Why eNavigation?

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eNavigation is about getting the ship safely, securely and efficiently from berth to berth in an environmentally friendly way, using globally enhanced systems for navigation and communication – with the human element in focus. This article, based on a presentation given at the NI Seminar in Delhi in December 2011, Chairman of IMO Working Groups on eNavigation looks at what this will mean for users in practice, and at the process that will lead to an implementation strategy.

In 2009 the IMO's Maritime Safety Committee (MSC) approved a proposal for a coordinated approach to the implementation of an eNavigation strategy, following concerns that developments in electronic maritime navigation and the consequent regulatory effort were not proceeding in a coordinated manner. The work will be undertaken by three sub-committees: NAV (Safety of Navigation), COMSAR (Radio communications and Search and Rescue) and STW (Standards of Training and Watch keeping). NAV, led by Mike Sollosi, is coordinating the efforts (see article, p21).

Why eNavigation?

There is an increasing intolerance of adverse impacts on the marine environment caused by shipping, and in particular of accidents that result in marine pollution. Due to the transboundary character of the shipping industry, environmental impacts draw global attention and global awareness. Our oceans are the common heritage of mankind, and home to a wide range of vulnerable forms of life.

Shipping might be the most international of all the world's great industries. At the same time it is one of the most dangerous, with the potential to cause major environmental damage. The best way of improving safety, including environmental protection, is by developing international regulations that are followed by all shipping nations.

Traditionally, coordinated action and regulation have evolved as a result of major accidents. The *Torrey Canyon* disaster of 1967 and the *Exxon Valdez* disaster in 1989 had far-reaching effects on our current regulatory framework. And in 1999 we saw new EU regulations emerge after the *Erika* accident. Here are some additional figures that demand reflection. According to *IHS Fairplay* world casualty statistics for 2010, 172 ships of 0.81 million gross tonnage were reported as total losses. The number of total losses of cargo carrying ships was 119 of 0.78 million GT (1.19 million dwt).

We also know that there are externalities not included in this equation. The losses of human life and damage to the oceans are difficult to measure. What is beyond discussion is that investment to reduce the risk of such incidents is money well spent.

Over the last 40 years or so, the shipping industry has focused on improving ship structure and the reliability of ship systems in order to reduce casualties and increase efficiency and productivity. We've seen improvements in hull design, stability systems, propulsion systems, and navigational equipment. Today's ship systems are technologically advanced and highly reliable. Yet, the maritime casualty rate is still high. Why? Why is it, with all these improvements, we have not significantly reduced the risk of accidents?

It is because ship structure and system reliability are a relatively small part of the safety equation. The maritime system is a *people* system, and human errors figure prominently in casualty situations.

About 75% of marine casualties are caused, at least in part, by some form of human error.

In the last decades we have seen huge developments in technology within navigation and communication systems. The use of digital communication has shown endless opportunities.

Manufacturers are developing solutions based on the different needs of the different users, but in order to be able to actually communicate, the users will need to be using the same maritime data structure. There is a need to coordinate systems.

With all this developing technological opportunities, we also need to ask if there is a sufficient link between technology, procedures, people and training?

Thinking ahead

This time we want to think ahead, and take action to reduce the risk of accidents. We focus on prevention, and mobilise forces to avoid such devastating accidents before they are occurring. To achieve our goal we are taking advantage of the newest, most outstanding technology.

There will be bigger and more complex ships, increased speed, greater port efficiency, more regulations and above all a far higher demand for public accountability in the maritime industry.

There will be a need for a technology convergence for safe navigation. We need to use technology to enhance safe navigation.

The IMO has taken a clear stand on the duties of the maritime community, on its responsibility for the environment.

In 2005 the British Minister of Transport launched an initiative concerning the lack of coordination in the field of electronic maritime navigation and related regulatory development.

IMO's Maritime Safety Committee was called to undertake a major new work

programme, with the intention to realise the vision of global eNavigation.

