

# NAVIGATOR

THE

Inspiring professionalism in marine navigators

FREE



## Ship and shore collaboration

Piecing together information to make good decisions not distractions



A free publication by **The Nautical Institute** in association with the **Royal Institute of Navigation**

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## Sharing data between ship and shore

Many years ago, when ships put to sea they were alone. The Master and crew made all their decisions based on their own knowledge, experience and observations. Although some might lament these 'simpler' times, it is hard to deny that an environment where ships and shore work well together improves safety and efficiency. Today, the flow of information between ships and shore is capable of adding great value. However, this is dependent on the information being accurate, timely, relevant, and presented in a way to help make good decisions, rather than creating distractions.

One great example of ship/shore collaboration is Vessel Traffic Services (VTS). In June 2018, The Nautical Institute published edition 18 of *The Navigator* on VTS, but as you will see in this issue, these services have been revised and improved since then. Jillian Carson-Jackson, a noted VTS expert (and past NI President)

explains the updates to the VTS resolution, emphasising the focus on the qualifications and training of VTS personnel to ensure that vital ship/shore relationship. This relationship is essential to help navigators do their job by providing information, for example on other ships, maritime safety information, limitations on restrictions and much more.

As this transfer of information between ships and shore has become more significant to supporting world trade and international logistics, it is not surprising that the 'science' of 'Maritime Informatics' has started to evolve. Mikael Lind looks at using information systems to increase the efficiency, safety, environmental and social sustainability and resiliency in global shipping. Good information needs to flow both ways, which places the ship as a key information node in the overall network. Navigators are not just expected to be well-informed but well-informing! Understanding the basics of maritime informatics will help

navigators in the future, and could lead to further career opportunities.

Comodore Nick Nash, a current sailing Master (and former NI President) looks at how mariners faced with different weather forecasts can understand the differences and make good decisions. As a cruise ship Master, he can build his own history of local port weather patterns and also be aware that a 'forecast' given for ten metres above sea level may differ significantly at 50 metres. However, he's clear that as a Master he can now make better-informed decisions based on a whole lot more data, but that the trick is to understand where the data is coming from, its source and its accuracy.

As ships become more established as 'information nodes', navigators will need to understand the limitations and opportunities associated with more information and how ships and shore can best collaborate to improve safety and efficiency.

## INSIDE THIS ISSUE

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### 03 ALL AT SEA

Contributions and opinions from readers of *The Navigator*

### 04-05 DIGITAL SKILLS: MARITIME INFORMATICS

An eminent group of experts discusses the emerging field of Maritime Informatics and its growing importance in ship and shore communications.

### 06-07 WORKING WITH VTS

Jillian Carson-Jackson looks at VTS and how this essential communications system has changed and evolved since *The Navigator* last examined it in 2018.

### 08 WIND AND WEATHER

Nick Nash takes a look at data

sources for weather forecasting and route planning and shares some valuable insights.

### 09: WHO'S NAVIGATING

Seafarer Yrhen Bernard Sabanal Balinis talks about his career to date, his aspirations and why it is so important to be part of a strong community at sea.

### 10 WAY POINT

George Shaw from the Royal Institute of Navigation examines how mutual trust and collaboration between ship and shore can increase operational efficiency and confidence.

### 11 TAKE TEN

Ten top tips to help navigators get the most out of ship – shore communications of all kinds.



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#### Published by

The Nautical Institute  
*The Navigator* (Print) – ISSN 2058-6043  
*The Navigator* (Online) – ISSN 2058-6051

#### Printed in the UK by

Stephens & George,  
Merthyr Tydfil, UK

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## What the future holds

The Nautical Institute has been celebrating fifty years of supporting mariners in their professional development – worldwide!

As part of those celebrations, we have held conferences in locations including the UK, Canada, the US, Singapore and Portugal, with more to follow in Hong Kong, India, Pakistan and South Africa. We have used the opportunity to ask what will shape the next fifty years at sea – and what training and support seafarers will need to make the most of it.

Here are some of the things that were said:

“The leaders of tomorrow are here with us today. We must support and give opportunity to the younger career professionals of today. Today’s seafarers handle highly sophisticated ships at the cutting edge of technology that require the best onboard operators to sail them and to manage them ashore.”

