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DEVELOPMENT OF AN E-NAVIGATION STRATEGY

Report from the e-Navigation Correspondence Group

Submitted by the United Kingdom

SUMMARY

Executive summary:	This document is the proposed high level strategy for e-Navigation submitted by the Correspondence Group, and also advises on the methodology adopted to identify user needs. It also proposes an implementation strategy for e-Navigation
Strategic Direction:	5.2
High-level Action:	5.2.4
Planned Output:	5.2.4.4
Action to be taken:	Paragraph 27
Related documents:	MSC/Circ.1091, MSC/Circ.878, MSC/Circ.346; resolution MSC.252(83); MSC/Circ.982; NAV 53/22, NAV 53/13, NAV 53/13/1; COMSAR 12/11 and NAV 54/INF.3

Introduction

1 NAV 53 agreed that in order to progress the work on the e-Navigation strategy for NAV 54, the intersessional Correspondence Group should be re-established under the co-ordination of the United Kingdom. The Group includes representatives from different Flag States, Maritime Agencies and Non-Governmental Organizations. Flag States who participated include Australia, the Bahamas, Bolivia, Brazil, Canada, China, Denmark, Finland, Germany, Japan, the Marshall Islands, the Netherlands, Norway, Panama, Poland, Portugal, the Republic of Korea, South Africa, Singapore, Spain, Sweden, Turkey, the United Kingdom and the United States. Other Governmental and Non-Governmental Organizations that participated include APA, BIMCO, British Chamber of Shipping, CIRM, IALA, ICS, IEC, IFSMA, IHMA, IHO, IMPA, INTERCARGO, INTERTANKO, MENAS, the Nautical Institute, and OCIMF.

2 NAV 53 also approved the terms of reference (see annex 1) for this Correspondence Group. Specifically the Group was asked to:

.1 identify all potential users of e-Navigation;

.2 define the user needs for e-Navigation;

.3 review the need to consult other maritime agencies and interest groups – navigational practitioners, support agencies, research organizations, equipment manufacturers and port managers; and

.4 continue to develop other aspects of the strategic vision for e-Navigation.

3 This report provides:

.1 a description of potential users of e-Navigation;

.2 a description of a methodology for capturing user needs from stakeholders;

.3 generic high level user needs for ship and shore based users using the above methodology;

.4 a strategic vision for developing e-Navigation based on user needs and in consideration of the need to involve other maritime agencies and interest groups – navigational practitioners, support agencies, research organizations, equipment manufacturers and port managers; and

.5 proposals for implementing the e-Navigation strategy based on; identifying existing systems, system requirements, gap analysis, role of cost benefit analysis, and system architecture.

4 In its work the Correspondence Group took into account relevant documents from NAV 53, progress made at NAV 53 relating to the development of an e-Navigation strategy, the guidance in MSC/Circ.1091 on Issues to be considered when introducing new technology on board ship and MSC/Circ.878-MEPC/Circ.346 on Human Element Analysing Process (HEAP). The Correspondence Group also acknowledges and is grateful for the work performed by other stakeholders – in particular, the work done by IALA in identifying users groups and their respective needs.

Background

5 MSC 81 included the task “Development of an e-Navigation strategy” as a high priority item in the work programmes of the NAV and COMSAR Sub-Committees with a target completion date of 2008. The NAV Sub-Committee was designated as the co-ordinator with NAV 52 giving preliminary consideration to this important matter.

6 NAV 52 established an intersessional Correspondence Group to develop the e-Navigation strategy. This first Correspondence Group consisted of 60 Members from Member States and non-governmental Organizations and was co-ordinated by the United Kingdom. As instructed, this Correspondence Group submitted a document for consideration by COMSAR 11 and made a comprehensive report to NAV 53 in July 2007. Based on the reports from Correspondence Group and COMSAR 11 as well as discussions in plenary, NAV 53 established a Working Group to progress and further refine the preliminary e-Navigation strategy.

Discussion

7 Based on the inputs from the intersessional Correspondence Group, COMSAR 11 and the Working Group, NAV 53 provisionally finalized the following for e-Navigation:

> *"e-Navigation is the harmonized collection, integration, exchange, presentation and analysis of marine 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."*

The concept is based on the harmonization of marine navigation systems and supporting shore services necessary to meet identified user needs.

