INTERNATIONAL MARITIME ORGANIZATION

E

SUB-COMMITTEE ON SAFETY OF NAVIGATION
58th session
Agenda item 6

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E-NAVIGATION

Report of the Working Group

1 GENERAL

1.1 As instructed by the Sub-Committee, the Working Group on e-navigation (the Group) met from 3 to 5 July 2012 under the chairmanship of Mr. John Erik Hagen (Norway).

1.2 The Group was attended by delegates from the following Member States:

ANTIGUA AND BARBUDA
ARGENTINA
AUSTRALIA
BELGIUM
BRAZIL
BULGARIA
CANADA
CHINA
CYPRUS
DENMARK
FINLAND
FRANCE
GERMANY
GREECE
INDONESIA
IRAN (ISLAMIC REPUBLIC OF)
ITALY
JAPAN
MARSHALL ISLANDS
NETHERLANDS
NIGERIA
NORWAY
PANAMA
PERU
PHILIPPINES
POLAND
PORTUGAL
REPUBLIC OF KOREA
RUSSIAN FEDERATION
SINGAPORE
SPAIN
SWEDEN
THAILAND
TURKEY
UNITED KINGDOM
UNITED STATES
VENEZUELA (BOLIVARIAN REPUBLIC OF)

1.3 The Group was also attended by a delegate from the following Associate Member of IMO:

HONG KONG, CHINA

and observers from the following intergovernmental and non-governmental organizations in consultative status:

COMITÉ INTERNATIONAL RADIO-MARITIME (CIRM)
INTERNATIONAL ASSOCIATION OF MARINE AIDS TO NAVIGATION AND LIGHTHOUSE AUTHORITIES (IALA)
INTERNATIONAL CHAMBER OF SHIPPING (ICS)
INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
BIMCO
OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF)
INTERNATIONAL MARITIME PILOTS' ASSOCIATION (IMPA)
INTERNATIONAL ASSOCIATION OF INSTITUTES OF NAVIGATION (IAIN)
INTERNATIONAL FEDERATION OF SHIPMASTERS' ASSOCIATIONS (IFSMA)
CRUISE LINES INTERNATIONAL ASSOCIATION (CLIA)
INTERNATIONAL TRANSPORT WORKERS' FEDERATION (ITF)
THE NAUTICAL INSTITUTE (NI)
INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO)
EUROPEAN COMMISSION (EC)

2 TERMS OF REFERENCE

2.1 The Group, taking into account decisions of, and comments and proposals made in Plenary, should:

.1 review the report of the Correspondence Group (CG), taking into account documents NAV 58/6/1, NAV 58/6/2, NAV 58/6/3 (Germany), NAV 58/INF.4 (Norway) and NAV 58/INF.10 (Australia) and provide comments and recommendations with respect to the actions requested in paragraphs 38.1 to 38.7 of document NAV 58/6 (Norway);

.2 taking into account the priorities of its work, review and revise the terms of reference for a CG to progress work intersessionally for reporting to COMSAR 17, STW 44 and NAV 59, based on the revised joint plan of work approved by MSC 90;

.3 if time permits:

.1 consider document NAV 58/6/4 (Republic of Korea) with respect to the need to include software quality assurance as part of the ongoing e-navigation gap and cost-benefit analysis and provide comments and recommendations, as appropriate;

.2 consider documents NAV 58/6/6 and Corr.1, NAV 58/INF.12 and NAV 58/INF.13 and Corr.1 (Japan) with respect to the draft Guidelines for usability evaluation of navigational equipment and provide comments and recommendations, as appropriate;

.3 consider document NAV 58/6/8 (Republic of Korea) outlining a method for feedback to enable Member States to provide the outcomes of test-bed projects with clear reference to the e-navigation development process and/or elements of the Strategy Implementation Plan and provide comments and recommendations, as appropriate; and

.4 submit a report on Thursday, 5 July 2012.

3 REPORT OF THE CORRESPONDENCE GROUP ON E-NAVIGATION

3.1 The Group reviewed the report of the CG and provided comments and recommended actions as outlined in the ensuing paragraphs.

Detailed e-navigation architecture

3.2 In considering the comments and observations of the CG concerning the development of the detailed e-navigation architecture for both the ship and shoresides (NAV 58/6, paragraphs 5 to 10 and annex 1), the Group was of the view that inputs from different experts from the industry, other organizations and stakeholders, in particular, shipborne and shore-based users should be taken into consideration during the further development of the detailed e-navigation architecture.