In 2009 the IMO's Maritime Safety Committee (MSC) approved a proposal for a coordinated approach to the implementation of an eNavigation strategy, outlining a joint plan of work for its three sub-committees. A correspondence group coordinates the work of the sub-committees.

Establishing a coordinated approach

Since the development of an eNavigation strategy plan three years ago, significant progress has been made in designing a coordinated approach to its implementation, covering not only safety of navigation, but also radio communications, including spectrum issues, search and rescue, and human element and training related aspects. The overarching architecture of the concept was finalised this year, the associated gap and cost-benefit risk analyses will be completed next year – which might lead to the Strategy Implementation Plan being finalised in 2014.

At NAV 57 the Secretary General of the IMO stated that 'As intensive work continues on the development and implementation of a global strategy on eNavigation, it is important not to lose sight of the aim being pursued, which is to contribute to meeting the needs for safe and efficient maritime navigation and shipping traffic in the 21st century'.

The MSC introduced both a vision and a definition of eNavigation at its eighty-fifth session:

'eNavigation is the harmonised collection, integration, exchange, presentation and analysis of maritime information onboard 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.'

eNavigation includes both onboard, ashore and communications elements. The vision is embedded in the following general expectations:

- On board, this will include navigation systems that benefit from the integration of own ship sensors, supporting information, a standard user interface, and a comprehensive system for managing guard zones and alerts. The core elements of such a system will include actively engaging the mariner in the process of navigation to carry out his/her duties in a most efficient manner, while preventing distraction and overburdening;
- Ashore, this will include the management of vessel traffic and related services enhanced through better provision, coordination, and exchange of comprehensive data in formats that will be more easily understood and utilised by shore-based operators in support of vessel safety and efficiency;
- And last but not least, it includes communications that will make up an infrastructure providing authorised seamless information transfer on board ship, between ships, between ship and shore and between shore authorities and other parties with many related benefits.

Based on identified user needs which includes several international surveys, a gap analysis is ongoing, and will be followed by risk and cost-benefit analyses.

The gap analysis at this stage identifies gaps in the present regulations and equipment performance standards that need to be addressed, and will be used to consider amendments to existing regulations or equipment performance standards.

The human element

A specific list of human elements is integrated in the gap analysis, and will be considered in the development of guidelines and regulations at the technical, operational, training and regulatory level.

A lot of the identified gaps are very similar, and 30 possible solutions have been identified that are expected to close the majority of the gaps.

The maritime system is a people system, and technology can not be introduced alone. A key success factor for eNavigation will be its ability to integrate technology, usability, and the human element in navigation. This is a concern for IMO, and IMO NAV have issued guidance on issues to be considered when introducing new technology on board ships.

There may be a need for people to have different competences onboard and ashore, but their ability to operate interactively is important.

It is fundamental that a framework for harmonising maritime information systems must be designed to facilitate the reduction of 'single person errors/single unit errors', particularly on board. This will require the system to reduce some of the basic errors in perception, communication and decision-making that can occur on board as well as ashore.

Standardisation is another key element. Development of standardised, module-based bridge layout adapted to the functions of the individual ship, is key to facilitate the smooth familiarisation of ship borne personnel when transferring from one ship to another.

The eNavigation strategy will also need to address training, competency, language skills, workload and motivation. Alert management, information overload and ergonomics are the prominent concerns.

Training is one of the components of the ongoing gap analysis, and will also be included in the formal safety assessment.

After an in-depth consideration in the Working Group at STW 42, it was stated in the report to the Maritime Safety Committee that the use of simulators would assist training and might assist in assessment, permitting the simulation of diagnostic and contingency responses.

Usability

Usability is another key element of eNavigation. Usability is important for familiarisation. In order to evaluate the usability of eNavigation elements, following evaluation methods are commonly used:

1. Usability testing;
2. Heuristic evaluation method;
3. Checklist method;
4. Questionnaire survey;
5. Field survey.

Taking into account commonly used methods for usability evaluation, one may identify characteristics of the maritime sector and elements necessary to be considered in developing a tool for usability evaluation of navigation equipment. The following four points may be addressed in usability evaluation:

1. Navigation experiences of test participants;
2. Computer literacy of test participants;
3. Scenarios for equipment to be used;
4. Collection of observations of test participants.