8 NAV 53 agreed that the core objectives of the e-Navigation concept using electronic data capture, communication, processing and presentation should be to:

.1 facilitate safe and secure navigation of vessels having regard to hydrographic, meteorological and navigational information and risks;

.2 facilitate vessel traffic observation and management from shore/coastal facilities, where appropriate;

.3 facilitate communications, including data exchange, among ship to ship, ship to shore, shore to ship, shore to shore and other users;

.4 provide opportunities for improving the efficiency of transport and logistics;

.5 support the effective operation of contingency response, and search and rescue services;

.6 demonstrate defined levels of accuracy, integrity and continuity appropriate to a safety-critical system;

.7 integrate and present information onboard and ashore through a human interface which maximizes navigational safety benefits and minimizes any risks of confusion or misinterpretation on the part of the user;

.8 integrate and present information onboard and ashore to manage the workload of the users, while also motivating and engaging the user and supporting decision-making;

.9 incorporate training and familiarization requirements for the users throughout the development and implementation process;

.10 facilitate global coverage, consistent standards and arrangements, and mutual compatibility and interoperability of equipment, systems, symbology and operational procedures, so as to avoid potential conflicts between users; and

.11 support scalability, to facilitate use by all potential maritime users.

9 NAV 53 agreed to the following expectations for the onboard, onshore and communications elements of e-Navigation:

.1 **Onboard:**
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. Core elements of such a system will include, actively engaging the mariner in the process of navigation while preventing distraction and overburdening,

.2 **Ashore:**
The management of vessel traffic and related services from ashore enhanced through better provision, co-ordination, and exchange of comprehensive data in formats that will be more easily understood and utilized by shore-based operators in support of vessel safety and efficiency, and

.3 **Communications:**
An infrastructure providing authorized seamless information transfer onboard ship, between ships, between ship and shore and between shore authorities and other parties with many related benefits, including a reduction of single person error.

These have been used as the starting point for the development of user requirements:

Compelling Need for e-Navigation

10 There is a clear and compelling need to equip shipboard users and those ashore responsible for the safety of shipping with modern, proven tools that are optimized for good decision making in order to make maritime navigation and communications more reliable and user friendly. The overall goal is to reduce errors. However, if current technological advances continue without proper co-ordination there is a risk that the future development of marine navigation systems will be hampered through a lack of standardization onboard and ashore, incompatibility between vessels and an increased and unnecessary level of complexity.

11 e-Navigation supports the global concept of Vessel Traffic Management (VTM), reflecting the interaction between shipborne and shore-based users.

12 Further justification for e-Navigation is contained in annex 2, which is drawn from research by The Nautical Institute on collisions and groundings over the last 10 years.

Potential users of e-Navigation

13 A significant number of potential ship and shore-based users of e-Navigation have been identified and are summarized in annex 3.

14 The needs of a typical SOLAS ship user and a generic shore authority have been used as the basis for developing this strategy.

Capturing e-Navigation User Needs

15 IALA has developed a methodology for capturing evolving user needs (annex 4). It is based on the elements contained within the accepted definition of e-Navigation and uses templates to define specific user needs based on the harmonized: collection, integration, exchange, presentation, analysis and human element aspects for all users. This methodology was accepted by the Correspondence Group and distributed amongst members of IMO, IALA and other maritime agencies and interest groups.

Analysis of e-Navigation User Needs

16 Following extensive feedback from Member States, other Maritime Organizations, and interested parties; an analysis was conducted resulting in the identification of high-level generic user needs for both ship and shore users. Annex 5 contains completed user need methodology templates for the SOLAS mariner and shore authorities (including VTS, coastal surveillance, SAR, counter pollution, port authorities, and other maritime services).

17 It is envisioned that more detailed user needs study may need to be performed in order to identify users with specific needs that were not captured in the initial analysis.