3.3 The Group invited the Sub-Committee to note the progress made with regard to the development of the detailed onboard e-navigation architecture and invite IALA, IHO and other relevant organizations to contribute to the further development of the detailed e-navigation architecture.

Gap analysis

3.4 As part of the Gap analysis, the Group had for consideration the following documents:

.1 draft list of gaps prepared by the CG, including comments and observations made by COMSAR 16 and STW 43 (STW 43/WP.3/Rev.1);

.2 NAV 58/6, annex 2, containing examples of operational, technical, regulatory and training e-navigation solutions to address identified gaps, including references to the Human Element Analysing Process (HEAP);

.3 NAV 58/6, annex 3, containing the HEAP in e-navigation, along with document NAV 58/INF.10; and

.4 NAV 58/6, annex 5, containing examples of e-navigation solutions to address identified gaps, including identified hazards.

3.5 In reviewing the list of gaps, including comments and observations provided by COMSAR 16 and STW 43, the Group:

.1 agreed to retain the column identifying the competent Sub-Committee(s) in order to facilitate the consideration of relevant issues under their respective competence during the further development of e-navigation, with the understanding that the implementation of consequent e-navigation solutions could be, in the future, under the competence of other bodies;

.2 amended the description of some of the gaps to clarify their meaning and avoid misinterpretations. In particular, the Group amended one of the gaps so as to include the need for an updating regime for software driven applications within the e-navigation framework;

.3 deleted some of the gaps which were considered redundant, repetitive or merely statements or which were currently under development (e.g. navigation displays);

.4 reorganized and combined some of the gaps;

.5 acknowledging the need to review some training elements in the future based on developments on e-navigation solutions, confirmed the deletion of some gaps related to training, including those already done by STW 43; and

.6 confirmed the deletion of some gaps related to radiocommunications and search and rescue, as recommended by COMSAR 16.

3.6 During the consideration of the list of gaps, some delegations expressed concerns, in particular, with regard to:

.1 the deletion of a gap related to the insufficient use of IMO Standard Marine Communication Phrases (SMCP);

.2 the deletion of a gap related to a type specific training regime which had been discussed in detail at STW 43; and

.3 the retention of the gap related to the lack of technical means to make information of vessels intentions available to relevant user stakeholders, indicating that such information was already available through different systems, like AIS and ARPA.

3.7 In reviewing the examples of e-navigation solutions and associated hazards given in document NAV 58/6, annex 5, the Group:

.1 was of the opinion that e-navigation solutions should be goal-based and their descriptions should be kept generic, which would then be expanded during the Formal Safety Assessment (FSA) process;

.2 consequently deleted some of the examples of e-navigation solutions associated with gaps which were deleted from the list of gaps;

.3 amended the description of some of the examples of e-navigation solutions and identified hazards to clarify their meaning and avoid misinterpretations; and

.4 noting the complexity of the FSA process, decided to group the potential e-navigation solutions into the following broad categories to facilitate the completion of the FSA process by NAV 59:

.1 Improved, harmonized and user-friendly bridge design;

.2 Means for standardized and automated reporting;

.3 Improved reliability, resilience and integrity of bridge equipment and navigation information;

.4 Integration and presentation of available information in graphical displays received via communication equipment;

.5 Information management;

.6 Improved access to relevant information for Search and Rescue;

.7 Improved reliability, resilience and integrity of bridge equipment and navigation information for shore-based users;

.8 Improved and harmonized shore-based systems and services; and

.9 Improved communication of VTS service portfolio.

3.8 The Group noted that the list of e-navigation solutions was not exhaustive and that further e-navigation solutions should be developed, in particular, those related to the shoreside and the relationship between ship and shore.

3.9 The Group was of the opinion that annex 2 to document NAV 58/6 provided information for the further identification of potential e-navigation solutions and Risk Control Options (RCOs).

3.10 During the consideration of an e-navigation solution concerning automated and timely updating of Electronic navigational charts (ENCs), nautical publications and other documentation, some delegations emphasized that the use of paper charts should be taken into account as it still existed on board many ships.

3.11 The Group reviewed the HEAP Methodology in e-navigation prepared by the CG (NAV 58/6, annex 3) and concurred with the above methodology.

3.12 The Group noted with appreciation the information provided by Australia in document NAV 58/INF.10.

3.13 Noting that the gap analysis had been completed, the Group invited the Sub-Committee to:

.1 approve the final list of gaps of e-navigation, as set out in annex 1;

.2 endorse the preliminary list of potential e-navigation solutions, set out in annex 2, as work in progress, and agreed that the above list should be used as the basis for the further identification of RCOs, as preparation for the FSA; and

.3 endorse the HEAP Methodology in e-navigation, as set out in annex 3 to document NAV 58/6.

