

international



e-Navigation  
underway 2016

## REPORT

e-Navigation Underway International 2016

# The coordinated approach

Copenhagen – Oslo – Copenhagen

**2 – 4 February 2016**

## NAVIGATION UNDERWAY INTERNATIONAL 2016

### CONFERENCE REPORT

#### Executive Summary



The sixth e-Navigation Underway conference was held from 2 to 4 February, 2016 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 *The Coordinated Approach*. The conference was attended by 148 delegates, representing 22 countries and 92 organisations. The associated exhibition attracted 8 exhibitors, displaying the latest developments in e-navigation.

Following welcoming remarks from the Secretary-General of IALA, Francis Zachariae, the conference chairman, Omar Frits Eriksson, set the scene and key notes speech was given by Mr Kitack Lim, Secretary-General of IMO and Mr Andreas Nordseth – Director General of the Danish Maritime Authority (DMA).

A series of 28 presentations were given under the following broad headings:

- The coordinated approach;
- Technical solutions and implementations;
- Concepts, training aspects and the human element:

A panel discussion considered a number of topical questions.

The conference generated five conclusions.

- 1 Stakeholders are cooperating and coordinating and are actively exploring methods to harmonise e-navigation data and communications.
- 2 IALA may be an appropriate organisation to coordinate the IMO unplanned output 6 on MSPs and harmonise the format, structure and communications channels for the exchange of information electronically.
- 3 Recognising the value of the BIMCO cyber security guidelines, the e-navigation stakeholders agreed that similar cyber and data security measures must underpin e-navigation.
- 4 Participants recognised that e-navigation should improve the human decision making process, not replace it.
- 5 Participants considered that the concept of the Maritime Cloud could support e-navigation infrastructure and trials are underway.

An invitation was issued to the 2016 e-Navigation Underway (North America) Conference to be held on October 17<sup>th</sup> to 19<sup>th</sup>, 2016 at the San Jacinto College, Maritime Technology and Training Center, Houston, Texas, USA.

The establishment of the CIRM User Feedback Forum, hosted on the CIRM website was announced as a joint venture by CIRM (representing the system designers and manufacturers) and the Nautical Institute (representing the users).

The presentations from the sessions are provided on the e-navigation.net web site.



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# INTERNATIONAL E-NAVIGATION UNDERWAY 2016

## THE COORDINATED APPROACH



### 1 INTRODUCTION

The sixth e-Navigation Underway International conference was held from 2 to 4 February, 2016 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 *The Coordinated Approach*. The conference was attended by 148 delegates, representing 22 countries and 92 organisations. The associated exhibition attracted 8 exhibitors, displaying the latest developments in e-navigation.



A list of participants is at 1ANNEX C.

### 2 OPENING OF THE CONFERENCE

Chaired by Francis Zachariae, Secretary-General of IALA.

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

Francis Zachariae, Secretary-General of IALA, welcomed the participants to the 6<sup>th</sup> e-Navigation Underway International conference and recalled the theme of the conference, The Coordinated Approach.

Mr Zachariae considered that a mistake had been made in 2007 in considering e-navigation as a project. It is an evolution that will not stop. He noted the need for a business plan that all stakeholders can work with and contribute to. The focus should be on simple solutions.



He noted that the conference incorporated coordination of both technical and human factors. While everyone wants to coordinate e-navigation, nobody wants to be coordinated. He questioned if e-navigation is a project and if there is a business plan? He considered what is needed and suggested a harmonised format, structure and communication channels providing connectivity.

Mr Zachariae welcomed all participants and speakers, with special thanks to Mr Kitack Lim, Secretary-General of the IMO, who was to give the keynote address. He thanked the DMA “Dream Team” for their excellent work in organising the conference.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.



## 2.2 Key Note Speech: Mr Kitack Lim, Secretary-General of IMO

Noting that this was the first major external event that he had been invited to address in his new role as Secretary General of IMO, Mr Kitack noted that one of his most important objectives at IMO is to ensure that the Organisation continues to draw on the experience and the knowledge of those involved in shipping at the operational level.



Considering what is meant by e navigation he felt that the aim of e-navigation is to meet present and future user needs through the harmonisation of marine navigation systems and supporting shore services; and the overall goal is to improve safety of navigation and to reduce errors by equipping users, on ships and ashore, with modern, proven tools, optimised for good decision making, to make maritime navigation and communication more reliable and user-friendly.

That strategy for the development and implementation of e-navigation identified IMO as the one, single, institution having the technical, operational and legal competences needed to define and enforce the overarching framework for the implementation of e-navigation. However, that does not mean that IMO has to carry out all the relevant tasks in-house. The development of e-navigation is clearly a collective task. IMO may play a central and co-ordinating role and Mr Kitack set up a number of associated responsibilities. The need to cooperate was emphasised – this also goes for IMO and IALA, and indeed for IHO.

Is the maritime community right now on the collective journey towards meeting the aims and objectives underpinning the development of e-navigation?

Mr Lim referred to the gap analysis from the development and implementation strategy for e-navigation and to five priority solutions which formed the basis of the e-navigation Strategy Implementation Plan (SIP). Although not prioritised at this stage the remaining identified potential e-navigation solutions would, it was agreed, be addressed in the future, as e-navigation evolves and develops.

The SIP contains a list of 17 tasks emanating from the five prioritised e-navigation solutions. These, it has been agreed, should be implemented between 2016 and 2019. Last year, the Maritime Safety Committee considered a number of proposals and agreed to include five new outputs in IMO's High-level Action Plan under the heading "Development and implementation of e-navigation".

The first three new output will be considered at the IMO Sub-Committee on Navigation, Communications and Search and Rescue in March this year. The fourth and fifth outputs of the five new outputs in IMO's High-level Action Plan are both planned for a 2018-2019 timeframe.

The development of other tasks will require further outputs or are tasks required to be conducted either by the industry or by organisations other than IMO. This output will require inputs from different organizations involved in the implementation of MSPs such as IALA, IHO and WMO.

There is also a need to review the list of gaps and to address the remaining potential e-navigation solutions that were not initially prioritised, driven by clearly identified user requirements, and not by technology with user needs addressed in a cost-effective manner. There is a need to ensure that the end-user sees some real value emerging from all this effort.

Mr Lim highlighted the vital importance of conducting technical cooperation and capacity-building activities in various parts of the world, to promote and provide information on the status of the implementation of e-navigation initiatives.

In concluding Mr Lim considered various meaning for the “e” in e-navigaiton.

The full text of Mr Lim’s speech is in 1ANNEX A.

## 2.3 Keynote speech by Mr Andreas Nordseth – Director General of the Danish Maritime Authority (DMA)

Mr Nordseth considered two key messages.

Firstly shipping of the future is closely linked to ICT with the possibility of being online everywhere, all the time. The potential for combining these data is enormous. The maritime world is a part of “Industry 4.0” – the fourth technological revolution. Smart, competitive shipping, ready for the future, depends on us unlocking this potential. To realise this potential, each stakeholder has a role to play and a coordinated approach is needed for the work ahead. Legislators must provide the right, legislative framework to support innovation, development and up take. The process can only be market-driven. The industry side must be actively involved and committed for the potential to be realized.



Secondly, the key to unlocking this potential for shipping of the future is a coordinated approach. Each stakeholder has a role to play, but a coordinated approach means pulling in the same direction across authorities, business sectors, regions and international fora. The coordinated approach must rest on sensible, smart solutions to support smart shipping. Smart, competitive and sustainable shipping depends, first of all, on efficiency. And to be sharp and efficient today and in the future shipping must embrace and fully use the potential of ICT-solutions.

Shipping has always been characterised by a need to communicate and about finding new, smarter ways to do so. Today’s opportunity is using information technology in combination with communication. This means that shipping has reached a critical juncture. And this big picture is bigger than e-navigation. It is about ICT changing the way we do business every day.

Maritime data is collected around the clock by a myriad of actors, around the world. e-Navigation is one of the ways in which information technology can be embraced. Big Data is already out there on the oceans – waiting to be fully utilised. Provided the right infrastructure is put in place, the maritime community will end up with a box of new and exciting tools. But all technological game changers have been accompanied with debates about, on the one hand, the potential benefits for our businesses and our welfare, and on the other, the potential threats.

The human element is still vital – it is simply applied in new ways. But e-navigation is a good example of the very human way of dealing with change. And it creates a natural push/pull-effect that may in fact work to advantage. The real challenge is expanding our mindset so that w ICT is applied on much bigger, global scale – and come to think of ICT not only as a new, extra tool, but as the foundation for the way in which business is done if competitiveness is to be retained.

How can the potential be realised. Experience shows that highly detailed regulatory framework can turn out to have a very negative impact while a basic, regulatory framework based on the idea of market-driven standards, can help industries prosper. The fourth industrial revolution is about fundamentally rethinking the way that goods are produced and services delivered. The maritime world revolves around a concept of cooperation between regulators and industry.

Just as new possibilities for using the technology are thought of every day, the drivers behind the technology have changed. There has been a move away from thinking only in terms of safety and security, towards optimisation, connectivity and human welfare on board ships.

The full text of Mr Nordseth’s address is provided in 1ANNEX B.

## 2.4 Status of needed governmental actions for the implementation of the e-navigation solutions – Mr John Erik Hagen, Regional Director Norwegian Coastal Administration

Mr Hagen provided a reminder of the expectations of e-navigation from the report of MSC 85 held in November 2008 in which the three areas where changes are expected were defined, that is on board, ashore and the communications supporting e-navigation in general.



He presented a summary of the decisions taken at MSC 95 in June 2015 for the progress of e-navigation and detailed the timescales for each output and the IMO sub-committee dealing with it. He provided some detail to the outputs and the work that needs to be done for the high priority items.

He presented the current IEC standardisation work that will have an effect on the programme as well as looking at the GMDSS modernisation plan and how future communications strategies will support e-navigation. He reviewed other input papers to NCSR 3 which may be relevant, as well as the Common Maritime Data Structure which is important.

The support of IGOs and NGOs at IMO is important for e-navigation and ideas were proposed where these organisations can help.

A short video from Australia on the Guidelines on Software Quality Assurance and Human Centred Design was included.

He asked how can e-navigation be done, both on board and ashore, now that all the pieces are on the table. He recalled the 5 solutions and looked at their effect on the equipment on board and looked at the future of ship reporting and the reception of MSPs. He posed questions on what needs to be done to prepare the shore side as well as the ship for a functioning e-navigation system.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.