**Andre LeGoubin FNI, President, The Nautical Institute**

“Ship operations – and indeed all of shipping – is about people; people work best when they work together, and people only work together when they see the bigger picture.”

**Richard Clayton, Chief correspondent, *Lloyds List***

“The greatest challenge is to ensure the seafarer of tomorrow remains current with modern technology – while not forgetting the basics of navigation.”

**Captain Vikrant Malhotra FNI, Managing Director, Anglo-Eastern**

“Technology and crew need each other now more than ever. Leadership is the human virtue that technology cannot replicate.”

**Ross Millar, Steamship Mutal**

“Everyone in the maritime industry, including lawyers and those in P&I, are better if they have experience at sea.”

**John Lloyd FNI, Chief Executive, The Nautical Institute**



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# Why navigation needs the digitally skilled navigator

Ship operations at sea and on shore have become increasingly digitally integrated. New initiatives build upon digital technologies to improve communication, collaboration and decision-making through data gathering, data sharing and data analytics. The emerging field of Maritime Informatics (using information systems to increase the efficiency, safety, environmental and social sustainability and resiliency in global shipping) explores the effective use of digitalisation and data in the maritime industry to help ship and shore work together



Image credit: Sandra Haraldson

In 1988, the IMO Member States adopted the basic requirements for a global maritime distress and safety system (GMDSS) as part of the Convention on the Safety of Life at Sea (SOLAS). GMDSS brought about the introduction of digital communications – digital selective calling (DSC). In addition, GMDSS provides a degree of automation for ship-to-ship or ship-to-shore communication.

Navigational practices have continued to evolve with the uptake of digital solutions supported by new technologies deployed on ships and ashore. These include Global Navigation Satellite Systems (GNSS), navigational solutions like ECDIS and Dynamic Under Keel Clearance (DUK). In addition, there are various pieces of digital marine communication equipment available with associated safety communication systems and electronic and autonomous surveillance technologies, such as radar and AIS. These solutions place the ship as an information node in the overall network, providing digitally enabled situational awareness.

The development of shore-based monitoring tools supports both regulators and commercial actors. For shipping companies, they can provide fleet surveillance, or give terminal operators accurate information on cargo throughput. Other users include shore authorities monitoring ship operations within their waters or supporting safety and security through Vessel Traffic Services (VTS), and engine manufacturers connecting propulsion systems with navigation systems. Progress has also been achieved in port collaborative decision-making (PortCDM) through projects such as port call optimisation and just-in-time arrival. If the port knows where a ship is, they can collaborate on calculating speed and arrival time to minimise waiting time and emissions in port, for example.

### Implications for officers onboard and ashore

Digital interactions between a ship and its environment are significant, and harnessing the information in a time- and location-sensitive manner is critical. A ship that is operating as a sophisticated sensor hub and data generator producing and transmitting data in real-time brings new requirements for those operating it. Today, officers face two fundamental questions:

- > How can officers onboard and ashore assess the quality of information; and
- > What role do officers play in creating data/information essential for maritime logistics?

In a digitally networked industry, each navigator is not only a node in a network of navigators, but also part of a network of other actors in maritime logistics. Ship's officers play an important role as user of data provided to them, and also as provider of data that help others to plan and manage their operations. Everybody who shares data provides components of information for enhanced situational awareness.

Increased connectivity also means higher vulnerability. Data that flows between systems may spread viruses. Automated systems may have in-built biases not immediately evident. Using multiple sources is a way to mitigate such cyber security risks. There is no single truth, no single source of data. Rather, it is a mix originating from multiple sources. However, the flow of information channeled to officers grows exponentially, which is already creating information overload and affecting the quality of decisions taken.

- Some examples of information that comes from shore to ship include:
- > Hydrographic (charts and chart updates)
  - > Meteorological reports / weather routing advice
  - > Maritime Safety Information (MSI)
  - > Port guidance and passage planning guidance
  - > Cargo and loading / discharge information
  - > Security information
  - > VTS / pilot guidance
  - > Quarantine health and safety information
  - > Charter information

### Opportunities for digitally savvy maritime personnel

The maritime officer of tomorrow is expected to be well-informed and well-informing. Some of this may relate simply to prudent seamanship and safe operations, such as updating AIS status or monitoring engine systems. Other functions may need skill sets beyond current STCW competencies.

