, smart port and autonomous ship. Based on the plan, the author shared the challenges needed to be solved and prepared at the level of authorities in order to achieve goals of the project in a most beneficial way to all stakeholder over the world.

Key points highlighted were:

1. Digitalization of maritime sectors is an unavoidable trend over the world as the tool to solve challenges that the world maritime communities face; safety, efficiency and environment
2. There are many stakeholders in digitalizing maritime sectors, and it is required to be introduced in a most beneficial way to all of them for facilitating digitalization and maximizing its effects.
3. The authority should be the main body to lead development and implementation of maritime digitalization over the world

The IMO needs to keep the e-navigation agenda for further discussion of the facilitation of maritime digitalization by linking smart ports and autonomous shipping.

### 6.3.3 Discussion

Discussion highlighted the following:

- Maritime is not isolated but linked to the trends of society and it is better to steer the future than be steered by external forces.

### 6.3.4 **European Maritime Simulator Network: A virtual large-scale test facility for e-Navigation and ship autonomy development**

#### 6.3.5 Presenter and author

Hans-Christoph Burmeister, Group Manager 'Sea Traffic And Nautical Solutions'

### 6.3.6 Abstract

The presentation addressed the following questions:

What are the benefits and barriers for first movers?

What is required from authorities when implementing new navigational technologies and how can authorities make use of and implement services?

What is required to prepare for a future with autonomous and smart shipping?

How do we ensure that safety is obtained and risks?

Innovation in the e-Navigation and ship autonomy domain often require larger changes not just to navigation or a single ship, but also to shipping in general. However, thoroughly testing of such concepts is often limited to simple user testing of disconnected, single installations neglecting changes and cross effects if several entities are involved. Instead, large scale test facilities are needed to bridge major gaps with regards to development of safe waterborne connected and automated transport, which has been acknowledged by the EU in its latest Strategic Transport Research and Innovation Agenda.

Ship-handling simulation (SHS) is a known tool for assessing navigational safety and appropriately incorporating the human factor, but so far has been limited to one to five 'manned bridges'. Within MONALISA 2.0 and the STM Validation project, several simulators across Europe have been connected to a virtual large-scale test facility: The European Maritime Simulator Network (EMSN). This presentation will introduce the EMSN, its technical backbone, and will explain how the EMSN was used in the concept testing of STM's e-Navigation solution testing.

Furthermore, an outlook of how the EMSN will assist in future training within the EMSN-Connect initiative as well as how it can be used in autonomous ship development will be given.

Key highlights included:

- Simulations are necessary to enable proper critical situation testing
- EMSN successfully connects end-users and mariners with e-Navigation technology allowing live experience of future tools under realistic conditions
- EMSN has successfully been used in the STM-V project for e-Navigation development

#### 6.3.7 Discussion

Discussion highlighted the following:

- That organisations that found benefit in the project could assist by endorsing simulation in order to secure funding.

### 6.4 The first e-Navigation testbed in Russia

#### 6.4.1 Presenter and author

Marat Ismagilov, Kronstadt Technologies

#### 6.4.2 Abstract

The following questions were addressed in the presentation:

- What is required from authorities when implementing new navigational technologies and how can authorities make use of and implement services?
- What is required to prepare for a future with autonomous and smart shipping?

The presentation covered the main results of the development of the testbed "Hermitage", the directions of the development of e-Navigation technology in Russia and the planned joint work with other European testbeds.

New developments in the field of VDES, RIS, hydrographic trawling complex, the use of UAVs and others were discussed

The presentation introduced Kronstadt Technologies and the ways e-navigation has been introduced in Russia through a range of federal and state programs. It then went on to explain that the project has included the introduction of three new VTS and VDES and an automated hydrographic trawling system.

To conclude it was stated that the state and authorities should play a more active role in the implementation of e-Navigation technologies.

## **6.5 Just in Time Arrival: benefits for ships and ports**

### **6.5.1 Presenter and Author**

Dmitry Rostopshin, Director, Traffic Control And Management Solutions, Wärtsilä

### **6.5.2 Abstract**

The presentation addressed the following questions:

- What are the benefits and barriers for first movers?
- What is required to prepare for a future with autonomous and smart shipping?
- Does regulation and standards need to be updated and changed when implementing new technologies now and in the future?
- What is required from authorities when implementing new navigational technologies and how can authorities make use of and implement services?
- What is required to prepare for a future with autonomous and smart shipping?