Consolidated High-level User Needs

18 The following high-level user needs are distilled from the user need analysis provided in annex 5:

.1 **Common Maritime Information/Data Structure**:
Mariners require information pertaining to the planning and execution of voyages, the assessment of navigation risk and compliance with regulation. This information should be accessible from a single integrated system. Shore users require information pertaining to their maritime domain, including static and dynamic information on vessels and their voyages. This information should be provided in an internationally agreed common data structure. Such a data structure is essential for the sharing of information amongst shore authorities on a regional and international basis.

.2 **Automated and Standardized Reporting Functions**:
e-Navigation should provide automated and standardized reporting functions for optimal communication of ship and voyage information. This includes safety related information that is transmitted ashore, sent from shore to shipborne users and information pertaining to security and environmental protection to be communicated amongst all users. Reporting requirements should be automated or pre-prepared to the extent possible both in terms of content and communications technology. Information exchange should be harmonized and simplified to reduce reporting requirements. It is recognized that security, legal and commercial issues will have to be considered in addressing communications needs.

.3 **Effective and Robust communications**:
A clear need was expressed for there to be an effective and robust means of communications for ship and shore users. Shore-based users require an effective means of communicating with vessels to facilitate safety, security and environmental protection and to provide operational information. To be effective, communication with and between vessels should make best use of audio/visual

aids and standard phrases to minimize linguistic challenges and distractions to operators.

.4 **Human Centred Presentation Needs**:
Navigation displays should be designed to clearly indicate risk and to optimize support for decision making. There is a need for an integrated 'alert management system' as contained in the present IMO Integrated Navigation System (INS) performance standards. Consideration should be given to the use of decision support systems that offer suggested responses to certain alerts, and the integration of navigation alerts onboard ships within a whole ship alert management system. Users require uniform and consistent presentations and operation functionality to enhance the effectiveness of internationally standardized training, certification and familiarization. The concept of S-Mode[1] has been widely supported as an application onboard ship during the work of the Correspondence Group. Shore users require displays that are fully flexible supporting both a Common Operating Picture (COP) and a User Defined Operating Picture (UDOP) with layered and/or tabulated displays. All displays should be designed to limit the possibility of confusion and misinterpretation when sharing safety related information.

.5 **Human Machine Interface**:
e-Navigation systems must be designed to engage and motivate the user while managing workload. As electronic systems take on a greater role, facilities need to be developed for the capture and presentation of information from visual observations, as well as user knowledge and experience. The presentation of information for all users should be designed to reduce 'single person errors' and enhance team operations. There is a clear need for the application of ergonomic principles both in the physical layout of equipment and in the use of light, colours, symbology and language.

.6 **Data and System Integrity**:
e-Navigation systems should be resilient and take into account issues of data validity, plausibility and integrity for the systems to be robust, reliable and dependable. Requirements for redundancy, particularly in relation to position fixing systems, should be considered.

.7 **Analysis**:
e-Navigation systems should support good decision making, improve performance and prevent single person error. To do so, shipboard systems should include analysis functions that support the user in complying with regulations, identifying risks, and avoiding collisions and groundings including the calculation of Under Keel Clearance (UKC) and air draughts. Shore based systems should support environmental impact analysis, forward planning of vessel movements, hazard/risk assessment, reporting indicators and incident prevention. Consideration should also be given to the use of analysis for incident response and recovery, risk assessment and response planning, incident detection and prevention, risk mitigation, preparedness, resource (e.g., asset) management and communication.

[1] S-Mode is the proposed functionality for shipborne navigation displays using a standard, default presentation, menu system and interface.

.8 **Implementation Issues**:
Training, good practices and familiarization relating to aspects of e-Navigation for all users must be effective and established in advance of technical implementation. The use of simulation to establish training needs and assess its effectiveness is endorsed. e-Navigation should as far as practical be compatible forwards and backwards and support integration with equipment and systems under existing IMO carriage requirements. The highest level of interoperability between e-Navigation and external systems should be sought where practicable.