### 2.4.1 Discussion

Responding to a query regarding when and how the other solutions as described by the IMO Secretary-General, Mr Hagen noted the need for resources for their work. Noting the good track record for implementing the MSC solutions, he hoped for a joint effort from all stakeholders and organisations.

Mr Hagen agreed that there is a need for care in managing the discussion at NCSR regarding the modernisation of GMDSS without change to user requirements.

## 2.5 Setting the scene, IALA's work on the physical and logical e-navigation communication framework – Mr Omar Frits Ericsson, DMA, Chairman IALA e-Navgation Committee and conference chairman

Mr Omar Frits Eriksson welcomed the audience, seeing many familiar, but also new faces, and took the participants through the practicalities of the trip ahead.



He also noted that if any of the speakers were uncomfortable with the presentation slides being put on the internet, they were welcome to request that the material not be made available online.

Considering the IALA ENAV Committee, he reviewed the background of the e-navigation concept and the IALA strategic goals, composition and terms of reference of the ENAV Committee and the ENAV Committee workplan. He noted the Maritime Infrastructure Framework and Maritime Cloud concepts and highlighted work on unique identifiers for maritime resources and information. Having described the failure of Kodak due to ignoring inevitable change, he considered that the maritime business is changing into the business of connectivity and advocated connect or go Kodak.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.



## 2.5.1 Discussion

Responding to a query re IALA harmonisation with organisations other than IMO regarding LRIT, Mr Eriksson agreed that this is something that could be progressed. He also noted that harmonisation does not mean interoperability but rather interfacing.

# Themed Sessions

The themed sessions comprised 25 presentations related to e-navigation, test beds, infrastructure, communication technologies, e-navigation and non-SOLAS vessels, specific e-navigation services, standardisation and other relevant topics.

## 3 THEME 1 – THE COORDINATED APPROACH

The Session was chaired by Francis Zachariae, Secretary-General of IALA.

Theme 1 presentations respond to the following central questions:

- a. How will your organisation utilise the e-navigation communications framework in creating value to your customers?
- b. How will your organisation assist in progressing e-navigation?

### 3.1 The IHO contribution to the implementation of the e-Navigation strategy

#### 3.1.1 Presenter and author

Mr Robert Ward, President, IHO.

#### 3.1.2 Abstract

Robert Ward, President of the IHO described his view of e-navigation and how the IHO is contributing to ensuring the smooth and successful implementation of the IMO's e-navigation concept.

He provided a brief summary of the digital information environment that now exists to progressively replace the paper-based nautical charting services traditionally provided by national Hydrographic Offices. He described how the developing digital charting environment and the need for a flexible and contemporary data transfer standard has also provided the S-100 baseline data transfer standard for e-navigation. He noted that e-navigation is inevitable and unstoppable but needs to be coordinated in its evolution and implementation.

He described the support that the IHO is providing for the S-100 standard and the collaboration and the cooperation that exists between the IHO and IGOs, NGO's, States and industry - all of which are now developing services to be delivered under an e-navigation environment. He announced that IHO is establishing a dedicated help desk officer for S-100 and invited applications.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.

#### 3.1.3 Discussion

Responding to a query regarding the implementation of schema for portrayal in S-100, Mr Ward noted that S-100 will never be finalised because it is a flexible and updatable structure. The work on portrayal will enhance S-100 in one area. There is a lack of expertise in IHO regarding portrayal and there is a general need for input and participation to develop user requirements.



## 3.2 IMPA

### 3.2.1 Presenter and author

Mr Simon Pelletier, President, IMPA.

### 3.2.2 Abstract

Advocating care when thinking outside the box, Simon Pelletier encouraged the correct focus and practicality for e-navigation. He considered that the use of e-navigation tools such as simulators and PPU's by pilots was a major benefit to their work. He described the use of PPU's in the St Lawrence seaways in Canada leading to safer, cleaner and more efficient transits. He considered that collaboration and coordination were basic.



The key considerations for implementation of e-navigation are consensus building while remaining both practical and realistic. The Canadian workshop for maritime stakeholders is proving effective. He considered that e-navigation is evolution rather than revolution. New technology compliments navigator experience and there is no substitute for local knowledge and experience.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.

### 3.2.3 Discussion

Responding to a query regarding the advisability of formalising the internal architecture of PPU's and certification, Mr Pelletier considered that lessons should be learned from the experience with ECDIS.

Considering data security, training and implementation, Mr Pelletier responded that pilots voluntarily adopted the PPU. Data is provided from reliable sources such as the Hydrographic Office and the Canadian Coast Guard.

## 3.3 Nautical Institute

### 3.3.1 Presenter and author

Mr David Patraiko, Director of Projects, Nautical Institute.

### 3.3.2 Abstract

David Patraiko explained how important e-navigation was to Nautical Institute (NI) members and how critical it was that mariner organisations worked closely with all other stakeholders during the development of e-navigation. The NI is the International professional body that "supports those in control of sea-going craft", and as such finds great value in participating in this IMO 'user needs led' concept of e-navigation. IMO has adopted that the compelling need for e-navigation is to ensure that complex navigation/communication systems remain user friendly into the future. The NI with its global network of branches and seagoing members spent many of the early years educating mariners about the goals of e-navigation and then soliciting from them what their needs were. Working closely with the IMO, IALA, IHO, CIRM and many others the NI was able to articulate some of these needs which have now been adopted as development priorities.



Examples include the need for more resilient systems with reliable data as mariners are challenged enough to make good navigation decisions but rarely have the ability to troubleshoot faulty systems or second guess the accuracy of data. Standard interfaces (S-Mode) is another issue where mariners have express a growing concern as epitomised with the wide variety of early ECDIS systems. The issue of greater standardisation has become a key challenge that is now being addressed by the wider industry through e-navigation. The application of user centred design for better ergonomics is also directly addressing issues raised through the NI by mariners. As e-navigation heralds a new approach to greater harmonisation of ship/shore co-operation on navigational issues, The Nautical Institute is proud to work closely with all the other e-navigation stakeholders to ensure that user needs are translated into effective systems that meet the shared IMO goals of safety, security and environmental protection. It is only through these multi-disciplinary collaborations that our industry can meet the challenges of the future.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.

### 3.4 CIRM

#### 3.4.1 Presenter and author

Ms Frances Baskerville, Secretary-General, CIRM.

#### 3.4.2 Abstract

The Comité International Radio-Maritime (CIRM) has a duty of care to make their members fully au fait with the established e- Navigation framework. CIRM is working hard to contribute to the development of e-navigation by helping to move the concept forward and advising decision makers on technical possibilities. To maximise benefits and ensure quality assurance, the most interesting elements were considered, with members' points of view highlighted for discussion. There is no doubt that navigation and communications equipment manufacturers worldwide are now ready to address the challenges of fulfilling the concept of e-navigation and Ms Baskerville showed what they are thinking and how there are already systems in place to help make e-navigation available to all.



The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.

#### 3.4.3 Discussion

Regarding harmonisation, Ms Baskerville stated that CIRM works with organisations such as IALA, IMO, etc.

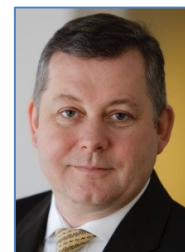
### 3.5 BIMCO

#### 3.5.1 Presenter and author

Capt Lars Robert Pedersen, Deputy Secretary-General, BIMCO.

#### 3.5.2 Abstract

Protecting IT systems and data against unauthorised access is a relative target. No system is 100% secure – it is all about how secure the system is required to be – a weighing of cost against benefit. A risk based approach is needed as the circumstances are diverse and differ from one company to another.



e-Navigation is about creating seamless exchange of data between ship and shore, between ships, and between shore based organisations and stakeholders in the maritime industry. To accomplish this, systems on-board and ashore need to trust one another. Ships and entities need to be uniquely identified, data encrypted and certificates maintained to document identities. A secure environment is needed to cater for such trust, and as cyber security is a moving target, it is hard, if not impossible, to construct ultimately secure systems.

Cyber security need to be managed on the technical level and on the human element level. Systems must be assessed, an appropriate risk profile adopted, protective measures applied, personnel trained, procedures established, and not least all of this maintained on both the technical and procedural level.

Cyber security guidelines have been developed for application to systems on-board ships. It was proposed that cyber security guidelines must be an inherent element in designing, implementation and operation of e-navigation solutions.

Trust is of essence, and all stakeholders must be able to rely on the data exchanged between parties.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.

#### 3.5.3 Discussion

Considering a query regarding the suitability of the guideline on cyber security as a basis for an IALA guideline for shore-based infrastructure, Capt Pedersen responded that the guideline is built on the NIST framework for cyber security and is available to anyone as a framework for further work.

It was also noted that built-in cyber security in equipment must be backed up by operational and maintenance procedures.

It could be considered that e-navigation reduces complexity in a world of ever increasing complexity.

The age demographic indicating response to new technology may imply a need for a change in the way that officers are trained.

## 3.6 INTERTANKO

### 3.6.1 Presenter and author

Mr Johan Gahnström, Senior Manager, INTERTANKO.

### 3.6.2 Abstract

INTERTANKO, the International Association of Independent Tanker Owners is committed to focus on the two ONLY really important things when taking e-navigation to the next step, Zero Groundings and Zero Collisions.



Despite a huge decrease in major oil spills since the 1970s due to proactive work by the industry there are still incidents happening in a number that INTERTANKO cannot accept. The human factor element in the shipping industry is vital. With efforts on raising the competency on-board, INTERTANKO drives the human factor to the next level. However there is also a need to assist the officer on watch as much as possible with new developing initiatives like e-navigation.

INTERTANKO will join the coordinate approach by:

**What:** INTERTANKO members will use the added value that e-navigation enables to enhance safety of navigation and security for seafarers and vessels. It is of outmost importance that the underlying purpose for any new development is that it simplifies and enables safer and possibly more environmental friendly shipping. The human element and the seafarer that uses the systems must always be kept in mind when engineering new systems.

**How:** Through member feedback in our committees and working groups INTERTANKO can give direct feedback and suggestions from the end users. INTERTANKO as an organisation will continue to actively participate in, and with, a coordinated approach.

INTERTANKO like to see:

- Standardised description of Data: IHO S-100 series to be used as THE TOOL for Standardised description of Data to be transferred in the e-navigation framework. Way too few testbeds use S-100 and that is not acceptable;
- Communications on-board: A new system standard needs to be developed;
  - Today: NMEA; is not open (at least not latest version), slow(not all), not secure, only scalable to a small extent. Communication is manufacturer specific; not open, secure??
  - Tomorrow, need for ONE system that is Scalable, Fast, Open [source], Secure, Use Internet of Things Technology??
- Communication Ship-Shore: A lot of effort is ongoing in this area, such as Efficiencysea 2.0, the Maritime Cloud, etc. However, a coordinated approach is needed to develop standard(s) for some concepts where service providers can then find a market for their products.