3.14 Due to time constraints, the Group was not in a position to consider documents NAV 58/6/1, NAV 58/6/2 and NAV 58/6/3 and recommended that the CG, if re-established, should consider the above documents when conducting the Cost Benefit and Risk Analysis.

Cost Benefit and Risk Analysis

3.15 The chairman of the Group, in his capacity as coordinator of the CG, gave a presentation outlining the FSA methodology, the identification of RCOs, and how the Cost Benefit and Risk analysis was intended to be undertaken based on the identified RCOs.

3.16 The Group concurred with the views of the CG related to the process for identifying RCOs (NAV 58/6, paragraphs 17 to 21) and agreed with the procedure for the FSA methodology, including the identification of RCOs, as set out in annex 3, which the Sub-Committee was invited to endorse.

Maritime Service Portfolios

3.17 The Group considered the information provided by the CG related to the development of Maritime Service Portfolios (NAV 58/6, paragraphs 22 to 24), including document NAV 58/INF.4, and invited the Sub-Committee to endorse it for further development.

Guidelines for usability evaluation of navigational equipment

3.18 The Group considered the key issues identified by the CG that should be taken into account when developing guidelines for usability evaluation of navigational equipment (NAV 58/6, paragraph 26), along with documents NAV 58/6/6 and Corr.1, NAV 58/INF.12 and NAV 58/INF.13 and Corr.1.

3.19 The Group recalled that NAV 57 had instructed the CG to consider the development of the above guidelines during the preparation of the Strategy Implementation Plan and noted that the issue had already been addressed as part of the gap analysis and that a potential e-navigation solution had already been identified.

3.20 The Group was of the opinion that the development of draft guidelines for usability evaluation of navigational equipment should continue to be progressed and invited the Sub-Committee to agree with its further development.

Guidelines for the harmonization of test beds

3.21 The Group considered the information and recommendations of the CG with regard to the development of draft Guidelines for the harmonization of test beds (NAV 58/6, paragraphs 32 and 33), along with document NAV 58/6/8.

3.22 The Group concurred with the views of the CG and invited the Sub-Committee to agree with the further development of Guidelines for the harmonization of test beds.

Strategy Implementation Plan (SIP)

3.23 The Group noted the information concerning the further development of the Strategy Implementation Plan (SIP) (NAV 58/6, paragraphs 29 to 31 and 34 to 37).

Software quality assurance

3.24 The Group noted that one of the gaps had been amended so as to include the need for an updating regime for software driven applications within the e-navigation framework.

3.25 After giving general consideration to the issue of software quality assurance (NAV 58/6/4), and recognizing the importance of software quality assurance in the process of e-navigation, the Group was of the view that the issue could be further considered by the CG, if re-established.

3.26 The Group noted that interested parties were considering organizing or requesting the organization of a workshop to progress the discussions on usability evaluation of navigational equipment, software quality assurance and human element issues.

4 RE-ESTABLISHMENT OF THE CORRESPONDENCE GROUP ON E-NAVIGATION

4.1 In light of the discussions set out in section 3 and as instructed by Plenary, the Group revised the terms of reference for a CG to progress the work intersessionally under the coordination of Norway*, as set out in annex 4, and invited the Sub-Committee to re-establish the CG on e-navigation and approve its terms of reference.

4.2 In order to facilitate the work of the COMSAR and STW Sub-Committees, the Group recommended that the reports submitted to them should identify specific questions under their respective competence (i.e. COMSAR: radiocommunication and SAR aspects – STW: training aspects).

5 ACTION REQUESTED OF THE SUB-COMMITTEE

5.1 The Sub-Committee is invited to:

.1 note the progress made with regard to the development of the detailed onboard e-navigation architecture and invite IALA, IHO and other relevant organizations to contribute to the further development of the detailed e-navigation architecture (paragraphs 3.2 and 3.3 and NAV 58/6, paragraphs 5 to 10 and annex 1);

.2 note that the gap analysis had been completed and:

.1 approve the final list of gaps of e-navigation (paragraph 3.13.1 and annex 1);

.2 endorse the preliminary list of potential e-navigation solutions, as work in progress, and agreed that the above list should be used as the basis for the further identification of Risk Control Options, as preparation for the Formal Safety Assessment (paragraph 3.13.2 and annex 2); and

.3 endorse the Methodology of the Human Element Analysing Process in e-navigation (paragraph 3.13.3 and NAV 58/6, annex 3);

.3 endorse the procedure for the Formal Safety Assessment methodology, including the identification of Risk Control Options (paragraph 3.16 and annex 3);

.4 endorse the further development of Maritime Service Portfolios (paragraph 3.17);

.5 agree with the further development of Guidelines for usability evaluation of navigational equipment (paragraph 3.20);

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.6 agree with the further development of Guidelines for the harmonization of test beds (paragraph 3.22);

.7 re-establish the Correspondence Group on e-navigation (paragraph 4.1 and annex 4); and

.8 approve the report, in general.