Developing an e-Navigation Strategy

19 The development of the e-Navigation strategy has followed a top-down, holistic approach through the Correspondence Group and in close cooperation with the IALA e-Navigation Committee (e-NAV). As identified in the report of NAV 53, it is essential that the strategy be based on a structured methodology and logical phases. The strategy has taken into account the previous work done by the Correspondence Group, the recommendations of COMSAR 11 and NAV 53 on the identification of essential functions for shipboard systems under the e-Navigation strategy (NAV 53/13/1) and work done by IALA in developing a methodology for capturing and defining user needs.

e-Navigation Strategy

20 In order to implement e-Navigation several steps are required. This includes a strategy comprising a number of elements (listed below), and additionally a gap analysis, cost benefit analysis and the creation of a detailed implementation plan. The implementation plan will need to identify responsible jurisdictions which would in turn be responsible for determining appropriate methods of delivery. Implementation of the strategy will also need to take into account public relations and promotion of the e-Navigation concept to key stakeholder and user groups.

21 In order to capture evolving user needs, it is important that the implementation strategy elements remain under review. A structured approach will be required to capture evolving user needs, making use of the existing agreed methodology, to incorporate any ensuing changes into the strategy and implementation plan.

22 Key strategy elements for e-Navigation include: Architecture, Human Element, Convention and Standards, Position Fixing, Communication and Information Systems, ENCs, Equipment and Standardization and Scalability.

.1 **Architecture**:
The overall conceptual, functional and technical architecture will need to be developed and maintained, particularly in terms of process description, data structures, information systems, communications technology and regulations.

.2 **Human Element**:
Training, competency, language skills, workload and motivation are identified as essential. Alert management, information overload and ergonomics are prominent concerns. These aspects of e-Navigation will have to be taken into account in accordance with IMO Human Element work.

.3 **Conventions and Standards**:
The provision and development of e-Navigation should consider relevant international conventions, regulations and guidelines, national legislation and standards. The development and implementation of e-Navigation should build upon the existing work of IMO. This includes SOLAS requirements for navigation and communication equipment; other provisions of SOLAS chapters IV and V; standards for GMDSS, ECDIS and INS; Human Element Issues of HMI, Ergonomics, and the implementation of new technology (MSC/Circ.1091); Performance Standards for the Presentation of Navigation-Related Information on Shipborne Navigational Displays (resolution MSC.191(79)), and the STCW Convention.

.4 **Position Fixing**:
Position fixing systems will need to be provided that meet user needs in terms of accuracy, integrity, reliability and system redundancy in accordance with the level of risk and volume of traffic.

.5 **Communications and Information Systems**:
Communications and information systems will have to be identified to meet user needs. This work may involve the enhancement of existing systems or the development of new systems. Any impacts affecting existing systems will need to be identified and addressed, based on technical standards and protocols for data structure, technology, and bandwidth and frequency allocations.

.6 **ENCs**:
At NAV 53 IHO reported, "There would be adequate coverage of consistent ENCs by the time any further mandatory carriage requirements were likely to be adopted by IMO". The Sub-Committee was also of the opinion that the availability of ENCs worldwide was most important and requested IHO and Member Governments to continue their efforts in increasing the coverage. E-Navigation will likely benefit from increased functionality of the future IHO S-100 standard.

.7 **Equipment Standardization**:
This part of the work will follow the development of performance standards and will involve users and manufacturers.

.8 **Scalability**:
IMO Member States have a responsibility for the safety of all classes of vessels. This may include the scalability of e-Navigation for all potential users. Extension of the concept to non-SOLAS vessels should be seen as an important task, to be addressed, in the first instance through consultation on user requirements.

Strategy Implementation

23 An implementation plan should include priorities for deliverables, resource management and a schedule for implementation and the continual assessment of user needs.

24 The identification of commonalities across users making best use of existing capabilities and systems should be considered.

25 In the future, the deployment of new technologies should be based on a systematic assessment of how the technology can best meet defined and evolving user needs within the e-Navigation concept. Similarly, proposed changes to tasks and process, such as those resulting from the analysis of maritime accidents, should also incorporate the assessment of user needs.

26 Cooperation with relevant maritime projects should be maintained throughout the implementation process (e.g., MarNIS, MEH) in order to benefit from synergies.

Action requested of the Sub-Committee

27 The Sub-Committee is:

1. requested to note the high-level user needs and support the proposed e-Navigation Strategy with its strategic elements; and

2. invited to consider an appropriate course of action for the adoption of the Strategy at MSC 85.