The operational concept is a brief outline of the possible solutions identified at this stage.

The eNavigation concept is based on structured and verified information to support decision-making. It relies on a largely automated communication infrastructure, seamlessly connecting ship and shore. The architecture is based on a common maritime data structure, and uses IHO Geospatial Standard for Hydrographical Data, s-100.

eNav solutions

eNavigation is about how to get the ship

safely, securely and efficiently from berth to berth in an environmentally friendly way, using globally enhanced systems for navigation and communication – with the human element in focus. In practical terms, this could mean a variety of things, some examples of which are listed below. Some of solutions will be possible to implement in the short term, others in the longer term.

Equipment familiarisation will be intuitive as symbology, material requirements and workstation layout are standardised. The mariner will have access to all available nautical information, and a default interface setup option is accessible by one touch (S-mode). Reliability of nautical equipment will be continuously verified by built-in-integrity tests. Several processes will be automated and autonomous in order to reduce the workload and administrative burden.

Electronic nautical charts and nautical publications will automatically be updated. Target detection and integration of available information in nautical graphical displays will be improved (e.g. information sharing including real-time own-ship status information, MSI, AIS, next gen AIS, charts, guard zones, radar, environmental information, berthing requirements etc).

The reporting burden will be eased by automated entry of internal ship data, standardised formats, single entry of reportable information, more efficient distribution of reportable information, and harmonised national reporting requirements and procedures.

eNavigation intends to improve the level of navigation assistance services (NAS) provided by VTS to mariners.

VTS will be able to provide enhanced traffic organisation service (TOS), through automatic transfer of traffic flow plans, coordination and exchange of reliable qualitative data in comprehensive formats to/from ships as well as to/from shore stakeholder institutions.

Shore authorities will be able to provide real time updates of navigation data, virtual navigation aids, weather updates and traffic information using standard symbology and automated information transfer.

Improved real time maritime picture will enhance decision making and monitoring for national authorities, ship owners, VTS, SAR and port authorities.

Shore based authorities will be able to remotely inspect navigation equipment and the quality of on-board navigation through determination of make and model of navigation equipment. eNavigation will enhance the SAR communication through automated communication, priority for distress communication, information collection and data coordination.

Training

Future training will need to take into account the important elements of eNavigation:

- harmonisation;
- integration;
- standardisation;
- efficiency and safety.

Possible benefits would be more efficient training under the STCW.

eNav in practice

The Marine Electronic Highway (MEH) project is a demonstration project in the Straits of Malacca and Singapore that is showing how eNavigation could work in practice. It began from the need for an enhanced information technology system in the Straits of Malacca and Singapore in order to address navigational safety and trans boundary marine pollution issues.

The four year regional demonstration project aims to link shore-based marine information and communication infrastructure with the corresponding navigational and communication facilities aboard transiting ships, while being also capable of incorporating marine environmental management systems. The overall objectives are to enhance maritime services, improve navigational safety and security and promote marine environment protection and the sustainable development and use of the coastal and marine resources of the Straits' littoral States, Indonesia, Malaysia and Singapore.

The role of IMO

The eNavigation project cannot be fully realised with the participation of only a limited number of States, organisations, institutions or private parties. Broad coordinated action would be necessary. IMO is in an unique position, possessing the strength necessary to bring the eNavigation programme safely to shore.

The final eNavigation strategy implementation plan will identify responsibilities; propose a phased implementation schedule, priorities for deliverables, and an agenda for the continual assessment of user needs. Furthermore, the plan will include a systematic assessment of how new technology can best meet defined and evolving user needs, and how, in the longer term, the development of any technology and institutional arrangements can fulfil the requirements of eNavigation. Proposals on public relations and promotion of the eNavigation concept to relevant stakeholders will be a key component. The identification of potential sources of funding, particularly for developing regions and countries and of actions to secure that funding, will also be important.