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ANNEX 1

DRAFT LIST OF GAPS OF E-NAVIGATION

Table 1 – Shipboard users

Identifier	Gaps	Competent Sub-Committee(s)
	1 Information/data management	
	1.1 Common data structure/harmonized data formats	
	Technical	
111-Gte01	Lack of harmonized data formats for the transfer of information received via communication equipment (e.g. Maritime Safety Information) to the navigational systems for presentation.	NAV/COMSAR
111-Gte02	There are no standardized data formats established for ship reporting.	NAV
111-Gte03	Lack of harmonized data formats for data requested from other systems, used to prepare other relevant documents on board.	NAV/COMSAR
111-Gte05	There are no means of processing or filtering the information exchanged via communication equipment.	NAV/COMSAR
111-Gte06	Lack of technical means to make information of vessels intentions available to relevant user stakeholders.	NAV
	Regulatory	
111-Gre02	Lack of interface standards for status of equipment.	NAV/COMSAR
111-Gre03	No mapping of specific services in the Maritime Service Portfolio to specific regions, which would result in a requirement of the necessary infrastructure in specific regions.	NAV
	Operational (no gaps identified)	
	Training (no gaps identified)	
111-Gtr01	Deleted.	
	1.2 Improved reliability and indication of reliability	
	Technical	
112-Gte01a	Lack of effective and harmonized means for assessment and indication of the accuracy, levels of reliability and integrity of indicated information.	NAV/COMSAR
112-Gte01b	Deleted.	
	Regulatory	
112-Gre01	Lack of standardized regulations for determination (standardized algorithms) of accuracy and integrity to assess and quantify reliability based on unambiguous thresholds.	NAV/COMSAR

Identifier	Gaps	Competent Sub-Committee(s)
	Operational	
112-Gop01	Lack of assessments procedure to quantify reliability parameters (e.g. specific assessment of electronic position fixing systems).	NAV
	Training	
112-Gtr01	Improved competence of installation and repair person for providing better reliability of systems and equipment.	NAV[1]
112-Gtr02	Deleted.	
	1.3 Nautical charts and publications	
	Technical (no gaps identified)	
	Regulatory	
113-Gre01	Lack of standardized symbology of all information required to display on the navigational system (e.g. S-52 exist but lack of symbology for MIO elements).	NAV
	Operational (no gaps identified)	
	Training	
113-Gtr01	Familiarization to presentation and context of information such as metadata and all ancillary data to charts.	STW
	2 Effective and robust voice communication and data transfer	
	Technical	
120-Gte01	No reference to determine reliability of maritime communication. Insufficient reliability of data/voice communications (users require communication without interference, disruption and noise). Lack of reliability standards for communication technology.	COMSAR
120-Gte02	Possible lack of bandwidth and assignment of adequate bandwidth for potential e-navigation communication needs, including short range communication.	NAV/COMSAR
120-Gte03	Lack of systems for source and channel management for communication equipment. Lack of seamless communication means for exchanging navigation information (e.g. intention, alarm, etc.) between ships. Insufficient techniques and procedures for exchange of data between ship, shore and on board. Insufficient data protocols to support the exchange of reliability information describing data and system integrity.	NAV/COMSAR

[1] The identified gap is not within the remit of the Organization or any of the relevant Sub-Committees.

Identifier	Gaps	Competent Sub-Committee(s)
120-Gte04	Signal security, system security, input security as well as management of access/protocols is insufficient.	NAV/COMSAR
120-Gte05	Lack of integrated GMDSS equipment.	NAV/COMSAR
120-Gte06	Deleted.	
	Regulatory	
120-Gre01	Lack of regulations for new communication equipment and systems addressing the potential e-navigation communication needs.	NAV/COMSAR
120-Gre02	IMO requirements for navigation and communication are not harmonized.	NAV/COMSAR
120-Gre03	Absence of structured communication link to notify incorrect operation of both shipboard and/or shore-based e-navigation related systems.	NAV/COMSAR
	Operational (no gaps identified)	
120-Gop01	Deleted.	
	Training (no gaps identified)	
120-Gtr01	Deleted.	
	3 Navigational bridge systems and equipment	
	3.1 Improved reliability and indication of reliability	
	Technical	
132-Gte01	Insufficient reliability of position fixing systems.	NAV
132-Gte02	Lack of self-checking functionality of the electronic equipment for improved reliability.	NAV
132-Gte03	Lack of automatic assessment functionalities to provide quantified reliability information.	NAV
132-Gte04	Lack of PNT relevant services for port operation and automatic docking.	NAV
	Regulatory	
132-Gre01	Lack of framework for resilient provision of PNT.	NAV
	Operational (no gaps identified)	
	Training (no gaps identified)	