With this, service providers and other stakeholders can, with a standard approach, sell and make available services to vessels with least administrative burden, being cost effective for the industry and lastly increase safety and security.

INTERTANKO and IMPA work very closely together. e-Navigation must support pilotage with an increasing amount of PPUs around, the officers on-board will not have the same information as the pilot. INTERTANKO would like to see solutions enabling pilots to use the ships equipment, in a way that the pilot needs and

requires. Remembering that a pilot will see every manufacturers systems, standard displays for the pilots (a P mode)? as well as S-100 Registry for the implementation!

The focus is on the two ONLY really important things when taking e-navigation to the next step - zero groundings and zero collisions. Think benefit for the navigator and ship safety when designing next generation of tools. Cyber security is becoming a concern for the industry - build in protection to the hardware and software!

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-1-3>.

### 3.6.3 Discussion

In discussion, Mr Gahnström noted that complexity leading to more difficult to operate systems should not be added to the bridge.

Information on collisions and groundings is collected from incidents and improvement in the sourcing of data is possible.

## 4 THEME 2 – TECHNICAL SOLUTIONS AND IMPLEMENTATIONS

Chair: Mr Jin Park, KRISO.

### 4.1 Communication gateway for e-navigation

#### 4.1.1 Presenter and author

Associate Professor Feixiang Zhu, Associate Professor, Dalian Maritime University, China.

#### 4.1.2 Abstract

**Background:** e-Navigation is the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment. Therefore, the exchange of marine information on board and ashore is the key issue of e-navigation.



**Needs:** Six outputs have been identified and prioritised, based on the original 18 tasks for the five agreed solutions from the approved e-navigation SIP during MSC 95. In addition, three outputs were identified as high priority items - INS modules, ship reporting guidelines and display guidelines - which are based on information exchange between navigation systems and communication systems.

Therefore, a communications gateway which connects the navigation systems and communication systems is aimed at bi-directional communications. Two potential functions are necessary, the first is routing the received navigational information from communication equipment into the integrated navigation systems, the other is routing the ship reporting information from the integrated navigation systems into the communication systems.

**Approach:** A communication gateway named “SCOM” is proposed to meet the needs of information exchange between ship and shore. It has bi-directional communication capability which enables the gateway not only to receive the control information sent by the systems on shore, but also select the best communication links according to the information types and sizes for sending the information to the systems on shore. Specifically, an intelligent routing algorithm based on information characteristics is developed. In addition, a polymorphism heterogeneous data acquisition method is proposed.

**Result:** The communication gateway proposed has been designed and implemented, and it has been installed by more than 40 ocean-going ships.

**Project:** This research has been supported by the National science and technology support project “Online Monitoring System for Ocean Ships and Cargo Transportation”.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.



### 4.1.3 Discussion

Considering a question if the ship-board equipment required any adjustment or renewal of type approval to meet the requirements of the communications gateway, Mr Zhu responded that the system uses fully automatic routing.

Regarding the selection of shore networks such as provided by Smartbooks for cheapest service, Mr Zhu stated that the gateway systems uses intelligent selection of communications channels.

## 4.2 Field Test of Pilot Small Sea Area Ship Information System using Maritime Cloud and Smart Phones

### 4.2.1 Presenter and author

Mr Yasuyuki Niwa, Senior Researcher, National Maritime Research Institute, Japan.

### 4.2.2 Abstract

At the e-Navigation Underway 2015 conference, Dr. Junji Fukuto, Japan made a presentation titled “Development of a pilot small sea area ship information system using Maritime Cloud and smart phones”. The presentation described the plan to develop a pilot small sea area ship information system (the information system) using the Maritime Cloud, which will provide maritime services via Internet.



Japan is going to carry out a field test of the information system from December 2015. Mr Niwa introduced the preliminary report on the field test.

The information system is composed of a server, an AIS receiver and smart phones. The server is built in the manner of the Maritime Cloud and acquires AIS information from the AIS receiver in the small sea area and GPS information from smart phones. It then provides area ship information through the Internet. The smart phone receives live ships' information of the small sea area and sends its own GPS position and attribute information from / to the Maritime Cloud.

The field test will evaluate the availability considering GPS position accuracy and the time delay of the smart phone and the Maritime Cloud server.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

### 4.2.3 Discussion

Considering a question regarding any future plans for further research on small ship information system, Mr Niwa responded that further research opportunities exist but require funding. The present research ends in March.

It was suggested that collaboration between KRISO and the National Maritime Research Institute on implementation of the Maritime Cloud would be useful.

## 4.3 Implementation of Joint Test Bed for the Dissemination of Electronic Marine Safety Information (eMSI) via AIS (Requirements for an AIS transmit service)

### 4.3.1 Presenter and author

Authors: G. Johnson, Alion Science and Technology, USA; B. Tetreault, U.S. Army Corps of Engineers, USA; and S. Fields, U.S. Coast Guard R&D Center, USA.

Presenter: Mr Brian Tetreault, Navigation Systems Specialist, US Army Corps of Engineer.

### 4.3.2 Abstract

The Automatic Identification System (AIS) is an autonomous and continuous broadcast system that exchanges maritime safety information between participating vessels and shore stations. In addition to providing a means for maritime administrations to effectively track the movement of vessels in coastal and inland waters, AIS can be a means to transmit information to ships in port or underway that contributes to safety-of-



navigation and protection of the environment. This includes meteorological and hydrographic data, carriage of dangerous cargos, safety and security zones, status of waterway infrastructure and Aids to Navigation (AtoNs), and other port/waterway safety information.

While AIS is a highly effective means of providing information about vessel position and identification to a Vessel Traffic Service (VTS) Center, it can also be used as a tool for communication by utilising AIS transmit capability. Since 2007, The U.S. Coast Guard Research and Development Center has been working to establish AIS transmit capability by identifying operational requirements, developing processes and procedures, and testing these processes and procedures in various AIS transmit test beds. One of the major outcomes of the test bed assessments was the identification and quantification of the processes needed in order to create and transmit Application-Specific Messages (ASMs). The identification of the processes led to the development of a prototype AIS Transmit architecture which includes the use of an ASM Manager and an AIS network controller or “AIS router” that is used to route data between the Physical Shore Stations (PSS) / AIS Base Stations (BS) and the various clients associated with the creation of ASMs (database storage, Electronic Charting Systems, etc.).

The USCG has partnered with the United States Army Corps of Engineers to test this architecture for the dissemination of enhanced Marine Safety Information (eMSI) along inland waterways in the Ohio River eMSI Demonstration. The goal of the eMSI project is to improve the safety and efficiency of maritime operations via the dissemination of navigation-related information that can be displayed on an Electronic Charting System (ECS). This information will be transmitted to vessels using Automatic Identification System (AIS) transmitters located along the rivers.

Information to be transmitted will include Synthetic and Virtual AtoN, Meteorological observations and forecasts, Current and forecast water depth, Observed, modeled, and forecast river currents, Lock status, including vessels awaiting lockage, lockage times, delays, etc, Lock and dam status. This information will be available for display on vessels using their existing AIS equipment and an ECS that is capable of processing and displaying AIS message 21 and appropriate ASMs.

Mr Tetreault discussed the AIS transmit architecture as implemented for the Ohio River eMSI Demonstration and the systems implemented for collecting and analysing data to assess performance. He also addressed lessons learned to date and potential applicability outside the United States, including incorporation of transmit architecture functions and requirements in appropriate international recommendations, guidelines, and standards. He issued an invitation to industry to collaborate.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

#### 4.3.3 Discussion

Responding to a query re authentication, Mr Tetreault responded that authentication is part of the message creation service and assumes that the transmit path is secure.

Regarding VHF data channel loading (VDL), Mr Tetreault indicated that the VDL monitoring system calculates the probability of the message being received. However more study is required and test are being carried out on the Ohio river.

It was added that IALA are working on a VHF data exchange system (VDES) which includes retaining the existing two channels for safety messages and adding an additional two channels for additional messages and application specific messages (ASM).

Chair: Richard Doherty, CIRM.

### 4.4 S-100 Based e-Navigation Application Prototype Development

#### 4.4.1 Presenter and author

Mr JJ Unggyu Kim, CEO, E-Marine, Korea.

#### 4.4.2 Abstract

Mr Kim presented an outcome of the four year e-navigation applications project, funded by Korean Ministry of Industry, trade and resource.

The project, now in its last year, is producing e-navigation applications, with IHO S-100 standard implemented, such as;

- S-101 ECDIS with multi-products of e-navigation messages including MSI, MPA, Route Information and weather information overlaid;
- On-Shore based S-100 Web/App services including Tile-Map service, ENC update streaming, mobile navigation, AIS traffic monitoring and others;
- AR (Augmented Reality) navigation system to integrate S-100 data onto real-time CCTV visual information.



The presentation aimed to share knowledge and experience through the project, highlighting the applicability of newly developing IHO S-100 standard data model into ship's navigation and communication equipment in the coming era of e-navigation.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

## 4.5 Data Supply Chain Certification - Quality Monitoring and Indication for e-Navigation Solution Reliability

### 4.5.1 Presenter and author

Mr Michael Bergmann, Director, Maritime Industry, Jeppesen, Germany.

### 4.5.2 Abstract

The crucial backbone of e-navigation is data streams enabling the systems on-board and ashore to perform the envisioned e-navigation tasks. This essential component of e-navigation needs to be reliable, as otherwise the e-navigation systems would not be trustworthy.



In order to reach the end user the data is processed through a supply chain, which may involve various stakeholders from data generators to data processors, data distributors and more. For decades the aviation community, in the form of the RTCA organisation, has developed and perfected a data standard called DO-200A. It is used in aviation circles for data chain certification for advanced, high precision navigational data streams. In the Hydrographic Office community, a group of hydrographic offices, organisations and expert contributors have looked into options to utilise the experience gained in aviation and the applicability for marine use.

Mr Bergmann provided an overview of the DO-200A standard and the results of the task group. He showed areas of applicability for marine and the necessary next steps to develop a maritime "Data Supply Chain Certification" standard as prerequisite for reliable data streams in e-navigation.