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ANNEX 1

Correspondence Group Terms of reference

1 NAV 53 agreed to progress the development of an e-Navigation strategy for NAV 54. The intersessional Correspondence Group was re-established under the coordination of the United Kingdom.

2 NAV 53 also approved the terms of reference for this Correspondence Group which should:

.1 identify all potential users of e-Navigation;

.2 define the user needs for e-Navigation;

.3 review the need to consult other maritime agencies and interest groups – navigational practitioners, support agencies, research organizations, equipment manufacturers and port managers; and

.4 continue to develop other aspects of the strategic vision for e-Navigation.

3 In its work the Correspondence Group took into account:

.1 NAV 53/WP.4 and NAV 53/13/1 (Japan),

.2 progress made at NAV 53 relating to the development of an e-Navigation strategy,

.3 guidance in MSC/Circ.1091 on Issues to be considered when introducing new technology on board ship, and

.4 MSC/Circ.878-MEPC/Circ.346 on Human Element Analysing Process (HEAP).

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ANNEX 2

The Case for e-Navigation

The original submission to MSC on the development of a work programme for e-Navigation (MSC 81/23/10) highlights the compelling need to equip the master of a vessel and others responsible for the safety of shipping with modern (but proven) tools to improve the reliability of marine navigation and communications thereby reducing the potential for loss of life, injury, environmental damage (both through normal operations, e.g., emissions, and in accidents, e.g., spillages) and unnecessary commercial cost. A recent report by the International Union of Marine Insurance indicates that raising trends of marine accidents both in terms of numbers and costs are those associated with collisions and groundings. There are numerous examples of accidents and incidents, especially collisions and groundings, which subsequent investigation and analysis suggests they might have been avoided had there been suitable input from the appropriate technologies in the navigation decision-making process. The following table summarizes the causes of collisions and groundings during the last ten years. The causal data and examples cited in the table are derived from Nautical Institute (NI) research into collisions and groundings[2]. This research indicates that, of the collisions and grounding investigated, around **60%** are caused by direct human error. Most accidents and incidents occurred outside of VTS and Pilotage areas "*indicating that VTS and Pilotage works effectively considering that most close quarter situations take place in these areas*[3]". The Nautical Institute research results are summarized in the following table:

Collisions	**Groundings**
▪ 24% were attributed to insufficient assessment of the situation ▪ 23% were attributed to poor or no lookout, in addition, in 13% of collisions one vessel was completely unaware of the other vessel ▪ Other causes were: o confusion in VHF communications (9%) o infractions of COLREGs (8%) o fatigue including officer of the watch (OOW) falling asleep (11%) o poor bridge management (4%) o pilot/master communications breakdown (1%)	▪ 17% were attributed to poor or no passage plan ▪ 18% were due to poor bridge management ▪ 12% were due to no lookout/one man on the bridge ▪ 14% were due to poor navigation ▪ 22% were due to fatigue, including 8% that were due to the OOW falling asleep ▪ 14% were due to poor communication with the pilot ▪ 3% were caused by a lack of procedures

The NI report quoted that "in 43% of all the collision cases involving merchant vessels that were investigated by the United Kingdom's Marine Accident Investigation Branch (MAIB) over a 10-year period, the watchkeeper was either completely unaware of the other vessel until time of collision or only became aware of the other vessel when it was too late to take effective avoiding

[2] The analysis uses data derived from the Nautical Institute and from the UK Marine Accident Investigation Branch (MAIB), Australian Transport Safety Bureau (ATSB), Swedish Accident Investigation Board, Transport Accident Investigation Commission (NZ), Transport Safety Board of Canada, ,Marine Accident Inquiry Agency (Japan), Isle of Man Ship Registry, Irish Marine Casualty Investigation Board (IMCIB), and Accident Investigation Board of Finland.

[3] Seaways, The International Journal of the Nautical Institute, July 2007, pages 4 and 5.

action". This is almost entirely due to very poor watchkeeping, where lookouts are either not present or ineffective, and the Officer of the Watch (OOW) is asleep, fatigued, absent, distracted or totally disengaged with the task of keeping a safe navigation watch. Despite advances in bridge resource management training, it seems that the majority of watchkeeping officers make critical decisions for navigation and collision avoidance in isolation, due to a general reduction in manning.

