Why e-Navigation?

e-Navigation is coming – though the implications of this initiative, and what it might practically mean for maritime stakeholders, are still not widely understood. *Fred Pot, Marine Management Consulting,* examines some of the current and future developments that will form the backbone of this new system

'Why e-Navigation?' really has meaning only for the few of us who understand what e-Navigation will be. My guess is that less than 500 people in the world today can claim to do so. For everybody else 'What is e-Navigation?' is a far more relevant question.

Why do so few of us understand e-Navigation? I blame part of the problem on the 'e-Navigation' name.

For most 'e-Navigation' conjures up images of on-board electronic navigation instruments. They associate e-Navigation with boxes and miss its much wider scope. To them it seems that, with mandatory carriage of Radar and AIS and soon of ECDIS, e-Navigation is close to reality.

This misconception is a clear threat to implementation of e-Navigation because, for it to be successful, we need broadly-based recognition both of what it is and what its benefits are.

A small step might be to give it a name that better captures it. For example, 'Marconi' might be better because it captures digital communications (albeit primitive) that allow information sharing and collaboration as well as automating administrative tasks. An even better idea might be to appropriate the 'EfficienSea' name, because it conveys e-Navigation's broad impact.

The overall goal of e-Navigation is getting ships safely, securely and efficiently from berth to berth in an environmentally friendly way. The high-level answer to the 'Why e-Navigation?' question is that it will improve our ability reach the overall goal more often.

To understand how e-Navigation will do that we have to dig deeper into the reasons why not all voyages are accomplished safely, securely and in an environmentally friendly way.

Gaps and solutions

Statistics show that human error is the root cause of about 60 per cent of collisions, allisions and groundings.

Incident investigations point to a number of causes of these errors. To get to the bottom of the errors, IMO's e-Navigation Correspondence Group (CG) identified mariners and shore-side users and asked them to enumerate problems they experience in discharging their responsibilities.

The problems ('Gaps') were captured in a (rather large, 47 page) table (Gap Analysis – see note 1). Gaps can be summarised in eight major categories:

1. Bridge lay-out/ergonomics problems
2. User unfriendly and unreliable bridge equipment
3. Lack of task oriented presentation of relevant decision support information on work stations (on-board and ashore)
4. Lack of (position) sensor accuracy indications (on-board and ashore)
5. Alarm handling problems
6. Too much time required to perform administrative tasks
   - Identifying, gathering, searching and updating relevant documents (ENC's, Guides, etc.)
   - Generation of ship reports for Coastal States' Maritime Domain Awareness (MDA) purposes
   - Shore-side processing of ship reports (Security, VTS, Environmental Monitoring, etc.)
7. Incomplete/unreliable information presented on MDA systems
8. Language issues particularly in voice communications

While e-Navigation users are expected to ultimately shape solutions that address these gaps, the CG will assess the costs, benefits and risks of an initial set of 30 high-priority solutions and will include them in the Implementation Plan. Addressing these gaps will pave the way for users to shape solutions that address other gaps.

We don't know yet which solutions the CG is considering but the Chairman of the CG (see note 2) indicates that they will be made public sometime later this year.

If you read the detailed descriptions of the gaps you can make an educated guess on what the actual solutions will look like. A few examples of likely solutions are:

1. Automatic downloading, installing and updating of relevant Electronic Navigation Charts (ENC's) and other (searchable) documents like port guides, VTS guides, light lists, pilotage charts, etc.
2. Task oriented geo-spatial presentation on the navigation screen of:
   a. Relevant Maritime Safety Information (MSI) using intuitive symbols
   b. Safety contours based on a waterway's tide-corrected bathymetry that is received from shore
   c. Weather and sea-state forecasts along with the recommended route
   d. VTS traffic flow plan (sequence, routes and speeds) through congested waterways
3. Close coupling of a Pilot's Portable Unit (PPU) with the ship's navigation systems
4. Close coupling of the ship's navigation systems with VTS for Navigation Assistance Service (NAS)
5. Remote inspection of a ship's navigation systems (position accuracy, make/model and software version)
6. Automatic ship report generation, transmission and processing for Coastal State MDA purposes
7. Manoeuvring and mooring decision support tools based on highly accurate shore-based (position) sensors

e-Navigation displays will integrate more information than is available with ENCs today

Infrastructure

The infrastructure technology required to implement many of these solutions is readily available. In fact some solutions are already available on a few of the more sophisticated ships.