He demonstrated the need for ensuring the quality of the complete data supply chain of marine navigational data. He highlighted that certification is much more desirable than a simple "trust" concept.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

### 4.5.3 Discussion

Responding to a query, Mr Bergmann said that the concept of ship domain/ arena is well known developing idea. Ship owners and navigators like the concept. There are pitfalls in that the error budgets are still not known. There is a parallel in aviation in the European Open Sky concept which defines a safety zone around an aircraft rather than the traditional fixed height separation.

## 4.6 Proposal for a Roadmap for Roll-Out of Automated Ship Reporting

### 4.6.1 Presenter and author

Authors: Yu Yung-Ho, Professor, College of Engineering, Korea Maritime and Ocean University Head, Advanced IT & Ship Convergence Center, Korea and Fred W. Pot, Principal, Marine Management Consulting, USA.

Presenter: Fred W. Pot, Principal, Marine Management Consulting, USA.

### 4.6.2 Abstract

The authors proposed a practical roadmap for the roll-out of automated ship reporting as one of the prioritised solutions to be addressed by e-navigation. Specifically, IMO's Sub-Committee on Navigation, Communications and Search and Rescue (NCSR) 1<sup>st</sup> session in March 2014 adopted "S2: means for standardised and automated reporting" as a prioritised solution. Task T9 of the e-navigation Strategic Implementation Plan (SIP) specifically lists *"Investigate the best way to automate the collection of internal ship data for reporting including static and dynamic information"* in 2016.



Mr Pot presented a prototype of an automated ship reporting system developed by Prof. Yu Yung-Ho in cooperation with Hanjin Shipping Co, and proposed a roadmap that includes several testbeds, each building on the results of the previous testbed. The tests would expand not only the coverage of the prototype system to include additional ports and vessel types but would also test additional features that could further streamline ship reporting processes and procedures if information privacy issues are addressed to the satisfaction of ship owners/operators.

#### Proposed Roadmap for roll-out of Automated Ship Reporting

- 1 IMO FAL Committee asks IALA & IEC to develop Ship Reporting Standards to create a viable "eco" system for reporting app developers.
- 2 IALA identifies and categorises Ship Reports in an open library with bi-annual updates.
- 3 IALA designs and publishes the Reporting Database S-200 PS with bi-annual updates.
- 4 IEC adopts emerging Internet of Things (IoT) standards for ship-board M2M interfaces.
- 5 ICS/BIMCO set-up and administer access to the Reporting Database by authenticated users at the direction of individual shipping lines.
- 6 ICS/BIMCO develops and publishes software that enable reporting app developers to "self-test" compliance with Ship Reporting Standards.
- 7 Shipping lines and 3<sup>rd</sup> party vendors develop and maintain reporting apps.
- 8 Shore-side Authorities develop and maintain Reporting Database query tools.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

### 4.6.3 Discussion

Responding to a query regarding the size of the bridge team, Mr Pot advised that the proposed automatic ship reporting system will collect data automatically from ship board systems. In scenario 2, input of data would be delegated to shore based operatives.

Considering the proposal that IALA should develop Ship Reporting Standards to create a viable "eco" system for reporting app developers and be owner of the Ship Reporting Library, it was felt that this relates to on-board systems and is outside the scope of IALA. It was suggested that there are 21 documents input to NCSR3, part of which relates to ship reporting and NCSR3 may be a suitable avenue to introduce the project to IMO. It was noted that CIRM should also be involved.

It was further noted that Mr Pot is planning to set up a special interest group arising from the IALA Seminar on Maritime Digital Infrastructure in Gothenburg and this may be the first step in progressing the project.

The idea of the Universal Resource Name was supported.

## 4.7 Case Study: e-Navigation Trials on APPS Project

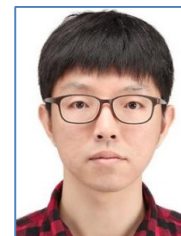
### 4.7.1 Presenter and author

Authors: Kilyong Kim, GMT Co., Ltd., Korea; Seung yul Lee, WBJSOFT Co., Ltd., Korea; Seojeong Lee, Division of Maritime IT Engineering, National Korea Maritime University, Korea, (corresponding author)

Presenter: Mr Kilyong Kim, Senior Research Engineer, Global Maritime Technology (GMT) Co. Ltd., Korea.

### 4.7.2 Abstract

APPS (Advancing Plug & Play Smart Surveillance) is an international joint R&D project in collaboration with 15 universities and companies from Netherland, Turkey, Spain and the Republic of Korea. Mr Kim introduced a case study on e-navigation of GMT as a Korean partner of APPS, developing a service interconnecting on-board sensors, introducing IoT technology and applying SQA (Software Quality Assurance). APPS is a service to interconnect various on-board sensors to analyse the ship's emergency situation, collision prediction and abnormal sailing pattern. IoT technology is introduced to guide a safe route in real time through exchanging information between the systems autonomously. To improve the software development process, the concept of e-navigation SQA and software engineering techniques were applied.



The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

## 4.8 The Concepts of the Maritime Cloud

### 4.8.1 Presenter and author

Authors: Axel Hahn (OFFIS), Jens Jensen (DMA), Mikael Lind (Viktorias Swedish ICT), Thomas Lutz (Frequentis), Benjamin Weinert (OFFIS)

Presenter: Prof Axel Hahn, Professor, OFFIS, Germany.

### 4.8.2 Abstract

**Introduction.** The Maritime Cloud concept has been derived as “a communication framework enabling efficient, secure, reliable and seamless electronic information exchange between all authorised maritime stakeholders across available communication systems”, based on the IMO e-navigation strategy. The vision reaches beyond the IMO strategy, matching the goals of the EU e-maritime initiative and more.



**Problem statement.** The mission of the Maritime Cloud is to enable an open vendor-neutral platform for the maritime sector that facilitates information exchange easily and securely across various communication channels such as the Internet, satellite and digital radio links. It will allow heterogeneous software systems on board various ship types, on offshore structures or on shore, including dedicated type approved systems, smartphones, tablets and personal computers to interact, according to standardised interfaces, protocols and access control rights.

The Maritime Cloud is not a product aimed at end users such as mariners or ship owners. Instead, it is a framework providing standardised protocol and functional support for Identity and role management, authentication, encryption, authenticity validation, service discovery and bandwidth efficient messaging in a geographic context. This enables easy development of innovative solutions targeted at maritime end users in a context of global interoperability, much as the internet is the enabler of interoperable systems for email, VoIP, webpages, blogs, social networks, and online shopping sites.

**Approach.** Prof Hahn gave an update of the recent development and status of the Maritime Cloud. He followed an Enterprise Architecture Approach by using the Maritime Architecture Framework to present the main conceptual ideas for the implementation of the Maritime Cloud elements as done in the context of the projects EfficienSea2 and Sea Traffic Management. He covered the Service Registry and Service Management, an Alamnac, the Maritime Messaging Service and the Maritime Cloud Client components.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.



### 4.8.3 Discussion

Responding to a query regarding the non acceptance of the Maritime Cloud for GMDSS, Mr Hahn said that the broadcast system could be hacked, giving rise to false information that could take time to detect and he advocated the common prudent use of multiple systems and redundancy.

Considering the method by which a service provider could be certified for inclusion in the Service Registry, Mr Hahn said that the services are all existing and qualification could be similar to internet services. He noted that there is also a need to qualify communications systems.

The concept of the Maritime Cloud was supported, although the IMO has not yet adopted it.

It was suggested that the Maritime Cloud and GMDSS should complement each other.

It was noted that the IALA IWRAP Risk Management Tool now includes a safety zone ellipse for each target vessel.

It was announced that Netherlands is joining the Maritime Cloud team.

## 4.9 GNSS Evolutions for Maritime

### 4.9.1 Presenter and author

Authors: Marco Porretta, David Jimenez Banos, Massimo Crisci, Giorgio Solari, Alessandra Fiumara.

Presenter: Ms Alessandra Fiumara, Liaison Officer, European Space Agency, France.

### 4.9.2 Abstract

At the end of 2013, the European Space Agency (ESA) started analysing possible GNSS evolutions within the maritime sector. Different techniques have been investigated in close collaboration with the maritime community - augmentation systems, Dual Frequency Multi Constellation (DFMC) schemes and new methods under development such as the Horizontal Advanced Receiver Autonomous Integrity Monitoring (H-ARAIM) technique. Ms Fiumara focused on the role of Satellite Based Augmentation Systems (SBAS). Although the use of SBAS is quite common in maritime receivers, no standard is currently available. As a result, each receiver manufacturer implements its own scheme for the use of SBAS corrections in their maritime products. Two possible steps (mid-term and long-term) for the development of a dedicated standard were discussed.



The first step is based on the SBAS capability of providing the end-users with differential corrections and system integrity information. As this is the same type of service provided by Differential GNSS (DGNSS), SBAS could be immediately used to complement DGNSS, thus providing a “seamless” augmentation service. The second step in the longer term, focuses on the identification of the role of SBAS in specific nautical tasks within the concept of resilient multi-system receiver developed under the IMO “e-navigation” strategy.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

### 4.9.3 Discussion

Responding to the vulnerability of GNSS, alternative ranging services such as R-Mode and eLoran are being studied. A roadmap will be developed at an intersessional meeting of the IALA PNT working group of the IALA ENAV Committee in February 2016 and participants were invited to attend this meeting from 11 February.

It was also noted that DGNSS is a world wide radionavigation service but its use is not mandatory.

It was also noted that Alan Grant, GLA R&RNAV, will attend a coming meeting of CIRM so that industry will be briefed on eLoran and R-Mode.

## 4.10 e-Navigation and Risk Management - the Insurance Industry Perspective

### 4.10.1 Presenter and author

Mr David Patraiko for Mr Jorge Pecci Saavedra, Executive Vice President and Head of Global Marine, AIG, representing IUMI.

### 4.10.2 Abstract

Risk is the foundation of both safety and insurance. People exist because of it. The insurance industry provides the financial support for instances when the unexpected occurs. Safety is accomplished when people identify and minimise (or mitigate) every possible hazard and risk. The industry has identified that there is a growing commercial and non-commercial fleet, both in size and number, a navigational space for shipping that shrinks by the minute, resulting in a quite complex environment with a substantial reduced room for error. Statistics reflect that current and available sophisticated technology applied to navigation has not achieved the expected reduction in collisions and groundings. Numbers also demonstrate that the cost of these groundings and collisions keeps increasing. While the number of serious accidents may have dropped in the last two years, the marine sector is lagging well behind other land based industries. The need of a harmonised approach to e-navigation is paramount to improve the performance of the marine industry. e-Navigation must have, at the core, the human element.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

## 4.11 e-Navigation Underway North America

### 4.11.1 Presenter and author

Mr Fred W. Pot, Principal, Marine Management Consulting, USA.