The IMO human element vision principles and goals (Resolution A.947(23)) contains the principle: *'In the process of developing regulations, it should be recognized that adequate safeguards must be in place to ensure that a "single person error" will not cause an accident through the application of these regulations.'*

IMO MSC/Circ.878 states: *'A single person error must not lead to an accident. The situation must be such that errors can be corrected or their effect minimized. Corrections can be carried out by equipment, individuals or others. This involves ensuring that the proposed solution does not rely solely on the performance of a single individual'*. In human reliability analysis terms, the presence of someone checking the decision-making process improves reliability by a factor of 10. If e-navigation could assist in improving this aspect, both by well-designed onboard systems and closer cooperation with vessel traffic management (VTM) systems, risk of collisions and grounding and their inherent liabilities could be dramatically reduced.

Although e-Navigation would have ameliorated the situations described above, technology alone would not have provided a complete solution but there is a need to also recognize the role of the practice of good seamanship, the provision of suitable training and the use of procedures.

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ANNEX 3

Preliminary list of Potential e-Navigation Users

The tables below provide preliminary lists of e-Navigation users classified into:

shipborne users, and

shore-based users.

Shipborne users
Generic SOLAS vessels
Commercial tourism craft
High speed craft
Mobile VTS assets
Pilot vessels
Coastguard vessels
SAR vessels
Law enforcement vessels (police, customs, border control, immigration, fisheries inspection)
Nautical assistance vessels (tugs, salvage vessels, tenders, fire fighting, etc.)
Counter pollution vessels
Military vessels
Fishing vessels
Leisure craft
Ferries
Dredgers
AtoN service vessels
Ice patrol/breakers
Offshore energy vessels (rigs, supply vessels, lay barges, survey vessels, construction vessels, cable layers, guard ships, production storage vessels)
Hydrographic survey vessels
Oceanographic research vessels

Shore-based users
Ship owners & operators, safety managers
VTM organizations
VTS centres
Pilot organizations
Coastguard organizations
Law enforcement organizations
National administrations
Coastal administrations
Port authorities
Security organizations
Port state control authorities
Incident managers
Counter pollution organizations
Military organizations
Fairway maintenance organizations

AtoN organizations
Meteorological organizations
Hydrographic Offices/Agencies
Ship owners & operators, logistics managers
News organizations
Coastal management authorities
Marine accident investigators
Health and safety organizations
Insurance and financial organizations
National, regional and local governments and administration
Port authorities (strategic)
Ministries
Marine environment managers
Fisheries management
Tourism agencies (logistics)
Energy providers
Ocean research institutes
Training organizations
Equipment and system manufacturers and maintainers

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ANNEX 4

IALA e-Navigation User Needs Capture Methodology Template

User: *[Define user here i.e. Merchant mariner, Flag administration, VTS operator etc..]*		
Primary need: *[State primary need as a clear mission statement here e.g., "e-Navigation should support mariners in the maintenance of safe passing, safe clearing distances and collision avoidance"]*		
	User Need	**Comments / Specifics**
Collection	"e-Navigation should allow the **collection** of all appropriate information needed to support the task of the Primary Need by all available means."	*[List the Harmonized Collection of information that is needed for you as a user for this primary need e.g., data from GPS, nautical publications, safety notices, etc… This section should detail the various pieces and sources of data needed to carry out the 'primary task' that you would benefit from if they were available from a single source or in a common format i.e. 'Collection'. If any preferred details of the source or format are known they should be mentioned...]*