Identifier	Gaps	Competent Sub-Committee(s)
	3.2 Improved ergonomics, standardization and alert management	
	Technical	
134-Gte01a	Ergonomic problems of navigation equipment exist in a sense that there is a lack of intuitive human-machine interface for communication and navigation means. Bridge layouts, equipment and systems are seldom designed from an ergonomic and/or user-friendly perspective.	NAV/COMSAR/ STW
134-Gte01b	Deleted.	
134-Gte01c	Deleted.	
134-Gte03	Lack of harmonized symbology for whole potential e-navigation information.	NAV
134-Gte04	Lack in presentation of manoeuvring information/data (engine-room telegraphs) on navigational display.	NAV
	Regulatory	
134-Gre01	Deleted.	
134-Gre02	Control (e.g. type approval) of software and hardware updates is not sufficient. Type approval procedure for navigation and communication equipment should become more flexible and progressive. Regulation of upgrading of navigation and communication equipment operating systems is missing. Lack of updating regime for software driven applications within e-navigation framework.	NAV/COMSAR
134-Gre03	Existing documents (performance standards, guidelines, etc.) with regard to ergonomics are missing harmonization and are seldom applied. Existing documents (performance standards, guidelines, etc.) with regard to ergonomics are not applied for communication equipment and systems (incl. GMDSS). Existing documents (performance standards, guidelines, etc.) for alert management are not applied.	NAV/COMSAR
134-Gre04	Currently, there are no guidelines or guidance for usability evaluation.	NAV/COMSAR
134-Gre05	Lack of standardization for operation of functions to observe the passage plan. Users require standardization on the level of function provided and the operating way of it, but not being restricted to future developments.	NAV
134-Gre06	Lack of performance standards for interoperability of systems and sensors (according to the modular concept).	NAV/COMSAR

Identifier	Gaps	Competent Sub-Committee(s)
	Operational	
134-Gop02	Seafarers sometimes experience difficulties in accessing necessary information because of ergonomic problems.	NAV/COMSAR
	Training (no gaps identified)	
134-Gtr01	Deleted.	
	3.3 Presentation of information received via communication equipment (e.g. MSI) on the navigation display	
	Technical	
135-Gte01a	Deleted.	
135-Gte01b	Lack of technical harmonized solutions for processing, routeing, filtering and display of information received via communication equipment to enable transfer of the information to navigational systems.	NAV/COMSAR
135-Gte01c	Deleted.	
135-Gte01d	Deleted.	
135-Gte01e	Insufficient means for sorting and display of MSI such as NAVTEX, SafetyNET. Insufficient network of storage, sharing and distribution of MSI.	NAV/COMSAR
135-Gte01f	Lack of user-selectable and task-oriented presentation of information received via communication equipment (including MSI) on navigational systems.	NAV
135-Gte01g	Deleted.	
135-Gte01h	Unless having prior subscription, the current system does not allow for MSI and other navigational warnings/broadcast, etc. to be received in real-time mode and be integrated or in conjunction with the navigation display.	NAV/COMSAR
135-Gte01i	Unavailability of information in real-time with possible presentation on the navigational display to support bridge operation.	NAV
135-Gte01j	Lack of integrated secondary screen option for digital publications and MSI.	NAV
135-Gte01k	Deleted.	
135-Gte02	Lack of information about special berthing requirements on navigation systems especially for pilotage.	NAV
135-Gte03	Deleted.	