### 4.11.2 Abstract

Fred Pot announced the 2016 e-Navigation (North America) Conference that will take place in Houston, Texas from 17 to 19 October 2016. The conference will be hosted by the San Jacinto College, Maritime Technology and Training Center and by the Seamen's Church Institute. IALA and the Danish Maritime Authority will be the organisers of the Conference.



The Conference theme is e-Navigation and the Gulf Area, Meeting Informational Needs where Brown Water, Blue Water and Port Facilities intersect. The first day will include visits to VTS and Simulator Facility and a tour of the Port of Houston Harbour.

Mr Pot invited participants to contact him at [fpot@enavsolutions.org](mailto:fpot@enavsolutions.org) for further details.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

## 5 THEME 3 – CONCEPTS, TRAINING ASPECTS AND THE HUMAN ELEMENT

Chair: Andre Bolles, OFFIS.

### 5.1 What is information overload? Human factors in presentation of data

#### 5.1.1 Presenter and author

Prof Thomas Porathe, Professor, Norwegian University of Science and Technology.

#### 5.1.2 Abstract

With the collection, exchange, integration, and analysis of information, e-navigation risks bringing even more information to the navigator on the ship's bridge. This poses a great challenge. Human attention, working memory and higher cognitive abilities are limited and the presentation of information must be designed to fit within the limits of the human user. Prof Porathe considered what are these limitations, and how can the risk of information overload be mitigated.



The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

### 5.1.3 Discussion

In discussion it was noted that any background noise or activity will reduce memory capacity.

## 5.2 May e-Navigation Mandate New Training Courses?

### 5.2.1 Presenter and author

Mr Mads Friis Sørensen, Branch Manager, FURUNO, Denmark.

### 5.2.2 Abstract

Based on the experiences gained during the ECDIS implementation and to utilise the lessons learned, Mr Sørensen presented a picture of the challenges in crew training gained by FURUNO INS Training Centre when providing both generic and type specific training and through the use of different training platforms (class room training, CBT and CAT).



When e-navigation solutions are considered it is important from the beginning to establish if the e-navigation solutions should be intuitive and easy enough to use and as close to the current tasks performed by the operators that training will not be necessary, or conclude that the new technologies and solutions introduced as part of e-navigation will require end user training at some level. Training should be part of the plan from the beginning involving IMO/STCW, authorities, training providers, manufacturers and ship owners in the process of defining the required training solutions.

In case of ECDIS the missing minimum standards for type specific ECDIS training from authorities has caused a competition on price rather than quality and content. The result can be seen in some of the ECDIS assisted groundings reported by MAIB. MCA's MIN 422 was an improvement of the situation due to the minimum requirements described in the same way as MPA and AMSA did.

To avoid repeating the ARPA assisted collisions and the ECDIS assisted groundings we can learn from our experience with ECDIS and we can be better prepared.

### 5.2.3 Discussion

In respect of training, it was considered that there is a need for balance in the sourcing of training. The basics must be in standardisation. ECDIS needs many different trainers because of no common user interface. However, over standardisation may stifle the freedom to introduce new features.

Considering the size of display screen, Mr Sørensen considered that displays should fit the ship environment, including retrofit screens where the size of the screen being replaced dictates size. Very large screens may not be the best solution.

## 5.3 A Study of the Mental Models of Ship Masters and VTS Officers Regarding Traffic Situations in the Straits of Malacca and Singapore

### 5.3.1 Presenter and author

Assoc Prof Marius Imset, Associate Professor, Buskerud and Vestfold University College, Norway.

### 5.3.2 Abstract

The goal of the SESAME Straits project is to develop a ship traffic management system that contributes to increased safety and efficiency in the Straits of Malacca and Singapore (SOMS). In order to achieve this, the project aims to "increase shared situational awareness and cooperative decision making between ship and shore personnel by new/improved technology systems".



As adopted into the concept of e-Navigation, principles of user centered design states that new systems should be based on a thorough understanding of end users

and the context of use. Thus, it is important that ship traffic management is understood and treated as a concept of cooperation between ship/bridge and VTS personnel. To examine this context as part of a user centered design process, models for teamwork and mental models were applied. A survey is used to collect data from ship masters/navigators and VTS officers, that address their perceptions of twelve challenging traffic situations in the SOMS. Prof Imset focused on how teamwork and mental models can be applied in the development of ship traffic management systems, as well as some initial findings from the survey.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

## 5.4 An Enhancement Method for Impact Assessment of e-Navigation Applications – the SMART Case

### 5.4.1 Author and presenter

Authors: Prof Michael Baldauf, World Maritime University, Malmoe, Sweden. and Hochschule Wismar, University of Applied Sciences: Technology, Business and Design, Department of Maritime Studies Warnemuende (Germany), Institute for Innovative Ship Simulation and Maritime Systems (ISSIMS). Sunbae Hong, Ministry of Oceans and Fisheries, Republic of Korea.

Presenter: Assoc Prof Michael Baldauf, Associate Professor, World Maritime University, Germany.

### 5.4.2 Abstract

Korea with its SMART-Navigation project specifically addresses the implementation of e-navigation solutions in their national waters as well as for all vessels flying the flag of the Republic of Korea on international and domestic voyages and even includes fishing vessels. The implementation of e-navigation solutions requires a comprehensive and thorough assessment of its potentials with respect to the improvement of maritime safety. With the draft e-navigation Strategy Implementation Plan (SIP) IMO has provided its vision of the concept in relation to on-board, on-shore and communication elements. The SIP is mainly to implement five prioritised e-navigation solutions by taking into account IMO's formal safety assessment.



Maritime Safety is often expressed and discussed in terms of numbers of accidents and incidents. Statistics provide detailed figures on frequencies and types of accidents, where those accidents occur and what types of ships are involved. National authorities investigate and monitor their individual situations in respect to their national waters and shipping fleets. IMO, according to the definition agreed at MSC 85, has developed the e-navigation concept, among others, "to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment." Regarding the introduction of new the e-navigation concept and related innovative systems into vessel traffic, there is potential utilisation for both SOLAS ships but also for non-SOLAS ships. Use of these national accidents and incident statistics form one basis for enhanced quantification of these potential effects.

The authors introduced the development of an enhanced method for the comprehensive assessment of implementing e-navigation applications. The method specifically focuses on the quantification of the impact of e-navigation solutions in terms of a reduction of the number of accidents that potentially can be avoided using new e-navigation applications. The method was introduced and discussed by reference to the Korean SMART-Navigation project.

In the frame of Korea's SMART project specific innovative solutions were presented as so called e-navigation tool kit applications. The assessment methodology elaborated in this presentation includes simulation trials for quantifying the potential impact considering selections of those tool kit solutions.

It was suggested that the methodology serve as a model case for comprehensively assessing the implementation of e-navigation taking especially into account the specific individual situations and conditions of each the coastal states. Case studies of specific application cases to other IMO member states were introduced and discussed.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

Session Chair: Thomas Christensen, DMA.

## 5.5 The STM Concept – the MONLISA 2.0 Outcomes and the Validation Project

### 5.5.1 Presenter and author

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

### 5.5.2 Abstract

The MONALISA 2.0 project, led by the Swedish Maritime Administration, has just been brought to completion. The project ran for three years, gathered 39 partners and had a total budget of €24m, 50% of which was co-financed by the EU. The project has defined Sea Traffic Management (STM), a concept for sharing secure, timely and relevant digitised information between trusted parties in the maritime domain. This is envisaged to maximise the utilisation of port facilities and minimize the use of energy to steam between ports. The challenge to be faced is that the shipping community consists of many competing autonomous actors with legacy systems and a lack of standards for service interaction. The proposed solution is a standardised digital service for distribution and information sharing environment developed through federated collaboration.



Studies in the MONALISA 2.0 project have shown, that in the Baltic Sea region alone, each percent of saved sailed distance saves society €100m per year. Furthermore, studies of historical AIS tracks have shown a saving potential of 12% sailed distance in the entrance areas for the Baltic Sea. In a studied port, 12% of ships anchored for a median time of 18 hours, corresponding to a potential 3 knots speed reduction for the 20 last hours of the voyage, saving 34% energy and emissions on that leg. While the maritime world suffers a 25 times higher rate of accidents than aviation, sharing of voyage plans and coordination of ships traffic has the potential to reduce risk situations for collisions and groundings by 83% and 73% respectively for the studied area in the entrances to the Baltic Sea.

If STM is accepted and adopted by the maritime domain, it is envisaged to start with voluntary and business driven applications in the time period up to 2020 and in the following five years possibly as regional requirements for particular areas. A binding, international adoption is a long process and is not likely until 2030 and beyond.

In the follow-up STM Validation project, running between 2015 and 2018, large test-beds with 300 ships, 13 ports and five shore centers will be used to validate the STM concept. The project gathers 39 partners from 13 countries and has a budget of €43m, again with a 50% co-financing from the EU. The scope of the project, apart from validation of the STM concept, is to start establishing standards and to push system development in the industry.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

## 5.6 Developing IMO S-Mode for e-Navigation

### 5.6.1 Presenter and author

Mr David Patiaiko, Director of Projects, The Nautical Institute, United Kingdom on behalf of the project team.

### 5.6.2 Abstract

David Patraiko opened his presentation by declaring that he was the spokesman for an informal S-Mode Workgroup and was reporting on behalf of that group and not specifically on behalf of the Nautical Institute (NI).

Much work will need to be done to progress the development of 'Guidelines for S-Mode' as foreshadowed by an IMO approved work programme item for e-navigation. Those interested in bringing well-formed proposals to the IMO's NCSR subcommittee when S-Mode is included on the agenda in 2018 have started some initial work. This presentation





provided an update on progress to date.

The latest in a series of workshops was held in Busan, Republic of Korea in November 2015. Following this workshop in Busan, two papers have been provided to IMO NCSR3, namely 3/28/1 and Inf.17.