For those that acquire advanced skills, new roles will emerge. Developments in maritime autonomous surface ships (MASS) will include actively engaging with ships from a remote location or monitoring movements from shore-based control rooms (Remote Control Centres). Automation aids the

onboard crew with specific autonomous functions and new decision support tools.

Digitalisation helps synchronise what happens at sea with activities ashore. This goes beyond physical coordination to enable more efficient and sustainable sea transport. Digitalisation reduces distances and allows for coordination beyond physical presence. Digitally connected ships and terminals using the same infrastructure across diverse applications support the users in tasks such as avoiding collisions, forecasting congestion, advising on feasible arrival times to ports etc.

### Maritime Informatics

Maritime Informatics offers a solid and well-anchored knowledge base and digital intelligence source, identifying the necessary skillset for tomorrow's maritime professionals. We can build on connected ships, ports and people, to provide new practices, such as:

- > Enhanced communication between ships and shore on timing of arrivals and departures
- > Conducting and monitoring remote operations
- > Enhanced situational awareness for well-founded decision-making aiming at synchronised operations, sustainable shipping and sustainable and safe navigation

Achieving such progress will require the enhancing of existing maritime education and training with digital capability development.

Digitalisation is disrupting the traditional role of navigators and engineers onboard ships, as it calls for upskilling from traditional operator competencies to data analysis skills. This includes the ability to validate data feeds, analyse data and derive patterns of behavior and predictions from multiple sources. However, once these competencies are in place, properly skilled seafarers can truly live up to their role in today's digitally enhanced supply chain networks.

### Authors

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# What YOU need to know about working with VTS

As a navigator, you will have learned about, and used, vessel traffic services – VTS. In this article, **Jillian Carson-Jackson** takes a look at how they can help you ensure a safer, more efficient time at sea – and explains what's different from what you may have read in our previous *Navigator* on this topic.

Since the 1940's, the use of VHF voice radio, combined with radar and other sensors, has been used to support safe, efficient and pollution-free transits. To understand how to make the most of VTS, you first need to understand the regulatory structure that it is based on. Additionally, it is good to have solid knowledge about the technology used in VTS, and how to operate it, including voice procedures.

A good place to start is to consult SOLAS Chapter 5, Regulation 12. This identifies where – and why – a VTS may be implemented and is supported by IMO resolutions, guidelines and circulars. The importance of VTS is also referenced in the Manila Amendments to the STCW 1978 Convention.

## Regulatory structure

In essence, a VTS is implemented in any port or coastal area where a risk assessment has determined a need for it. The establishment of VTS is dependent on national law and relevant international conventions, and considers factors such as the volume of traffic, degree of risk and geographical and environmental conditions. It is not just based on the number of vessel movements – sometimes, there may be VTS implemented in a port with less traffic than another port which does not have VTS, based on environmental concerns, for example. Information on the VTS will be shared in appropriate maritime publications, as well as port-user handbooks and websites.

According to SOLAS Chapter 5, Regulation 12, VTS can be made compulsory within the territorial sea, and it can also be established in association with other IMO regulations. It may also be established beyond the territorial seas of a coastal state to provide information and advice on the basis of voluntary participation.

In 2021, the IMO approved a revised resolution on VTS – IMO A.1158(32). This new guideline replaces the previous IMO A.857(20). So, if you thought you knew all about VTS because you were familiar with IMO A.857(20), beware! While, at its core VTS remains the same, some aspects have definitely changed.

One such change can be found in the terminology surrounding VTS. While the definition of VTS remains essentially the same, there have been revisions made to the 'authorities' related to VTS. Check out the box opposite for the latest definitions.

The resolution also highlights the qualification and training of VTS, noting that VTS professionals are a major factor in its operation. VTS personnel are only considered competent when appropriately trained and qualified for their VTS duties. This includes a detailed training programme with on-the-job teaching, periodic assessments and revalidation of training.

## Purpose of VTS

We all know that VTS contributes to the safety of life at sea. It improves the safety and efficiency of navigation and supports the protection of the environment within a VTS area by mitigating the development

of unsafe situations. So, how is this done? VTS provides timely and relevant information and communications between ship, shore, and other shore agencies – information that helps you, as a navigator, to do your job. This can include information on other ships, maritime safety data, any limitations or restrictions in place and more.