They tend, however, to be vendor specific and proprietary. For e-Navigation to reach its overall goal, solutions will need to be made available to the great majority of ships and share a common, non-proprietary Information Technology (IT) and communications infrastructure that can be used for multiple solutions.

Designing, developing, testing and rolling out this infrastructure is a major undertaking. Even though it clearly is IMO's prerogative to establish standards for the best infrastructure, it probably will rely on others to propose alternative infrastructure designs.

'Others' in this context could well be IT and communications systems vendors (represented by their Member State delegation).

What will the e-Navigation infrastructure look like? What will solutions like the ones mentioned above require?

At minimum they probably will require an on-board (plain vanilla) IT infrastructure (LAN, servers, back-up servers, routers, Integrated Navigation System and other workstations, etc.) and a communications infrastructure that builds on the existing GMDSS, the existing satellite (Inmarsat, Iridium, etc.) and the existing communications network that currently connects sensors (i.e. GPS, AIS, Radar, etc.) with the navigation work station (i.e. Integrated Navigation System or 'INS').

e-Navigation solutions will likely be software applications that run on the on-board servers, and will be accessible (with proper authorisation) from any workstation.

It is likely that existing bridge equipment will need to be upgraded to enable solution applications to address gaps. For instance, INS, at least currently, cannot present MSI in a geo-referenced format and sensors don't generally indicate their accuracy or the results of Built-In Integrity Tests (BIIT).

Shore-side, solution application software will likely run on office and cloud-based servers that are accessible (with proper authorisation) from any connected workstation (i.e. PC, iPad, etc.). On-board solution applications will use the new e-Navigation communications infrastructure to automatically, reliably and securely exchange data with shore-side solution applications.

Standards

The geo- and time-referenced S-100 protocol will be used not only for ENC's but for all navigation related information (MSI, Tides, Currents, Port & VTS Guides, Lights Lists, Weather Forecasts, etc.). This will ensure that ship and shore-based solution applications use a common protocol to exchange data.

By implication, all bridge and shore-side equipment will need to be able to, natively, process S-100 formatted information or use an external gateway that translates the S-100 formatted information to and from the current common communications protocol (IEC 61162) or the equipment's proprietary protocol.

Apart from the S-100 protocol, IMO will have to develop standards for the security, quality, reliability, timeliness, the user interface and the (task oriented) presentation of information that solution serv-

ices will provide. Even though such standards should be common rather than proprietary, vendors will probably need to play a key role in defining them.

IMO will need to establish many more standards before e-Navigation solutions can be implemented. An important one is a single, world-wide standard for ship reports that are acceptable to all Coastal States' MDA authorities and non-governmental organisations.

IMO's efforts in this area (Convention on Facilitation of International Maritime Traffic/Single Window Concept) are a start, but have a long way to go before they become acceptable to every Coastal State without a long list of exceptions.

IMO will also need to publish standards for e-Navigation-compatible equipment.

Such equipment will need to pass a usability test, it will need to be able to communicate with the local e-Navigation IT infrastructure, it will need to share the results of its Built-In-Integrity Test (BIIT), sensors will need to communicate their accuracy, and bridge and shore-side work stations will need to present task oriented geo- and time-referenced (S-100) information using intuitive symbols (much like the current INS standard).

IMO will rely on Member States' participation in (IEC, IALA, IHO, etc.) Work Groups to bring equipment performance standards up to e-Navigation standards, but the current process is too cumbersome and lengthy. Furthermore it is too expensive and time consuming for vendors to certify their equipment.

The process will need to be streamlined to enable vendors to release new versions of equipment software two or three times per year to accommodate new requirements, improve performance and fix bugs.