Containerships, on average, spend 6% of their time waiting at anchor due to delays at port. Uncoordinated ship-to-shore operations often results in extra fuel consumption, congested ports and further raises the risk of accidents. An obvious solution is slow steaming, which optimizes a vessel's speed to match the arrival time to a slot opening at the port, enabling a substantial reduction in fuel consumption as well as local and global emissions. According to a study conducted by environmental group, Seas at Risk, a 10% reduction in the speed of world fleet would result in a 19% reduction in CO2 emissions.

The good thing is that technical solutions for it already exist, and the key is information sharing. The presentation explains Portify, a digital communication platform that allows for smooth data exchange between the vessel and the port community. The platform thus helps actualize the benefits of real-time coordination and ultimately achieve speed and route optimization for just-in-time arrival, based on the availability of the berth and all players involved in the vessel arrival operations.

### **6.5.3 Discussion**

Discussion highlighted the following:

- Benefits for charter parties should be considered going forward.
- Just-in Time arrival gives more reliability for estimating when goods will arrive

## **6.6 Optimizing port calls – open innovation and introduction of new technology**

### **6.6.1 Presenter and Author**

Mads Billesø, Project Manager, DFDS

### **6.6.2 Abstract**

The presentation addressed the following questions:

- What are the benefits and barriers for first movers?
- What is required from authorities when implementing new navigational technologies and how can authorities make use of and implement services?
- What is required to prepare for a future with autonomous and smart shipping?

The presentation introduced the history of DFDS. For future operations it will be a requirement to have a full picture of the cargo of when it will arrive and when the customer requires it. Cooperation is key and DFDS actively promotes open innovation and co-creation. There are various projects including drones supporting terminal logistics and improving data on cargo



## 7 SESSION 4 - CYBER SECURITY

The Session was introduced by Astrid Haug, Conference Facilitator.

### 7.1 Identity, Authentication and Blockchain Technologies for Maritime Systems

#### 7.1.1 Presenter and author

Axel Hahn, Group Manager, OFFIS

#### 7.1.2 Abstract

The presentation addressed the following question:

- How do we ensure that safety is obtained and risks reduced?

Today most communication mechanism used in eNavigation are lacking a mechanism to ensure security of the communication. AIS, GMDSS etc. do not provide support to identify the origin and integrity of a message. The only way to check the integrity of MSI seafarers is to compare the received information by messages from other sources or by their meaningfulness. Not to mention encryption which is of minor interest in maritime safety application but has its use cases as in transportation chain management.

The presentation addressed these security issues and provided examples for cyber threads as motivation for identification and authentication of messages.

The presentation introduced public key architectures for the most applied mechanism for authentication. For maritime applications it makes sense to extend this by decentralized technologies like blockchains to handle situations with limited or no communication capabilities.

In the project named HAPTIK identification, authentication and blockchain technologies will add to the Maritime Connectivity Platform. The user case of HAPTIK is using the MCP and block chain technology for bills of lading as it is not a safety related application.

The main conclusions were:

1. Cyber Security in eNavigation needs identification and authentication mechanisms
2. Maritime Connectivity Plattform and blockchains can contribute to cyber security in eNavigation
3. Cyber Security is addressed in the new eNav working program of IALA

### 7.2 Cyber security-tackling the risks involved

#### 7.2.1 Presenter and author

Ashok Srinivasan, BIMCO

#### 7.2.2 Abstract

The presentation addressed the following question:

- How do we ensure that safety is obtained and risks

There is an accelerated development in digitalization in not only shipping but also other industries. When things move fast, there is a tendency to miss out on some important things along the way. Cyber security is one such thing. It is an important link in the chain of digitalization that should be kept as strong as the other parts.

The maritime industry and the ships have seen several cyber attacks to various degrees. Some of these could also be termed as cyber safety issues, but the effects to business and the required responses remain the same. A brief look into some of the cyber security incidents onboard ships.

BIMCO, along with other industry bodies has been issuing guidelines for cyber security onboard ships, which is now in its third version. The core approach of cyber risk management in maritime operations remains

important. An explanation of the differences between the version 2 and version 3 of the guidelines were explained.

The new guidelines contain a detailed approach of linking the cyber risk management to the safety management system of a ship. It was emphasized the importance to have a single physical disconnect button to safeguard the ship against a cyber-attack.

The three most important pillars to effective cyber resilient ships are:

1. Equipment software should be designed with cyber risks in mind
2. Ships should be built in a cyber resilient way
3. The cyber risk must be managed by the ship owner

IACS has made 12 recommendations on building cyber resilience. Building a ship based on these guidelines is a starting point for cyber resilience.

Lastly, BIMCO's Cyber security clause and BIMCO's position on cyber security were introduced.