NCSR 3/28/1 makes a number of interesting statements that shows a subtle change in collective thinking about S-Mode, such as:

- “Australia and the Republic of Korea have held workshops on S-Mode during 2015. These workshops have involved Human Factors experts, maritime trainers, seafarers (including marine pilots), regulators, representatives from the marine electronics industry and others. These workshops have helped refine the possible scope of an IMO guideline on S-Mode. They have identified that less focus could be placed on the idea of an independent mode, should another approach achieve the same goals.”
- A proposed description of the content or scope of the guideline on standardised modes of operation, S-Mode, is as follows: "Guidance on the standardisation of design for navigation and communication systems, encompassing displays, interfaces, and functionalities able to provide the bridge team and the pilot with timely access to essential information for the conduct of navigation throughout the voyage, from berth to berth."
- S-Mode may also incorporate provisions for the configuration of personal settings. These may be stored in the system. They will allow a user to rapidly customise the system to their preferred settings (e.g. overlay custom display features or give access to customized information).

Mr Patraiko further outlined how the process of user needs assessment, testbed and simulation trials might take place in the next few years with a target of 2019 to complete.

He mentioned that future workshops would be held in London on Friday 26 March (pre NCSR3), and on Monday 11 April at the Australian Maritime College in Tasmania (post Ergoship conference). Those wishing further information were encouraged to contact Dr. Min Jung - Associate professor, Korea Institute of Maritime and Fisheries Technology (KIMFT) ([seamini@naver.com](mailto:seamini@naver.com)) or Nick Lemon at AMSA ([nick.lemon@amsa.gov.au](mailto:nick.lemon@amsa.gov.au)).

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-2-3>.

Chair: Omar Frits Eriksson

## 5.7 Integrating IEC and ISO Information Models into the S-100 Common Maritime Data Structure

### 5.7.1 Presenter and author

Mr Ørnulf Jan Rødseth, Senior Scientist, MARINTEK, Norway.

### 5.7.2 Abstract

The implementation of new e-navigation services will be heavily dependent on the Common Maritime Data Structure (CMDS) based on the IHO S-100 framework. Much work is already being committed to this. However, the development of CMDS is not trivial and there are two issues in particular that deserve more attention:

- S-100 is a geographic information system (GIS) type data modelling framework. A significant part of the information exchanged in e-navigation applications will not be geographical in nature, but rather will be operational. Information on hazardous materials or waste is an example of data elements that cannot easily be mapped to a GIS feature. There is a need to develop a principle for how such information shall be incorporated into the CMDS.
- There are already a number of data structures that have been standardised for use in the maritime domain. Examples of this include EDIFACT messages for ship reporting, ISO 28005 for



electronic port clearance and IEC 61162 for digital interfaces on the bridge. It is also necessary to develop principles for how the CMDs can incorporate these data models.

Mr Rødseth showed some more details of the examples of issues and suggested some possible ways to resolve them.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-3-3>.

### 5.7.3 Discussion

Mr Rødseth confirmed that the SafeSeaNet XML reference guide is based on ISO 28005.

Mr Rødseth confirmed that he is aware of the work of the IHO S-100 working group on streaming data and that this will add to his work.

Responding to a query regarding solutions, Mr Rødseth advised that solutions are available for simple cases but solutions are more complex for IEC work.

Considering the IMO FAL convention, it was considered that the FAL does not include waste or emissions.

It was noted that China has completed the launch of 25 Beidou system satellites.

## 5.8 ANNOUNCING THE LAUNCH OF THE CIRM USERS FEEDBACK FORUM

### 5.8.1 Presenter and author

Mr Richard Doherty, Chief Technical Officer/ Deputy Secretary-General, CIRM.

Mr David Patraiko, Director of Projects, The Nautical Institute, United Kingdom.

### 5.8.2 Abstract

The concept of Human-Centred Design (HCD) is of critical importance in the development of maritime instruments and systems, as also reflected in the recent publishing of IMO Circular MSC.1/Circ.1512 – Guideline on Software Quality Assurance and Human-Centred Design in e-navigation.

In practice, as confirmed by the recently-concluded FP7 CyClaDes project, system designers and manufacturers may struggle to find users willing to participate in product development and provide feedback. Therefore CIRM (representing the system designers and manufacturers) and the Nautical Institute (representing the users) have come together to establish the CIRM User Feedback Forum. Hosted on the CIRM website, the Forum will make it easy for system designers and manufacturers to get in touch with users who are willing to take part in product development exercises and arrange their participation, in support of effective HCD.

The presenters outlined the background to the establishment of the Forum, explained how it works, and announced the Forum's official launch.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-3-3>.

### 5.8.3 Discussion

In discussion it was confirmed that anyone can use the User Feedback Forum. CIRM membership includes service providers so the Forum allows engagement of service providers, manufacturers and mariners.

The Forum is envisaged as a means of establishing one-to-one relationships rather than the public relationship of Facebook.

## 5.9 Ship Connectivity – How Current Developments in Communication Technologies May Impact Shipping

### 5.9.1 Presenter and author

Mr Steinar Låg, Principal Researcher, DNV GL, Norway.



## 5.9.2 Abstract

Traditionally, once a ship left port it was isolated. This was true until the introduction of radio on ships at the beginning of the 20<sup>th</sup> century. Since then, both the capacity and coverage of ship to shore communication has been gradually evolving. Although satellite communications has been available to vessels since the 1970s, broadband data capabilities have not been commonly available until the last 10 years. In the period 2008-2014 the number of maritime VSAT (broadband data) installations almost quadrupled and the aggregated VSAT bandwidth over oceans in 2016 will be five times higher than in 2011. It is set for further growth due to new High Throughput Satellite (HTS) initiatives such as Inmarsat GX, Intelsat Epic NG, Iridium Next and Telenor's Thor VII. Over the coming years, mariners will experience a significant increase in data rates at lower cost.



Mr Låg addressed how this development will impact the maritime community, which new applications may be enabled by it, and discussed opportunities and challenges that will come with it.

The full presentation is available at <http://www.e-navigation.net/index.php?page=day-3-3>.

## 5.9.3 Discussion

In discussion it was noted that Inmarsat is working with CISCO to develop an app which will be available via the iPhone store and a similar approach on cooperation could be adopted in the maritime world.

A ship is a remote unit for 90% of the time and therefore needs a substantial local data store capability. Mr Låg advised that the suip connectiviety project has not considered pushing data to smart phones. The adopted architecture is correct for maritime applications. The need for high on-board data storage implies the need for bandwidth efficiency and cyber security.

## 5.10 Panel discussion

Facilitator, Omar Frits Eriksson, Chairman IALA ENAV Committee.

A panel comprising Richard Doherty (CIRM), Thomas Christensen (DMA), Jin Park (KRISO) and Andre Bolles (OFFIS) posed a number of questions to the audience.

### 5.10.1 Considering that the first phase of e-navigation as defined by the IMO comprises gap analysis and solutions, what gaps are filled and what gaps remain, as well as new gaps?

The required data and protocols are known but there is a risk of data overload and decreased decision making support on-board due to lack of portrayal and ability to filter the data into information. This is a present gap. The IHO S-100 is defining interoperability between layers in relation to portrayal so something is being done to fill the gap.

A further gap may exist in relation to provision of publications in digital form. An example of this is the IHO publishing in .pdf format using a private document publishing system rather than in open digital format. IHO have standards for publishing all information on nautical publications in digital form but there is a cost which the market will not presently support. e-Navigation is a framework for many types of data and demand for S-101 ENC's will be driven by demand from other s-101 products. Standards for vectorised publications are becoming available. However this is a training needs recognition here and CIRM are looking for other NGO/IGOs to help define requirements. Hence the fundamentals are in place and work is in progress.

### 5.10.2 Considering the importance of standardisation, what is happening in IEC TC80 in preparation for e-navigation?

IEC TC80 is addressing each of the IMO 5 prioritised solutions and is addressing cyber security through standard 61162-460. Work is in progress and further work is planned.

#### 5.10.3 From present studies and testbeds, what functions of e-navigation are yielding savings and quantify these savings?

Studies have shown savings from anchor time and running speed optimisation of about 12%. Dynamic routing has also shown savings of €100m per year per saved % of time in the Baltic. It was noted that the M/S PEARL SEAWAYS ferry used 360,000 litres of fuel during e-Navigation Underway and it is considered that altering time of departure could yield savings. However there are other key performance indicators (KPI) which are key enablers. Fluctuations in costs, particularly fuel costs, will influence savings.

#### 5.10.4 How can e-navigation services be defined and implemented – what is the killer app that will deliver e-navigation?

A key requirement for e-navigation is a vehicle to transport the data. The Maritime Cloud is such a vehicle and may be a killer app which could lead to an acceleration in the development of e-navigation.

Another possible killer app is a service that will transport information from shore to on-board where the information is required for decision making. The IALA strategy drawn up in 2015 address the issue of sharing of VTS information so work is being carried out in this area.

The variation in ship reporting requirements in different ports and regions creates difficulties for implementing automatic ship reporting. These are cultural problems so there is a need to get the ports involved to deliver automatic ship reporting. However, automatic ship reporting is unlikely to be a killer app.

#### 5.10.5 With the BIMCO cyber security guideline and IEC work on safety and security, is cyber security being addressed sufficiently?

To address cyber security on-board, there is a need for a culture change which could start with training.

The BIMCO cyber security guidelines could be updated to include use of USB ports on ECDIS, in fact, why have USB ports on such vulnerable systems.

In addition to cyber security, authentication is required and can be provided through digital signatures similar to aviation practice. Management of public key infrastructure is an issue.

Cyber security should be viewed as part of the whole lifecycle of communications. Connecting ships and shore securely and reliably will provide added value to ship owners.

The issue of cyber security are being addressed as a problem to be solved rather than a disaster in e-navigation.

#### 5.10.6 Considering the successful introduction of innovation in the automobile industry without initial regulation, is regulation a help or a hindrance when introducing innovation in e-navigation?

A CIRM meeting addresses the use of non-type approved equipment for displays on the bridge. While safety is the baseline, a lot of value is available from tablets, mobile phones and wifi. There is no universal definition of non-type approved equipment. Radar and vector cartography are examples of systems that contribute to safety that were initially introduced before standards were available. While it is good to have type approved equipment to ensure quality but questions must be asked if added quality and safety can be brought to the bridge with non-type approved equipment.

The discussion raised the question of the advantages of mandatory versus voluntary uptake of new technology. There was a view that mandatory systems are not delivering full opportunities and the main driver for introduction of new technology is the business case rather than regulation.

Some felt that there is enough mandatory equipment on the bridge already. Ability to reliably send and receive data to the shore is most important and there is a need for standardisation.

Many of the user requirements are qualitative and it was suggested that a quantitative approach is need to drive the introduction of new technology. A time series graph showing the level of safety regionally/ locally could be used to measure the effectiveness of e-navigation.