Identifier	Gaps	Competent Sub-Committee(s)
	Regulatory (no gaps identified)	
	Operational (no gaps identified)	
	Training (no gaps identified)	
	3.4 Documents in electronic form and automated updates of information	
	Technical	
136-Gte01a	New equipment/system or task based on INS-task (functionality) concept MSC.252(83) for management of information formerly available in printed format is necessary.	NAV
136-Gte01b	Information may be difficult to localize in electronic documents (search function).	NAV
136-Gte01c	Lack of automatic updating of documents.	NAV
136-Gte01d	Electronic systems can not automatically determine the status of available data and automatically retrieve the most current and comprehensive data.	NAV
136-Gte01e	Regulations for new navigational display systems should be standardized.	NAV
	Regulatory	
136-Gre01	Legal aspects regarding access and usage rights of updating information are not solved.	NAV
136-Gre02	Documentation requirements possibly not allow for documentation in electronic form.	NAV
136-Gre03	Too many regulations are adding to the administrative burden of the mariner on board.	NAV
	Operational	
136-Gop01	Ineffective access to information.	NAV
	Training (no gaps identified)	
	4 Ship reporting	
	Technical	
140-Gte01 140-Gte02	Lack of automated and standardized ship reporting function (e.g. FAL Convention documents, coastal State and additional port entry requirements as part of Ship Reporting Systems).	NAV/COMSAR
140-Gte03	Single-window and/or automated and single entry for any required reporting information into the system for it to be shared by authorized authorities without further intervention by the ship during and/or before navigation, except it has any relevance for navigational purposes (VTS/PILOT/HARBOUR/COLREGs).	NAV

Identifier	Gaps	Competent Sub-Committee(s)
140-Gte04	Automated entry of internal ship data for reporting (including updates of information) is not available.	NAV
140-Gte05	(Moved under shore-based users).	
	Regulatory	
140-Gre01	Legal aspects regarding access and sharing of reporting information are not solved.	NAV
140-Gre03	Lack of a legal protocol that permits a government agency to automatically (and without notice or agreement from the master) pick up the ship in an MDA system and maintain an interest in it for security reasons.	NAV
140-Gre04	Transnational reporting requirements are not harmonized.	NAV
140-Gre05	Lack of standardized reporting formats.	NAV
	Operational	
140-Gop01	Reporting procedures are not globally standardized.	NAV
140-Gop02	Deleted.	
	Training	
140-Gtr01	Deleted.	
	5 Training and familiarization	
	Technical	
150-Gte01a	Insufficient familiarization material for safety-related equipment.	NAV
	Regulatory	
150-Gre01 (ex 150-Gte01b)	Lack of specifications of familiarization material for new and existing performance standards.	NAV
	Operational	
150-Gop01	Insufficient familiarization, understanding and awareness training of seafarers and relevant personnel in the detection and reporting of anomalies to appropriate channel, feedback and recording of subsequent action/measures.	STW
	Training	
150-Gtr01	Deleted.	
150-Gtr02	Insufficient training in correct use and activation of priority messages.	STW

Table 2 – Shore-based users

Identifier	Gaps	Competent Sub-Committee(s)
	1 Information/data management	
	1.1 Common data structure/harmonized data formats	
	Technical	
211-Gte01	Lack of a common maritime information/data structure harmonizing the policies for the security and use of data. Insufficient identification of harmonization needs for standards, formats and protocols. Lack of protocols, formats and data structure that enable shore-based authorities to exchange information with other authorized shore-based users. No standardized format for data exchange between VTS centres and other e-nav stakeholders.	NAV
211-Gte02	There is a gap between information capability of current information management systems and those that will be required as volumes of information increases. Tools that have the capability to manage increased levels/volumes of information are not in use.	NAV
	Regulatory	
211-Gre01	Inconsistent rules that require some coastal States to maintain domain awareness. Insufficient collection of data required to establish accurate and reliable marine domain awareness.	NAV
	Operational (no gaps identified)	
	Training (no gaps identified)	
	2 Effective and robust voice communication and data transfer	
	Technical (no gaps identified)	
	Regulatory (no gaps identified)	
220-Gre01	Deleted.	
	Operational (no gaps identified)	
	Training	
220-Gtr01	Lack of international guidance on security of data and its sharing.	NAV

Identifier	Gaps	Competent Sub-Committee(s)
	3 Systems and equipment	
	3.1 Presentation of Information	
	Technical	
235-Gte01	Insufficient delivery and presentation of maritime information that shore-based authorities are required to provide to ships. There are no standard data formats for onboard capture and presentation that cover the entire scope of information provided by a VTS.	NAV
	Regulatory (no gaps identified)	
	Operational	
235-Gop01	Lack of harmonized presentation of domain awareness to improve situational awareness for allied and other support services.	NAV
	Training (no gaps identified)	
	4 Ship reporting	
	Technical	
235-Gte01 (ex 140-Gte05)	Insufficient means for ship reporting on shoreside.	NAV
	Regulatory (no gaps identified)	
	Operational	
240-Gop01	Deleted.	
	Training (no gaps identified)	
	5 Training and familiarization	
	Technical (no gaps identified)	
	Regulatory (no gaps identified)	
	Operational (no gaps identified)	
	Training	
250-Gtr01	IALA VTS guidance may not be being developed in harmony with the concepts of e-navigation. VTS Operating procedures and guidelines should be harmonized with e-navigation.	NAV
250-Gtr02	Not only the shipboard users but also shore-based users (e.g. VTS operators, etc.) need to be appropriately trained in order to efficiently use and obtain the maximum benefit of e-navigation.	NAV