The main points of the presentation were:

1. The risks involved in cyber security are real and must be tackled at every stage.
2. To safeguard ships against potential cyber-attacks, cyber security should be in-built into the safety management system
3. A cyber resilient ship is a one where the software, hardware and the operational practice are all designed to deter an attack.
4. Having a robust cyber security clause will protect the interest of shipowners in the business arena.

### **7.3 Danish Strategy and Initiatives on Maritime Cyber and Information Security**

#### **7.3.1 Presenter and author**

Bjørn Borbye Pedersen, Chief Analyst, Cyber Security, Danish Maritime Authority

#### **7.3.2 Abstract**

The presentation addressed the following questions:

- How do we ensure that safety is obtained and risks reduced through cyber security?

As society becomes increasingly digitalized and connected the vulnerability towards failures, crash and cyber-attacks surges. To meet this risk the Danish Government made a national strategy on Cyber Security last year. In the strategy, six sectors were pinned out as critical for the society to function. This includes the maritime sector. To follow up on the national strategy Danish Maritime Authority released this January a strategy for cyber and information security for the maritime sector.

The maritime strategy is broad and includes everything from development of new regulation, extraordinary demands on critical digital infrastructure, better treat rapports, and awareness campaigns. The presentation will give an overview for initiatives and discuss what is further needed.

#### **7.3.3 Discussion**

Discussion highlighted the following:

- Consideration should be given to focussing upon specific maritime issues and learn from other higher risk sectors for general threats.
- Maritime software should be updated in order to guard against the latest cyber threats.

## **7.4 Maritime Messaging Service (MMS): The Value Transporter of the Maritime Connectivity Platform**

### **7.4.1 Presenter and Author**

Jin Park, Principal Researcher, Korean Research Institute Of Ships And Ocean Engineering

### **7.4.2 Abstract**

Communication is important in the maritime industry. MCP is a communication framework. The barriers to connectivity at sea were identified including expensive bandwidth. Sharing data is important to overcome these barriers. The design goals / principles and core functions of the Maritime Messaging Service were then shared. Trust between all stakeholders is key to the success of MMS.

MMS provides connectivity to all maritime stakeholders and the presentation urged participants to join the MCP consortium.

## **7.5 Signing Ceremony**

IALA Secretary General Francis Zachariae facilitated a signing ceremony that established the Maritime Connectivity Platform Consortium (MCC) as a neutral and independent group of interested parties that will coordinate provision of guidelines and standards to maritime navigation and transportation systems.

Mr Zachariae went on to observe that MCP had been around for a long time and it was now appropriate for a governing body to form for MCP. Over a hundred organizations have joined the platform which is why a permanent governing body is needed. It is an important step for e-navigation and this body is structured in a similar manner to the World Wide Web Consortium. All relevant organizations are encouraged to join and to conclude the ceremony, DFDS joined as a regular member.

## **7.6 Fuck it, ship it**

### **7.6.1 Presenter and Author**

Jacob Bøtter

### **7.6.2 Abstract**

The presentation started by discussing twitter as a tool for sharing issues and problem solving. Mr. Bøtters book promotes a dogma that he believes start-ups should adopt – just do it. Technology companies stand out because they follow different management models such as employee self management and they embrace technology. Technology is adopted without much debate in these environments. Tools are available now to change the way we work and so participants were invited to challenge traditional ways of working and take risks in their business activities.

## **7.7 E-Navigation Underway 2019 Asia-Pacific**

Author and Presenter

Sunbae Hong

Mr Hong thanked the organisers of e-Navigation Underway International.

The Asia Pacific Underway Conference was introduced to participants and following participants voting the location was confirmed as Seoul. All were invited to come to Korea in September 2019.

## **8 CONFERENCE HIGHLIGHTS**

### **8.1 Conference highlights**

Francis Zachariae, IALA, and Anette Dybdal Fenger, presented the conference highlights derived from the conference proceedings.

1. The need for standards persists and all stakeholders, including industry, should continue to bring harmonized standards forward.
2. Current and future technology should increase the potential of humans to work with that technology to improve safety.
3. It is important to share data with as little restriction as possible.
4. Consideration of cyber security must be an integral part of technological developments and implementation.
5. VDES is important and SAT downlink is essential to improve global connectivity. All ITU Member States are encouraged to provide support at WRC19.
6. The European Maritime Simulation Network has been proven to be useful in identifying.

The highlights were ranked in order of importance by participants. The results can be found online at <https://www.iala-aism.org/news-events/e-nav-underway/e-nav-underway-international-2019/>.