#### 5.10.7 Is there a benefit in the harmonisation/standardisation of PPUs to enable them to use new services?

Traditionally PPU services are defined by local conditions and requirements. Vendors use standard systems and protocols and therefore there is standardisation of individual features.

## 6 CONCLUSIONS

### 6.1 Conference conclusions

Ómar Frits Eriksson, the Conference Chairman presented the conclusions derived from the conference's proceedings.

It was made clear that IALA will consider the following Conference conclusions and identify any appropriate actions required, thus there are no associated Recommendations.

The conclusions were:

- 1 Stakeholders are cooperating and coordinating and are actively exploring methods to harmonise e-navigation data and communications.
- 2 IALA may be an appropriate organisation to coordinate the IMO unplanned output 6 on MSPs and harmonise the format, structure and communications channels for the exchange of information electronically.
- 3 Recognising the value of the BIMCO cyber security guidelines, the e-navigation stakeholders agreed that similar cyber and data security measures must underpin e-navigation.
- 4 Participants recognised that e-navigation should improve the human decision making process, not replace it.
- 5 Participants considered that the concept of the Maritime Cloud could support e-navigation infrastructure and trials are underway.

## 7 CLOSING OF THE CONFERENCE

Mr Francis Zachariae, Secretary-General of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) in his closing address to e-Navigation 2016 thanked all participants for their attendance. He congratulated the speakers, supporting organisations and the steering committee for the excellent arrangements as well as the conference partners. He expressed thanks to the Assistant Minister from the Republic of Korea for attending and noted the major contribution of Korea to the development of e-navigation. In particular, on behalf of all attendees, he thanked the keynote speaker, Danish Maritime Authorities 'Dream Team' and Graham and Partners for all of their dedicated efforts and preparations.

All participants were invited to e-Navigation Underway 2017 from 31 January to 2 February 2017.

In closing, Mr Zachariae wished all delegates a safe voyage home and looked forward to attending the 2017 e-Navigation Underway International Conference.



## 8 EXHIBITION

### 8.1 Exhibitors

The names of the exhibitors and their products are given below:

Name of exhibitor	Products
<b>Danish Maritime Authority *</b> Thomas Christensen	<b>ACCSEAS test bed project</b> Accessibility for Shipping, Efficient Advantages and Sustainability
<b>MARINTEK</b> Ørnulf Jan Rødseth	<b>Unmanned ships and sea traffic management</b> Technical coordinator in the European project MUNIN performing a feasibility study on an unmanned merchant ship. <b>Arctic e-Navigation</b>
<b>Jeppesen *</b> Michael Bergmann	<b>ENC</b> Voyage Management
<b>NSI bvba</b> Christof Groven Freddy Caubergh	<b>Marine keyboards and pointing devices</b> Optimum custom products fulfilling the exact user's requirements.
<b>Swedish Maritime Authority *</b> Per Setterberg	<b>Sea Traffic Management (STM)</b> Defining Sea Traffic Management Presentation of STM project validation process Dynamic route exchange in practice
<b>DLR – German National Aeronautics and Space Research Centre *</b> Ralf Ziebold	<b>Systems for maritime traffic routing and safety</b> Provision of nautical data in time and on demand ensuring the comprehensive and reliable description of traffic situation.
<b>Kongsberg *</b> Todd Schuett	<b>The SESAME Strait Project</b> Secure, efficient and safe maritime traffic Management in the straits of Malacca and Singapore. <b>VDES Satellite Transceiver</b> <b>ASRx50 AIS satellite receiver</b>
<b>OFFIS Institute for Information Technology</b> Axel Hahn	<b>eMaritime Integrated Reference Platform</b> Integration of German test beds on maritime safety <b>Augmented reality system for TUG operations</b>

\* Indicates an IALA member

## **9 SOCIAL EVENTS**

### **9.1 Welcome Reception**

On day 1, following a welcome reception in the Columbus Club on board, a buffet dinner was held in the 7 Seas Restaurant of the M/S Pearl Seaways. Omar Frits Eriksson from DMA welcomed the delegates and wished a pleasant journey towards Oslo, reaching for the goals of e-Navigation. On day 2, a 3 course buffet dinner was provided in the Blue Riband Restaurant followed by a visit to the live music in the Columbus Club.

### **9.2 Weather**

Participants experienced difficult weather conditions throughout the voyage with strong winds on the outbound leg of the voyage.

### **9.3 Acknowledgments**

The conference expressed its appreciation to the Danish Maritime Authority and IALA for its joint organisation of e-Navigation Underway International 2016. The “Dream Team” led by Thomas Christensen was congratulated on an excellent event. It wished particularly to acknowledge the support given by:

The Nautical Institute (NI)

Comité International Radio-Maritime (CIRM)

International Hydrographic Organisation (IHO)

Baltic and International Maritime Council (BIMCO)

International Chamber of Shipping (ICS)

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

Photographs provided by DMA are available on the memory sticks provided at the end of the Conference.

## **ANNEX A      TEXT OF KEYNOTE SPEECH BY MR KITACK LIM, SECRETARY GENERAL OF THE IMO**

Let me first of all thank you for the opportunity to participate in this conference and to deliver this keynote speech. A special thank you goes to IALA Secretary-General Mr Francis Zachariae and to Mr Andreas Nordseth, the Director General of the Danish Maritime Authority.

This is the first major external event that I have been invited to address in my new role as Secretary General of IMO, and I must say how appropriate it is that the conference should take place on board a ship. One of my most important objectives at IMO is to ensure that the Organisation continues to draw on the experience and the knowledge of those involved in shipping at the operational level, so being here on a ship has a symbolic resonance, in that respect, that I really appreciate.

One advantage of a ship as a conference venue is that the organisers really do have a captive audience – but in this case, I think the subject matter alone is enough to ensure full houses at every session. E-navigation is the future; but it has been "the future" for a long time now. Through conferences such as this, and through the continuing work at IMO and by all the other stakeholders we will hear from during this conference, the challenge now is to turn "the future" into "the present" so that all the much heralded benefits and advantages of e-navigation can be fully realized. Having said that, e-navigation has indeed already been realized in some way, as I will explain to you later. E-navigation includes a wide range of concepts and has been the subject of a long and continuing effort at IMO.

During the course of this conference you will hear and see a number of fascinating presentations about technical developments and far-reaching initiatives to build such developments into viable solutions for the shipping industry. Both shipboard and shore side technologies will be showcased, as well as the related training and human-element aspects that are essential if they are to be effective.

But I want to begin this keynote by taking a step backwards. What do we mean by e navigation? What is it that all these innovations and developments are leading towards? There is, of course, the formal definition of e-navigation, which was adopted by IMO back in 2008 and which, I am sure, you all know off by heart. I don't intend to go over that again now. But I think it is worth recalling, once again, the aims and the overall goals that were adopted at the same time, as these provide a timely reminder of the journey we are undertaking.

So: the aim of e-navigation is to meet present and future user needs through the harmonization of marine navigation systems and supporting shore services; and the overall goal is to improve safety of navigation and to reduce errors by equipping users, on ships and ashore, with modern, proven tools, optimized for good decision making, to make maritime navigation and communication more reliable and user-friendly.

At the same time as adopting these aims and objectives, a strategy for the development and implementation of e-navigation was also approved. That strategy identified IMO as the one, single, institution having the technical, operational and legal competences needed to define and enforce the overarching framework for the implementation of e-navigation.

Of course, that doesn't mean that IMO has to carry out all the relevant tasks in-house – as this conference will clearly show, there are other stakeholders which are quite properly taking the lead in many different areas, according to their competence and expertise.

The development of e navigation is clearly a collective task. IMO may play a central and co-ordinating role but that also brings with it a number of important responsibilities, for example:

- developing and maintaining the vision
- defining the services, including their scope in terms of users, geography, and operational concept
- identifying responsibilities for the design, implementation, operation and enforcement of e-navigation – and it is important in this to acknowledge the rights, obligations and limits of flag States, coastal States, port States and the various authorities within those States

- defining the phased transition to e-navigation in a way that enables early benefits to be realized and existing and emerging equipment, systems and services to be re used
- taking the lead in setting appropriate performance standards for e navigation, covering all dimensions of the system – shipborne equipment, shore-side systems and the communications that link them
- ensuring that the concept accommodates and builds on existing systems – and funding programmes
- facilitating access to funding from international agencies, such as the World Bank, the regional development banks as well as international development funding
- assessing and defining the training requirements associated with e navigation and assisting the relevant bodies to develop and deliver the necessary training programmes
- monitoring implementation to ensure that contracting States are fulfilling their obligations and ensuring that e-navigation users are also complying with requirements; and, last but not least,
- leading and coordinating the external communications effort necessary to support the case for e-navigation.

This is clearly something of a juggling act, and it requires successful input not just from IMO but from all the organisations involved in e-navigation if it is to succeed. Indeed, I cannot emphasize enough the need to cooperate – this also goes for IMO and IALA, and indeed for IHO.

So, where we are right now on the collective journey towards meeting the aims and objectives underpinning the development of e-navigation?

The development and implementation strategy for e-navigation called for a gap analysis, which was duly undertaken and completed in 2012. This gave rise to the identification of nine potential e-navigation solutions. Further analysis led to five of these being given the highest priority, based on seamless transfer of data between various equipments on board and between ship and shore – in all directions.

These five priority solutions are, as you are aware:

- improved, harmonized and user-friendly bridge design;
- the means for standardized and automated reporting;
- improved reliability, resilience and integrity of bridge equipment and navigation information;
- integration and presentation of available information in graphical displays, received via communication equipment;
- improved communication of the VTS service portfolio.

Although not prioritised at this stage the remaining identified potential e navigation solutions would, it was agreed, be addressed in the future, as e-navigation evolves and develops.

The five prioritised e-navigation solutions formed the basis of the e navigation Strategy Implementation Plan, or SIP, which was finalized in 2013 and later approved by the Maritime Safety Committee in 2015.

The SIP contains a list of 17 tasks emanating from the five prioritized e navigation solutions. These, it has been agreed, should be implemented between 2016 and 2019. Last year, the Maritime Safety Committee considered a number of proposals and agreed to include five new outputs in IMO's High-level Action Plan under the heading "Development and implementation of e-navigation".

The three first are:

- Additional modules to the Revised Performance Standards for Integrated Navigation Systems relating to the harmonization of bridge design and display of information
- Revised Guidelines and criteria for ship reporting systems

- Guidelines for the harmonized display of navigation information received via communications equipment

Each of these three is to be considered at the IMO Sub-Committee on Navigation, Communications and Search and Rescue in March this year. Of vital importance here is the need for harmonization in all of these areas – for example, harmonization of data formats, of the symbols used, and harmonization between equipment, systems and interfaces. This will, of course, require a coordinated approach between international organizations and the industry. Indeed the important role of the industry in the design and development of equipment and systems cannot be overestimated.