Identifier	Gaps	Competent Sub-Committee(s)
	6 Traffic monitoring	
	Technical	
260-Gte01	Traffic monitoring Tools that have the capability to manage increased levels/volumes of information are not in use.	NAV
260-Gte02	Current VTS infrastructure may not have the capacity for increased collection, integration, exchange, presentation, storage and analysis of data.	NAV
260-Gte03	Lack of procedures that enable shore-based authorities to monitor quality of navigation systems on board as well as quality of information and effectiveness of communication.	NAV
260-Gte04	Current VTS infrastructure may not have the capacity for real time display of vessels' track to provide a Navigational Assistance Service (NAS) or Traffic Organization Service (TOS).	NAV
260-Gte05a	Some operating systems and software are no longer supported.	NAV
260-Gte05b	In some VTSs, there is a problem of interoperability between applications.	NAV
260-Gte06a	Bandwidth limitations shore/ship. Shortage of VHF marine frequencies.	NAV/COMSAR
260-Gte06b	Deleted.	
260-Gte07	There is a lack of effective measures to prevent the transmission of inaccurate AIS data.	NAV/COMSAR
	Regulatory (no gaps identified)	
	Operational	
260-Gop01	Lack of common understanding of the scope and evolving procedures of NAS and TOS internationally.	NAV
	Training	
260-Gtr01	Not all VTS Operators are trained to IALA V-103 model training courses. Not all VTS training organizations have accredited VTS training courses.	NAV
260-Gtr02	There is a lack of understanding by seafarers as to the type of VTS service being provided.	NAV

Table 3 – SAR users

Identifier	Gaps	Competent Sub-Committee(s)
	1 Information/data management	
	Technical	
310-Gte01	Lack of mechanisms to provide SAR (RCC) function with the full range of relevant e-navigation information in digital format.	COMSAR
	Regulatory (no gaps identified)	
	Operational	
310-Gop01	Insufficient access to and quality of information from ships in distress.	COMSAR
310-Gop02	Insufficient access to LRIT data to ships or units participating in SAR operations.	COMSAR
	Training (no gaps identified)	
	2 Effective and robust voice communication and data transfer	
	Technical	
320-Gte01	Lack of an automated data network connecting all stakeholders in SAR intervention, including improved communication between RCC and shore-, land-, sea- and air-based entities. Lack of access to the details of all relevant onboard communication and capabilities for SAR authorities. Limited resources for communication infrastructure in SAR operation.	COMSAR
	Regulatory	
320-Gre01	Deleted.	
	Operational	
320-Gop01	Deleted.	
	Training	
320-Gtr01	Deleted.	
	3 Systems and equipment	
	Technical (no gaps identified)	
330-Gte01	Deleted.	
	Regulatory (no gaps identified)	
	Operational (no gaps identified)	
	Training (no gaps identified)	
	4 Operation (no gaps identified)	

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ANNEX 2

PRELIMINARY LIST OF POTENTIAL E-NAVIGATION SOLUTIONS

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
S1	**Improved, harmonized and user-friendly bridge design**					
S1.1	Ergonomically improved and harmonized bridge and workstation layout	Improved ergonomics	Shipboard user	Familiarization requirements	Suboptimal performance or accident due to lack of familiarity with bridge equipment/slow response due to not finding the correct information/control/alarm	134-Gte01 134-Gre01 134-Gre03 134-Gre04 134-Gop01
S1.2	Extended use of standardized and unified symbology for relevant bridge equipment	Standard interface	Shipboard user	Improved ergonomics	Suboptimal performance or accident due to misinterpretation of information or problem locating correct information	113-Gre01 134-Gte01 134-Gte03 135-Gte01
S1.3	Standardized digital familiarization material for relevant equipment	Familiarization requirements	Shipboard user	Standard interface	Suboptimal performance or accident due to lack of familiarity with bridge equipment	150-Gte01 113-Gtr01 134-Gtr01
S1.4	Standard default settings, save/recall settings, and S-mode functionalities on relevant equipment	Standard interface	Shipboard user	Familiarization requirements, Improved ergonomics	Suboptimal performance or collision and grounding due to lack of familiarity with bridge equipment or using settings not appropriate to task	[NAV 56/WP.5/Rev.1 Annex 2]