Integrate	"e-Navigation should **integrate** all appropriate data and information needed to support the primary need."	*[Once data has been 'collected', it will need to be integrated in a harmonized way into a system in order for it to be used in conjunction with other data for the benefit of the end user. If there are any specific system requirements or limitations for such integration (e.g., software, hardware, protocols or system integrity needs) they should be mentioned here in either detailed or general terms.]*
Exchange	"e-Navigation should allow for the **exchange** of any data or information needed to support the primary need."	*[Harmonized information and/or data exchange issues should be considered between any parties such as ship/ship, ship/shore, shore to shore or broadcast needs. If specific exchange issues such as radio frequency, bandwidth or protocols are known, they should be stated.]*
Presentation	e-Navigation should facilitate the clear **presentation** of all information pertaining to the primary need in a manner that supports the decision making process, engages the user and minimizes any risk of distraction or over burden. It should also provide easy to use facilities for a user to interact with the system and input data.	*[List any special requirements from your specific user need for the presentation of information that will improve your decision making ability. This may include the ergonomic grouping of information, (presentation options such as video and/or audio,) or a preferred layout of equipment and controls..]*

Analysis	"e-Navigation should support the user through the appropriate **analysis** of data and information to support the primary need."	*[Analysis needs may refer to any additional functionality for decision support tools, or the rapid and systematic processing of routine tasks..]*
Human Element Issues	"e-Navigation should support the user through the application **of Human Element principles** to support the primary need."	*[This section should be used to identify all user needs related to the human element on board and ashore, (such as effective training, competencies, familiarization, human centred work environment, distraction from primary tasks, human engagement, workload, fatigue and job satisfaction).]*
Any other Comment: *[This section should be used to identify any restrictions or limitations assumed when defining the primary need, (for e.g., when defining 'safe navigation' you might state that the task of 'grounding avoidance' has been dealt with separately for simplification. Or to make any other suggested 'user needs' that you feel have not been addressed elsewhere in the exercise.]*		

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ANNEX 5

e-Navigation High Level User Needs for SOLAS Mariners and for Shore Authorities

User: Generic SOLAS Ship Mariner		
Primary need: Safe and efficient berth to berth navigation		
	User Need	**Comments / Specifics**
Collection	e-Navigation should allow the **collection** by electronic means of all appropriate information needed to support safe and efficient berth to berth navigation.	All information needed to plan a voyage should be up to date, [approved] and available in a standard format. Such information should at least include; own ship information, hydrographic, environmental, regulatory, sailing directions; ships' routing systems; navigational warnings; company instructions, charter details, pilotage information/ plan, and master's and navigators' knowledge and experience. All information needed to execute a voyage should be easily accessible and in a standard format. This information shall include all planning information as well as sensor information such as Radar, Electronic Position Fixing, AIS, Gyro, Speed, under keel and air draft clearance, and visual observation data. It should also include communicated information from other ships (e.g., AIS), VTS and other shore authorities.

Integrate	e-Navigation should **integrate** all appropriate data and information needed to support a safe and efficient berth to berth navigation.	Information shall be automatically checked for validity and plausibility. Data failing these checks should not be used by the system, and a warning shall be given. The integrity of information should be monitored and verified automatically before being used. e-Navigation systems must have sufficient integrity and/or redundancy commensurate with the safety, security and environmental protection requirements. All passage related information should be made available to the mariner in an effective manner via an integrated system.
Exchange	e-Navigation should allow for the **exchange** of any data or information needed to support safe and efficient berth to berth navigation.	Relevant data and information should be able to be exchanged throughout the ship, between ships, and between ships and shore. The mode and level of automated/manual exchange should take into account the workload placed on the mariner while observing all international and national requirements.
Presentation	e-Navigation should facilitate the clear **presentation** of all information pertaining to the safe and efficient berth to berth navigation in a manner that supports the decision making process, engages the user and minimizes any risk of distraction or over burden. It should also provide easy to use facilities for a user to interact with the system and input data.	Passage planning and execution information from the e-Navigation system must be displayed in a manner that optimizes the decision making process while reducing the effects of information overload. Consideration must be given to a simply activated standardized presentation display and operating system, such as the concept of S-Mode. Displays should have the functionality to support tactical and planning operations, collision avoidance, and the management of integrated alerts. The presentation of information should be designed to reduce ‘single person errors’ and enhance bridge team operation including the pilot and lookout.