The fourth and fifth outputs of the five new outputs in IMO's High-level Action Plan – which are Guidelines on standardized modes of operation, or S-mode, and Revised General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids relating to Built-In Integrity Testing for navigation equipment are both planned for a 2018-2019 timeframe.

In all these endeavours, it is clear that the software developed for the equipment and systems of the future is absolutely vital. Good software can help ensure proper harmonization across platforms and holds the key to cyber-security – securing and protecting the information that is being processed.

So, as you can see, there is a great deal to be done – but these outputs address most of the tasks contained in the SIP. The development of other tasks will require further outputs or are tasks required to be conducted either by the industry or by organizations other than IMO.

For example, we expect the Maritime Safety Committee in May to consider a revised proposal for a new output related to the implementation of Maritime Service Portfolios, or MSPs. This output will require inputs from different organizations involved in the implementation of MSPs such as IALA, IHO and WMO.

Other significant documents already approved by the Committee include Guidelines on Harmonization of test beds reporting; and Guidelines on Software Quality Assurance and Human Centred Design for e-navigation.

So, we are engaged on a long and continuing voyage towards e navigation, but we have already come a considerable distance and I think we have charted a good course ahead for the future.

Let me take this opportunity to encourage continued participation – greater participation if possible – in the implementation of e-navigation and, in particular, the work associated with the five new outputs approved by the Organization.

Let me also highlight the need to review the list of gaps and to address the remaining potential e-navigation solutions that were not initially prioritized, so that we can identify further tasks and then incorporate them in the SIP, as and when required. And, in this context, let me stress once again how important it is that this whole process is driven by clearly identified user requirements, and not by technology; and that the user needs are addressed in a cost-effective manner. We must not lose sight of the fact that the end-user needs to see some real value emerging from all this effort.

I would also like to highlight the vital importance of conducting technical cooperation and capacity-building activities in various parts of the world, to promote and provide information on the status of the implementation of e-navigation initiatives. This conference is a good example but I think this is one area in which considerably more could be done.

Ladies and gentlemen, the development of e-navigation is clearly a team effort, and any good team is built on good communication between the individual players. Once again, conferences such as this help to promote the exchange of information and ideas between all stakeholders, including IMO, its Member States, the industry and the various other organizations that are playing an active role in bringing this concept to reality, and I thank and commend the organizers of this event for putting together such a timely and relevant programme.

In conclusion, it is interesting to note that the "e" in "e-navigation" can be used in several connotations. Does it stand for "electronic" navigation? Well, perhaps, although electronic navigation has been with us



for a very long time and the array of related acronyms such as AIS, ECDIS, IBS, INS, ARPA, LRIT, and GMDSS are all very familiar. And e-navigation also looks at issues that are clearly not electronic, such as operational procedures, familiarization, documentation and manuals and, of course, training.

Perhaps the "e" stands for "enhanced" navigation – there is certainly a clear understanding that e-navigation should deliver an improvement on what we already have.

Of course, back in 2008, when the first proposal on this subject was presented to IMO, "e" was the fashionable prefix to indicate something advanced and ground-breaking; maybe if that proposal was initiated today, it would talk about "i-navigation" – "i" for integrated, or perhaps "i" for improved.

But what we have is e-navigation: and I think the most appropriate way to define this might actually be "evolved" navigation. Because there are so many ways in which e-navigation can offer enhanced safety, better environmental protection, improved traffic management and commercial benefits. And, as our journey continues, there is no doubt that both the technological advances and the advantages they can bring are continuing to evolve.

Our challenge is to make sure the vision and the strategy for e-navigation allows that evolving potential to be fully realised.

**ANNEX B****KEYNOTE ADDRESS BY MR ANDREAS NORDSETH, DIRECTOR-GENERAL, DANISH MARITIME ADMINISTRATION.**

Thank you Mr. Secretary-General.

Ladies and gentlemen.

It is a great pleasure to welcome you on this trip from Copenhagen to Oslo. And a great pleasure to meet such a distinguished group of representatives from all parts of the maritime world.

I want to take this opportunity to make 2 points today

First of all: Shipping of the future depends on Information and Communications Technology.

Shipping of the future is closely linked to ICT. We now have the possibility to be online everywhere, all the time. Maritime data is collected around the clock by a myriad of actors, around the world. Each piece of data has its own, specific purpose. The potential for combining these data is enormous – allowing us new insight, new services and new business models. The maritime world is a part of “Industry 4.0” – the fourth technological revolution, no question mark! There is enormous potential. And this makes right now a defining moment for shipping. Smart, competitive shipping, ready for the future, depends on us unlocking this potential.

To realise this potential, we each have a role to play, and we need a coordinated approach to the work ahead. Legislators must provide the right, legislative framework to support innovation, development and up take. But legislation will not drive the process. The process can only be market-driven. The industry side must be actively involved and committed for the potential to be realized. A coordinated approach means pulling in the same direction across authorities, business sectors, regions and international fora. The possibility to be online everywhere, all the time, combined with the huge amounts of maritime data collected around the clock, is a game changer for shipping. The same way it has been for other industries and societies.

There is enormous potential. And this places us on the door step to a defining moment for shipping. By unlocking this potential, smart competitive shipping can jump into the future.

My second message is that the key to unlocking this potential for shipping of the future is a coordinated approach.

We each have a role to play, but a coordinated approach means pulling in the same direction across authorities, business sectors, regions and international fora.

Our coordinated approach must rest on sensible, smart solutions to support smart shipping. Smart, competitive and sustainable shipping depends, first of all, on efficiency. And to be sharp and efficient today and in the future shipping must embrace and fully use the potential of ICT-solutions.

This is the reason we are here today. To bring all stakeholders together and discuss the common goal and how we can construct a framework that will help realize this potential.

But, first, let me take a step back and look at the bigger picture.

[Point 1: Shipping of the future is linked to ICT].

Shipping has always been characterized by a need to communicate and about finding new, smarter ways to do so.

Just as the progression from sails to engines, from traditional stowage to standardized containers, the means of communication have also progressed. From visual aids to telegraph and voice radio.

And now on to satellite technology - and using information technology in combination with communication.

This also means that shipping has reached a critical juncture. And the big picture is bigger than e-navigation. It is about ICT changing the way we do business every day.

Maritime data is collected around the clock by a myriad of actors, around the world.

e-Navigation is one of the ways in which we can embrace information technology.

Big Data is already out there on the oceans – waiting to be fully utilised.

A ship like Maersk Triple-E has 2000 sensors onboard. And AIS data is available from each ship on route.

But putting Big Data to smart use requires digitalization and connectivity. Active use of data means actively sharing data.

Provided we get the right infrastructure in place, we will end up with a box of new and exciting tools.

As I see it, connectivity and the smart use of maritime data provides us with four, overall possibilities:

1. It will strengthen safety and security.
2. It will ensure optimization and efficiency.
3. It will open up for all kinds of new business models related to data, like remote maintenance and other new services – maybe even remote control.
4. And finally, it will break social isolation by bringing all ships and seafarers full connectivity and infotainment.

Like the introduction of steam power, electrification, the combustion machine, digitalization has proved an essential game changer.

All technological game changers have been accompanied with debates about, on the one hand, the potential benefits for our businesses and our welfare, and on the other, the potential threats.

We are enthusiastic about the ways in which technology will make our lives better and our industries safer and more prosperous. We imagine increased welfare, increased safety and security, and increased cost-optimization.

At the same time we have a tendency to fear what it means, if we allow ourselves, the human element, to be replaced by technology.

History has shown us that this fear is not warranted. New services, combining cyber possibilities and human effort, have emerged in the decades behind us.

The human element is still vital – it is simply applied in new ways.

But it is a good example of the very human way of dealing with change. And it creates a natural push/pull-effect that may in fact work to our advantage: Although it may to some extent slow down development, at the same time it makes us more prone to consider relevant safety mechanisms.

To think twice before we decide how to approach the possibilities before us.

So it is with ship connectivity, Big Data and today's topic of e-navigation as well, I think.

The concept has been taken on board, and we know and imagine its great potential. But, at the same time it has proved a challenge to lay the tracks we need, for this potential to be realized.

I would argue that we seem to be better at applying ICT in our immediate communities – I'm thinking about using our GPS to go on vacation, obtaining information about our children's school activities or letting our friends know which restaurant we visited last night.

In fact most of us use a smartphone to obtain all necessary information and service in any given situation.

The real challenge is expanding our mindset so that we apply ICT on much bigger, global scale – and come to think of ICT not only as a new, extra tool, but as the foundation for the way in which we do business, if we want to stay competitive.

[Point 2: How to realise this potential? Design principles + a coordinated approach]

So the question is: how do we do it? Obviously there is no simple answer – if there were, we wouldn't be sitting here today.

We know from experience that the wrong, high detail regulatory framework can turn out to have a very negative impact.

But we also know that a basic, regulatory framework based on the idea of market-driven standards, can help industries prosper.

I think we have to approach this question as we do in other areas related to “Industry 4.0”.

The fourth, industrial revolution is about fundamentally rethinking the way we produce goods and deliver services. And it is also about thinking about what qualifications we need to equip our workforce with.

It is about using digitalization and technology in new ways to retain employment, to create and develop new types of competences and employment and thereby promote new growth. It is about strengthening productivity and increasing our competitiveness.

Shipping of the future must be approached the same way.

But one thing is guiding principles. The other part of the equation is a coordinated approach.

The maritime world revolves around a concept of cooperation between regulators and industry. Indeed, a conference such as this is a reminder of this inherent, maritime strength.

We each have our own, specific role to play. But we share an overlapping responsibility to make sure we realize our common goal.

A coordinated approach is not only possible but also the only realistic way of doing things.

Just as new possibilities for using the technology are thought of every day, the drivers behind the technology have changed.

We have witnessed a move away from thinking only in terms of safety and security, towards optimization, connectivity and human welfare on board our ships.

Regulators and industry must continue working together, pulling in the same direction, so that we stay on top and ahead of this game. To me, this is a truly coordinated approach.

In conclusion, ladies and gentlemen, let me thank you for listening.

This conference will, I hope, be one of the stepping stones for bringing industry, researchers and regulators together to inspire each other to take the next steps into the future.

Thank you.

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