VTS has access to some great equipment to help monitor the VTS area (and usually a bit beyond the limits of the area). By using these tools, and additional information from allied services, VTS monitors and manages ship traffic to keep the waterway safe and support efficient ship movements. This can include planning movements in advance, organising water space allocation, using traffic clearances and providing route advice, as well as ensuring compliance with regulatory provisions (where they are empowered to do so).

Thanks to all the information they have, and the monitoring tools available, VTS can also respond to developing unsafe situations. For example, it can provide support to a ship that is unsure of its position, notify a ship when it is deviating from the planned route, provide emergency responses, support emergency services... you get the idea.

### Technical tools

The digitalisation of the maritime environment means that VTS tools are getting more and more sophisticated. As

## TERMS AND DEFINITIONS

Some of the terms and definitions used in connection with vessel traffic services, as set out in IMO Res A-1158(32):

**Vessel traffic services** – services implemented by a Government with the capability to interact with vessel traffic and respond to developing stations within a VTS area

**Competent authority** – the entity made responsible by the Government for vessel traffic services

**VTS provider** – the organization or entity authorized by the Government or competent authority to provide vessel traffic services

**VTS area** – the delineated, formally declared area for which the VTS provide is authorised to deliver vessel traffic services

**VTS personnel** – persons performing tasks associated with vessel traffic services, trained in vessel traffic services operations and appropriately qualified

a navigator, you will almost certainly have communicated with a VTS using VHF, but you may also have checked out information on a website or exchanged information by email or other digital means.

VTS uses different tools to monitor the waterway – not only the ships, but also other aspects, such as the state of the tide and tidal stream, weather, port operations such as diving, dredging and even yacht races. Input from the different sensors is displayed in the VTS centre and presented through what is known as a Decision Support Tool, or 'DST'. A DST can combine radar, AIS, CCTV, tidal data, under-keel clearance systems and more.

In addition to all the tools to monitor the waterway, VTS also has tools to connect with other allied services to support safe and secure operations. VTS is an important information hub for the port.

### Operational procedures

Just like the navigator onboard ship, the VTS operator has their own set of operational procedures. These include agreed parameters for when different activities can take place, minimum separation distances or time separations for movements and so much more.

A key element for communication with the VTS is the VHF voice procedures. VTS professionals are taught specific voice procedures to ensure clear and unambiguous communications using the same Standard Marine Communication Phrases (SMCP) that navigators are taught. VTS use message markers specifically to help with the communications, noting the critical and often time-sensitive nature of their communications.

Message markers can really help focus the communications.

For example, when asking for confirmation of the vessel's draft, the VTSO

would say 'QUESTION:

what is your maximum draft?' To help support the communications, IALA has developed Guideline 1132 on VTS Voice Communications and Phraseology.

If you are interested in anything related to VTS, go to the IALA website and type 'VTS' into the search bar – you will find lots of great information there!



## Wind and weather data

There is so much information now available on the Internet, compared to the single forecasts of even 20 years ago. The big question is, however, which source should you trust? **Cdre Nick Nash, FNI**, looks at available data sources for weather and route planning and explains why a simple set of spreadsheets can help him get a better handle on the wind

As a Master of a 145,000 GRT large passenger cruise liner, weather information, particularly wind forecasts, is vital to our safe and efficient harbour manoeuvres and transits – we have a 13,800m<sup>2</sup> sail area, after all. There is so much information now available on the Internet, compared to the single forecasts of even 20 years ago. Today, there are no less than eleven global weather models, of which the two best known are the European Centre for Medium-Range Weather Forecast (ECMWF) model and the National Weather Service's Global Forecast System (GFS) model.

The big question is, which one do you trust, particularly, or more annoyingly, when they disagree – which is quite often? I tend to try and use a 'Government' sponsored website, if available, such as the UK Met Office, met.no for Norway and, of course, NOAA for the USA. Their accuracy does vary, but in complaining about this, a Master of a large vessel must take into account the fact that these weather forecasts are all intended for a ten-metre height, whereas most large cruise liners have their anemometer at least 50m above sea level.