Analysis	e-Navigation should provide the user with the appropriate **analysis** of data and information to enhance the safety and efficiency of berth to berth navigation.	e-Navigation should support decision making, improve performance and prevent single person error. The system should include analysis functions that support the user in complying with regulations; identifying risks, avoiding collisions and groundings, managing alerts, and complement mariners' capabilities while compensating for any limitations.
Human Element Issues	e-Navigation should support the user through the application **of Human Element principles** in order to achieve safe and efficient berth to berth navigation.	Systems need to be designed to manage the workload of the mariner while also motivating and engaging the mariner and supporting the decision making process. Training, certification, good practices, familiarization need to be addressed for all functional aspects of e-Navigation. Standardized information presentation, symbols, abbreviations, and coding should be used. Consideration should be given to ergonomics, ease of use, standardization, and the working environment to optimize human performance.
Any other Comment: This template describes the basic user needs for e-navigation from the perspective of a mariner on a generic SOLAS ship. Further or alternate functional requirements for mariners on other vessels will be contained in additional templates.		

User: Generic Shore-based Authority (Including VTS, Coastal Surveillance, SAR, Counter Pollution, Port Authorities, and other maritime services.)		
Primary need: **Effective management of the maritime domain, including support for safe and efficient navigation, security, and the protection of the marine environment.**		
	User Need	**Comments / Specifics**
Collection	e-Navigation should allow the **collection** of all appropriate information needed to effectively manage the maritime domain.	Collect all information needed to accurately represent the static and dynamic maritime domain, including hydrographic, environmental, vessel data, AtoN information and known hazards. Collect all guidance and regulatory information pertaining to the domain. Collection of all other existing information that can add value to the awareness of the maritime domain, including voyage and vessel specific data, emergency logistics, communication networks and general infrastructure.
Integrate	e-Navigation should **integrate** all appropriate data and information needed to effectively manage the maritime domain.	Information shall be automatically checked for validity, and plausibility. Data failing these checks should not be used by the system, and a warning shall be given. The integrity of information should be monitored and verified automatically before being used. e-Navigation systems must have sufficient integrity and/or redundancy commensurate with safety and security requirements. All pertinent information should be made available to authorized users in an effective manner via an integrated system.
Exchange	e-Navigation should allow for the **exchange** of any data or information needed to effectively manage the maritime domain.	Relevant data and information should be able to be exchanged throughout the domain, including between ships, between ships and shore, and between shore users. The mode and level of automated/manual exchange should take into account workload, safety, security and other regulatory issues. Communications within the domain should focus on tasks, (point to point or broadcast) with a high level of system transparency (e.g., choice of frequency or technology).

Presentation	e-Navigation should facilitate the clear **presentation** of all information pertaining to the need to effectively manage the maritime domain in a manner that supports the decision making process, engages the user and minimizes any risk of distraction or over burden. It should also provide easy to use facilities for a user to interact with the system.	The presentation of e-Navigation information should be flexible and focused on the needs of authorized users. Presentations should be task-based and offer the optimum information, tools and scope to facilitate the user's decision making requirements. Consideration should be given to using a Geographical Information System (GIS), and a layered, or tabulated format.
Analysis	e-Navigation should support the user through the appropriate **analysis** of data and information for the effective management of the maritime domain.	e-Navigation should support decision making, improve performance and prevent single person error. It should also contribute to the process of assessing impacts on the environment, including: operational planning, hazard/risk assessment, reporting indicators and incident prevention. Consideration should also be given to the use of functional analysis including: incident response, situation recovery, risk assessment, planning and mitigation, potential incident detection and prevention, preparedness, resource management and communication.
Human Element Issues	e-Navigation should support the user through the application **of Human Element principles** in order to effectively manage the maritime domain.	Systems need to be designed to manage the work load of the user, while also preventing single person errors, motivating and engaging the user and supporting the decision making process. Training, certification, good practices, and familiarization need to be addressed as appropriate for all functional aspects of e-Navigation. Consideration should be given to ergonomics, ease of use, standardization, and the working environment to optimize human performance.
Any other Comment: This template describes the basic user needs for e-Navigation from the perspective of a generic shore authority user, including VTS, Coastal Surveillance, SAR, Counter Pollution, Port Authorities, and other maritime services. Further or alternate functional requirements for shore based users will be contained in other templates.		