To ensure that vendors will be able to periodically roll-out software upgrades for their equipment, they will probably need to be included to a greater extent in the standard development process than they have been.

The service life of e-Navigation hardware will probably be shorter than the current norm because eventually software upgrades, that enable the equipment to add more and more features, will reach hardware performance limits (i.e. processing speed, memory, storage, input/output options, etc.).

Funding

Designing, developing and testing the e-Navigation infrastructure is a major undertaking. IT and communications vendors may be interested in funding the development of infrastructure proposals if they can look forward to collecting usage fees once their design has been tested, accepted and implemented.

e-Navigation infrastructure proposals will likely be tested in test beds such as the Marine Electronic Highway (MEH) in the Strait of Malacca, that is partially funded by the World Bank, and the ACCSEAS test bed in the Greater North Sea Region. The latter is currently being designed and is expected to have a budget of about €6 million, funded mainly by North Sea Regional, Coastal State and Port Agencies.

Similarly, if they can look forward to collecting usage fees, ENC publishers and other vendors may be interested in funding the design, development, certification, distribution, training and marketing of e-Navigation solution services that take advantage of the infrastructure.

Once the e-Navigation infrastructure and solution services have been thoroughly tested and new minimum carriage requirements have been adopted by Flag-, Coastal- and Port-States, ship owners and shore-side authorities will be required to install and maintain on-board and shore-based e-Navigation IT infrastructure, or to modify the current infrastructure.

They will, also, be required to upgrade bridge and shore-side equipment (sensors, work stations, etc.) to make it e-Navigation-compatible. Furthermore, they most likely will be required to purchase a minimum set of e-Navigation solution services and will have the option to purchase additional services.

The cost of updating equipment performance standards will probably be funded by IMO-, IALA- and IHO-Member Countries and by other international organisations, as it traditionally has.

Development of e-Navigation-compatible equipment standards differs, however, from development of traditional equipment standards in that they will need to be established for all bridge and shore-side e-Navigation equipment almost simultaneously and that the standard development process needs to be streamlined.

It will be necessary to replace current processes and procedures with a new process that allows for dynamic, rather than the current, basically static, performance standards. The budget for doing so will, therefore, need to be significantly larger than it traditionally has.

Implementation and Roll-out

From the description of e-Navigation above it should be obvious that it will be rolled out over time. Full implementation will take many years; however, it is likely that some e-Navigation solution services will be implemented in the not too distant future.

Roll-out is likely to start with solution services that do not require upgrading of bridge equipment and could be implemented with an early, still incomplete (prototype) version of the e-Navigation IT and communications infrastructure.

An example is automatic downloading, installing and updating of relevant Electronic Navigation Charts (ENC's) and other (searchable) documents like port guides, VTS guides, light lists, pilotage charts, etc.

To roll out this solution, publishers of these documents would need to reformat them to fit the S-100 format, publish their subscription offers, fulfil subscription requests and set up automated processes and procedures to update documents for subscribers.

General awareness of e-Navigation, not only of what it is but particularly what its benefits are, is going to be crucial when key decision makers are approached to contribute time, effort and funds to implement it. If its nature and benefits are widely known then key decision makers are more likely to support its design, development and implementation.

Who are the stakeholders? Apart from those who will directly benefit from it (mariners and shore-based operating personnel) there are many who will benefit in-directly. Completing more voyages in a safe, secure, efficient and environmentally friendly manner will benefit all concerned and should appeal to a wide audience.

The author hopes that this 'Why e-Navigation?' article will contribute in a small way to its awareness but a much wider audience will need to be informed to generate discussions and enthusiasm.

A formal e-Navigation awareness plan should be developed soon to identify the audiences, the appropriate communication channels for each audience, the message to be conveyed and to assess the audience's e-Navigation awareness before and after.

As a first step it might be appropriate to stage a press event around the unveiling of the 30 e-Navigation solutions for which the CG will pursue implementation. DS

References

1] The current version of this document is available at http://bit.ly/It5lsv Annex 2, Page 25

2] Mr. John Erik Hagen, Regional Director, Norwegian Coastal Administration

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