### Writing down the wind

I have found the best way to determine the accuracy of the forecast for each particular port is by making a spreadsheet of 'forecast wind' and 'actual wind' at key waypoints on the approach – outside, pilot area, inside and berth wind.

A spreadsheet like this, built up over numerous calls, gives the Master confidence in the forecast model they tend to use. A refinement could be to include a column noting the different forecast models.

A further issue that a Master can face is the afternoon 'sea breeze'. This is rarely forecasted and a day forecast for, say, Marseille gives a wind forecast of 10-15

knots throughout the day (Windfinder) with a slight increase in the afternoon to, say, 18 knots. In reality, the SW on-shore wind can easily increase to 30-35 knots from 3pm to 7pm. Again, I have an Excel spreadsheet that tries to predict when this afternoon sea breeze will kick in by recording weather, pressure and noon temperatures, alongside morning wind speeds.

### Data

There is a feeling, particularly among older seafarers, that the Master's decision-making has been diluted by shore communications and the amount of web-based information now available to them. I don't think this is so. I feel as a Master that I now make better-informed decisions based on a whole lot more data. The trick is to understand where this data is coming from – its source and how far you can be confident in its accuracy. This is easier with government-sponsored sites,

such as the UK Hydrographic Office, UK Met Office, NOAA, MPA (Singapore), Australian Chart Agency, SEMAR (Mexico) etc.

Route planning has become a growth industry. This is no longer a case of a lone second officer drawing course lines on charts laid out on a table tennis table to ensure all the rhumb lines match up at chart changes! Intelligent software can collate, integrate and analyse marine information to support decision-making.

For some companies, the use of a fleet-based operation centre assists this by offering a number of pre-planned routes for the ship's navigator to choose from, say, from Miami to the Caribbean. These routes will take into consideration elements such as fuel economy, environmental boundaries/restrictions and possible medical deviations – as well as that all-essential factor: weather.

The Master now has an abundance of information and support available to enable them to plan, depart, transit and arrive safely, on time, environmentally compliant and economically.



## Seafaring is not besting others, rather, it's relating with them

Seafarer Yrhen Bernard Sabanal Balinis, AMNI, discusses his career, his aspirations for the future and why it is so important to be part of a strong community at sea

### What career path led you to your current role?

I am a seafarer by profession with a Bachelor's of Science degree in Marine Transportation from Mariners' Legazpi in Legazpi City, Philippines.

### What do you like best about working at sea?

Many would probably answer seeing different sunsets, travelling the world for free, earning dollars... and although those are all great perks of seafaring, what strikes me most is the humanity present in an iron-clad floating community. The crews and officers with whom I have sailed have supported me, motivated me and even tolerated my mishaps!

### Where do you see yourself in five years? Ten?

I envision that I will still be advocating for a fairer future for seafarers, supporting the cadets and junior personnel in their career progression, be it onboard or ashore. Professionally speaking, I am aiming to be a Captain within that timeframe (and may that happen by God's grace). I have seen a few 30- or 25-year-olds who have already sailed as chief officers and Masters. They have successfully broken the age barrier and shrugged off the archaic misconception: "but you're still too young to lead"! However, make no mistake, they are not supposed to be the outliers; they should be the norm.

### How can experienced navigators help those coming up behind them improve on their knowledge and skills?

For officers, allow your junior personnel to take rounds with you: have them join your monthly safety maintenance meetings,

assign them tasks like updating crew lists, plotting the NAVAREAs, preparing arrival reports etc., all within your supervision. These may be small responsibilities but it gives them a sense of accountability that somebody views them as being capable of more than their current rank. That they can be – and do – more.