## **9 CLOSING OF THE CONFERENCE**

Mr Francis Zachariae, Secretary-General of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) thanked all participants for their attendance. He congratulated the speakers, Astrid Haug as Conference Facilitator, break out Chairs, supporting organisations and the steering committee for the excellent arrangements as well as the conference partners. He hailed e-navigation Underway International 2019 as a success with great participation and new faces from different stakeholders.

All participants were invited to the e-Navigation Underway Asia-Pacific conference in the Republic of Korea in September 2019 and the IALA Symposium that focuses on e-navigation and VTS in June 2020.

The Conference highlights were then introduced to delegates (see section 8).

Anette Dybdal Fenger, DMA, closed the conference by thanking IALA and supporting organisations and the participants. She wished all involved a safe and pleasant journey home.

## **10 EXHIBITION**

### **10.1 Exhibitors**

Safebridge GmbH ([www.safebridge.net](http://www.safebridge.net)) exhibited some of the latest e-navigation technology such as myCert. myCert is a digital platform that acts as a veritable digital ecosystem for all maritime certificates, connecting the three key players in this field: the issuers, the holders and the verifiers. All participants including IMO Secretary General Kitack Lim had a chance to visit Safebridge throughout the Conference.

## **11 SOCIAL EVENTS**

### **11.1 Welcome Reception**

On day one, the Conference was welcomed by Francis Zachariae at a reception in the Columbus Club on board, a buffet dinner was held in the Seven Seas Restaurant of the M/S Pearl Seaways. On day two, a three course dinner in the Blue Riband Restaurant.

### **11.2 Weather**

Participants experienced fair weather conditions throughout the voyage with moderate winds and calm seas.

### **11.3 Acknowledgments**

The conference expressed its appreciation to the Danish Maritime Authority and IALA for its joint organisation of e-Navigation Underway International 2019. In particular the support given by the following organizations was acknowledged:

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The Nautical Institute (NI)  
Comité International Radio-Maritime (CIRM)  
International Hydrographic Organisation (IHO)  
Baltic and International Maritime Council (BIMCO)

Thanks were also extended to those who contributed to the drafting of the conference highlights.

## ANNEX A PARTICIPANTS LIST

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Jakob	Bang	Danish Maritime Authority
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Jeoungkyu	Lim	KOREAN REGISTER
Kwang Hyun	Lim	SMART-Navigation Project Office / KRISO
Kitach	Lim	IMO
Xiang	Linhao	China Classification Society
Ziwen	Luo	CHINA MSA
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Forename	Surname	Company
Chatrine	Steenberg	FORCE Technology
Anne	Steffensen	Danish Shipping
Michael	Strandberg	Danish Maritime Authority
Michael Kirkedal	Thomsen	Department of Computer Science, University of Copenhagen
Jan	Thorn	Søfartsstyrelsen
Alexandre	Trottier-Lapointe	Marine Press
Durairaj	Venkataraman	DIRECTORATE GENERAL OF LIGHTHOUSES AND LIGHTSHIPS INDIA
Eduard	Verbeek	Netherlands Pilot Cooperation
Dierik	Vermeir	ALSIC BVBA
Eric	Verschoor	Datema Delfzijl
Gustav	Wain Bretton-Meyer	DanPilot
Søren	Westerskov	DanPilot
Susan	White	
Paul	Williams	General Lighthouse Authorities
Erik	Wolf	Lauritzen Kosan A/S
Haibo	Xu	Navigation Safety Administration of East China Sea, MOT, P.R.China
Larry Juneyoung	Yim	KIMFT(Korea Institute of Maritime and Fisheries Technology)
Francis	Zachariae	IALA
Almir	Zerem	RISE Research Institutes of Sweden

## ANNEX B RESULTS OF THE BREAKOUT SESSIONS

### SUMMARY OF THE BREAK-OUT SESSION - BARRIERS

The break-out session was organized in four phases:

1. Individual work: Everyone wrote their assumption of „Barriers“ on „PostIt“ Notes
2. Group Work: The group was split in two and each gathered around a Flip Chart, put their notes on the flip chart and then group the notes in categories
3. Group discussion: The teams presented their findings to the plenary followed by plenary discussion
4. Dot voting: Everyone had three „dots“ to put them on the most important barrier category

The following table contains all notes given:

Note	Category
Reluctance to open up to new requirements	Conservative
Reluctance on the impact on part of international bodies	Conservative
Reluctant to open up to contribution from outside the own project camp	Conservative
Earn customers trust in new technologies	Conservative
Data collaboration – Companies hold data very tightly	Conservative
National pride – “not invented here”	Conservative
Not learning from others – “Aviation”, “Road transport”	Conservative
Reluctant to open up to truly international harmonization at appropriate competent international bodies	Conservative
Conservative culture	Conservative
Protectionism by companies not willing to consider others	Conservative
Employees are not ready to perform additional work	Conservative
Wait and see approach / Leadership	Conservative
Lack of budget	Budget
It could be a barrier for e-Nav. - the sharing of sea time at traditional ships	Budget
Costs: Monetary, Time, Safety	Budget
Ship owners who will not upgrade unless mandated	Budget
Commercial interests / vested interests	Budget
Shipowners do not want additional costs	Budget
Clear Value proposition	Budget
High barrier entry costs driven by public funding levels	Budget
Need to know where to be a market	Budget
Hesitation to make investments if market is unclear	Budget
Lack of continuity at the end of e-Nav projects	Risk
STM governance needs to be in place	Risk
Training – STCW, Crews not qualified enough even now for today's environment (ECDIS)	Risk
STM concept needs to be adopted outside the EU also	Risk
Convenience Customer	Risk
Find Test beds	Risk
Risk vs. Reward not clear	Risk
Harmonization	Risk
No international cooperation and leadership	Risk
Lack of understanding what e-Navigation actually is	Risk
Moving too fast and blaming on “Humans” (Human error)	Risk
Need to know which system needs standards	Risk
No interface documents	Documentation
Certification	Documentation
Lack of Standards	Documentation

The IMO Instruments	Documentation
Standards – need to know what to build	Documentation
Complexity of documentation and large volume of documentation concerning e-Navigation	Documentation
Infrastructure regulation standard	Clash with regulations
No legal framework	Clash with regulations
New technology clashes with existing regulation	Clash with regulations
Technology moves faster than standardization process	Clash with regulations
VDES in SOLAS Chapter V instead of AIS	Clash with regulations
Electro Magnetic Compatibility of equipment	Enhanced Technology
Transition from analogue to digital radiocommunication	Enhanced Technology
Harmonized shore-based infrastructure for e-nav radiocommunication	Enhanced Technology
Software Quality Assurance (SQA)	Enhanced Technology
The confusion on what is the next step	Humans
Scared to share	Humans
Transparency	Humans
A proven market	Humans
Inertia of the “establishment”	Humans
Supportive state/governmental environment for new-comers	Humans
Traditional thinking	Humans
“If it isn’t broken don’t fix it” mentality	Humans
Risk avoidance on public and private side	Humans
Userneeds	Humans
People – Humans – Boards	Humans
Protection of Intellectual Property to seemingly maximize profit	Humans

On dot-voting following result was reached:

1. “Conservative” 23 votes
2. “Humans” 22 votes
3. “Budget” 11 votes
4. “Clash with Regs” 13 votes
5. “Risk” 10 votes
6. “Documentation” 8 votes
7. “Enhanced Tech” 6 votes

## SUMMARY OF THE BREAK-OUT SESSION - BENEFITS

The Benefits for Industry, Shipping

First movers vs second movers

- Reputational benefits of capturing markets on basis of 1<sup>st</sup> movers
- Early adopters would have more influence on standards and frameworks
- Build knowledge to increase competitive advantage

Does not replace humans rather enhances human

- Many humans error based on analysis
- Can expect to reduce amount of human error

Clear benefit of applying/adopting to applying technology

- In Collision accidents
  - can provide early warnings
  - Would help humans/ not reduce them
- Reputational

- Brand value would be important factor for shipping companies

## Safety

- Current projects to involve lower amount of “near misses” onboard
- Tailored information for decision making
- E-navigation: needs to move into a different psychological area
  - Human interaction with e navigation
  - Human machine interface: AI assistance
- Efficiency (related to fuel consumption)
  - Outcome of Mona Lisa project – would be able to save fuel by optimizing route(s).
  - Efficiency also through ports/vessel through MCP consortium
  - Reduction in administrative burden
- Reducing Human Error
  - Potential benefit to reduce human error
    - Better informed (data)
  - Automated reporting would save up to 20,000 man hours a year
    - 72 ships; 42,000 voyages a year

## Environmental effect : Region, Nation : GHGs, Micro dust

- Korea: Micro dust-needs to minimize
- To be seen as environmentally responsible
- By implementing e-nav: an opportunity to use big data for effective and efficient way
  - Fulfill regulations made by IMO
- Increased safety also has increased environmental effects
  - Oil spills
  - Reduce time duration of port calls
    - Reduced anchor time
    - Greater risk of collision