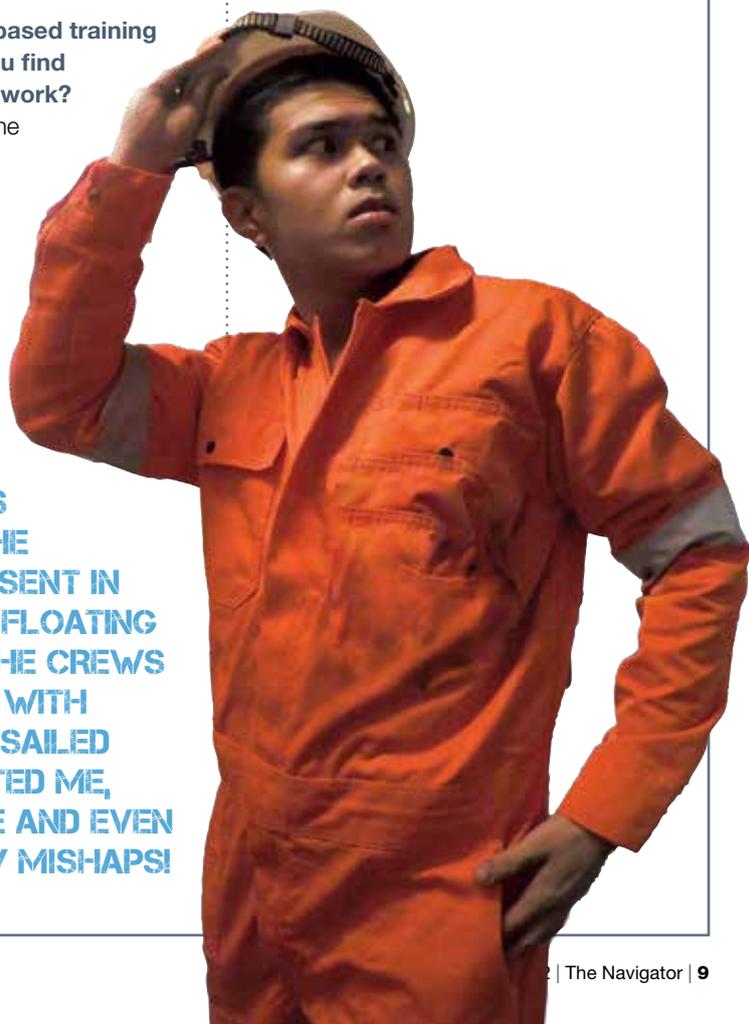
For crew, do not frown upon junior personnel speaking their mind. They may have new and unexplored ideas which may just solve a critical problem. They are not your competition. Seafaring is not besting others, rather, it's relating with them.

### What kind of shore-based training and resources do you find most helpful in your work?

I am an avid learner. The rise of online courses brings a bounty of opportunities for me to widen my skills

base. The Nautical Institute regularly conducts free-to-attend webinars for the public. Every session discusses modern maritime technical knowledge with experts in the field. The NI also offers its members exclusive free online courses, and highly in-demand short courses (such as Casualty Management, Blockchain for Maritime Professionals, among others). As the maritime industry gears towards modernisation and digitisation, why would I want to be left behind?

**WHAT STRIKES ME MOST IS THE HUMANITY PRESENT IN AN IRON-CLAD FLOATING COMMUNITY. THE CREWS AND OFFICERS WITH WHOM I HAVE SAILED HAVE SUPPORTED ME, MOTIVATED ME AND EVEN TOLERATED MY MISHAPS!**





# WAYPOINT

George Shaw FRIN

## Collaboration, communications and confidence: the winning combination?

George Shaw from the Royal Institute of Navigation examines how mutual trust and collaboration between ship and shore communications can lead to enhanced operational efficiency – and increased confidence all round

Effective ship/shore collaboration relies on mutual trust and shared goals between parties. They must be willing to co-operate and use dependable communications throughout the voyage. Positive outcomes from this include enhanced operational efficiency (timely arrival, minimal emissions/fuel used) and a safer vessel. Sharing wider situational awareness is essential in increasingly complex sea areas with a growing number of offshore installations. Rigorous co-operation, based on trustworthy crowd-sourced and networked data, could smooth potential voyage conflicts and reduce delays, supporting navigator decisions on course or speed.

A positive operational culture of mutual collaboration and shared benefit is the most important part of achieving efficiency gains safely. Technology also plays a key role. In order for participants to rely on information, underlying data must have inherent integrity. Communications must be secure (resistant to cyber assault), robust (resistant to physical interference) and resilient (minimising interruptions and recovering rapidly).

AIS messaging is currently overburdened and insecure, with ever-increasing demands for data quantity with low latency to support burgeoning digital services. The introduction of the VHF Data Exchange System (VDES), together with expanding satellite communications, offers much greater data capacity and geographic coverage, with cybersecure and authenticated messages. VDES will

enable mariners to check that messages truly originate from a recognised authority, and that the information is timely and as intended. Furthermore, standardisation of machine-readable information formats provided by the IHO S-100 family of data product specifications avoids misinterpretation and underpins effective portrayal of information to the mariner. All of this supports dynamic decision-making.

### **ENHANCED SHIP/SHORE COMMUNICATION MUST NOT DISTRACT THE NAVIGATOR FROM THEIR PRIMARY RESPONSIBILITY: THE SAFETY OF THE SHIP, CREW, CARGO AND ENVIRONMENT**

#### **Voice**

Voice communications will always play a part, but caution is needed when used in safety-related applications. The aviation world continues to use voice communications, despite issues of language and cognition. In a recent incident, a Swedish A320 plane descending to Paris came within two metres of ground collision, following a confusion in transposing digits in the altimeter setting conveyed from ATM by voice. Maritime services need to heed this lesson.

Even with advances in VDES, underlying data sources may have no inherent integrity, with no warning of statistical uncertainties or

flags for possible occurrences of dangerous errors. Importantly, GNSS position information cannot be trusted for maritime safety applications. Aviation GNSS benefits from regional satellite-based augmentation services (e.g. WAAS/EGNOS), but no equivalent yet exists for maritime. Until GNSSs are complemented with resilient, high integrity positioning services, mariners must be alert for misleading information and consider the impact on decisions and services.

Collaborative developments, supported by a progressive culture, training and appropriate technologies, should aspire to reduce the workload on the navigator and free up time for vital 'thinking space'. Procedural and technological developments could rationalise paperwork required for port calls via automatically generated standard forms. Co-operative digital services for passage adjustments en route and dynamic checks of under-keel clearance may also help, building towards the introduction of wider Sea Traffic Management (STM) services, such as those currently being evaluated in the EU.

Such steps herald safer expansion towards autonomous vessel operations. However, enhanced ship/shore communication *must not* distract the navigator from their primary responsibility: the safety of the ship, crew, cargo and environment. The combination of culture and technology is a matter of trust and confidence to deliver safety, but this is not easily won.

# TAKE TOP 10

Ship and shore communications are an integral part of the navigator's role. Here are ten key points.

## 1

### A sea of information

We live in a world of information with shipping in the thick of it. Ships and their crews need to understand how to use the information that is exchanged between ship and shore to make the best decisions.

## 2

### Collaboration is key

Sharing information between ship and shore can add value to both parties. Ships benefit from advanced knowledge of weather and routing options, while shore decisions can improve, the more they know about a ship.

## 3

### Good, great or dangerous?

Good information can be great, but not all information is good or useful – and some can be dangerous. Always question the value of information before making critical decisions.

## 4

### Playing many parts

It is critical for navigators to carry out their role safely. However, as an employee of a commercial venture, it is also important for navigators to use and provide commercial information to best effect. Understanding how information flows support your company's business models will help you to add value.

## 5

### Beyond the horizon

Information provided by shore services can offer you a clearer picture of what lies beyond the horizon. Weather forecasts, voyage planning advice and even berth and cargo availability can improve your decisions.

## 6

### Stay cyber aware

Cyber threats are very much a reality, so take time to understand (as best possible) where risks lie, what your company policies say and the contents of recovery plans.

## 7

### Knowledge is power

As maritime become more integrated into global logistics and supply chains, the more navigators know about information management, the faster they can progress.

## 8

### Share and share alike

Don't be fooled into thinking that an understanding of information management comes with rank; the use and understanding of data and information can be gained by all ages and experiences.

## 9

### All available options

Ship/shore collaboration does not necessarily need to be formal. Official information is usually best, but intelligence and knowledge about regions or ports can also be gained from informal internet sources, discussions with locals and sharing information with other navigators.

## 10

### Into the future

Increasingly you will come across decision support tools like artificial intelligence, machine learning etc... Understand these the best you can, but never forget the skills and experience you have as a mariner.

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| ENGLISH<br>@SEA | NAVIGATION<br>@SEA      | ENGLISH@<br>SEA PLUS | ENVIRONMENT<br>@SEA |
| WRITING<br>@SEA | NAVIGATION<br>@SEA PLUS | LEADERSHIP<br>@SEA   | METEOROLOGY<br>@SEA |