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
S1.5	All bridge equipment to follow IMO BAM (Bridge Alert Management) performance standard	Alert management	Shipboard user		Suboptimal performance or accident due to not responding to relevant alert	134-Gre03
S1.6	Information accuracy/reliability indication functionality for relevant equipment	Indication of reliability	Shipboard user		Suboptimal performance or accident due to actions taken based on inaccurate information	112-Gte01 132-Gte03
S1.6.1	Graphical or numerical presentation of levels of reliability together with the provided information					[...] complete
S1.7	Integrated central bridge display system (INS) for improved access to shipboard information	Effective and robust communications	Shipboard user	Improved ergonomics	Suboptimal performance or accident due to not applying available information/ overburdening	[136-Gop02]
S1.8	GMDSS equipment integration – one common interface	Effective and robust communications	Shipboard user		Suboptimal performance or failure to mitigate accident due to poor communication	120-Gte05
S2	**Means for standardized and automated reporting**					
S2.1	Single-entry of reportable information in single-window solution	Standardized and automated reporting	Shipboard user		Suboptimal performance or accident caused by distraction/high workload	140-Gte02 140-Gte03 140-Gte05
S2.2	Automated collection of internal ship data for reporting	Standardized and automated reporting	Shipboard user		Suboptimal performance or accident due to distraction/ high workload	140-Gte04

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
S2.3	Automated or semi-automated digital distribution/communication of required reportable information, including both "static" documentation and dynamic information	Standardized and automated reporting	Shipboard user		Suboptimal performance or accident due to distraction/ high workload	140-Gte01 140-Gte02 140-Gte03 140-Gte05 140-Gre04 140-Gre05 140-Gop01
S2.4	All national reporting requirements to apply standardized digital reporting formats based on IMO FAL Forms and SN.1/Circ.289	Standardized and automated reporting	Shipboard user		Suboptimal performance or accident due to distraction/ high workload	111-Gte02 140-Gre04 140-Gre05 140-Gop01
S3	**Improved reliability, resilience and integrity of bridge equipment and navigation information**					
S3.1	Standardized self-check/built-in integrity test (BIIT) with interface for relevant equipment (ex.: bridge equipment)	Improved reliability	Shipboard user		Suboptimal performance or accident caused by bridge equipment failure	132-Gte02 132-Gte02-Sop01 132-Gte02-Sop02 132-Gte02-Ste01 132-Gte02-Ste02 132-Gte02-Sre01
S3.2	Standard endurance, quality and integrity verification testing for relevant bridge equipment, including software	Improved reliability	Shipboard user		Suboptimal performance or accident caused by bridge equipment failure	134-Gre02 120-Gte01 112-Gre01
S3.3	Perform information integrity tests based on integration of navigational equipment – application of INS integrity monitoring concept	Improved reliability	Shipboard user		Suboptimal performance or accident due to actions taken based on inaccurate information	112-Gte01-Ste01 112-Gte01-Sre01 112-Gte01-Sre03 112-Gte01-Sre04 112-Gte01-Sre05

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
S3.4	Improved reliability and resilience of onboard PNT systems by integration with external systems	Improved reliability	Shipboard user		Suboptimal performance or accident due to poor information from PNT systems	132-Gte01
S4	**Integration and presentation of available information in graphical displays received via communication equipment**					
S4.1	Integration and presentation of available information in graphical displays (including MSI, AIS, charts, radar, etc.) received via communication equipment	User-selectable information received via communication equipment	Shipboard user	Maritime Safety Information (MSI), Improved target detection, Guard zones	Suboptimal performance or accident due to misinterpretation of information or problem locating correct information, information overload and poor situational awareness	111-Gte06 134-Gte04 135-Gte01 135-Gte02 135-Gte03
S4.1.1	Implement a Common Maritime Data Structure and include parameters for priority, source, and ownership of information					111-Gte01-Ste03 111-Gte01-Sre03 135-Gte01-Ste09 211-Gte01-Ste01 211-Gte01-Sre01 211-Gte01-Sre02 211-Gte02-Ste02
S4.1.2	Standardized interfaces for data exchange should be developed to support transfer of information from communication equipment to navigational systems (INS)					111-Gte01-Ste01 111-Gte01-Ste02 111-Gte01-Sre01 111-Gte01-Sre02 135-Gte01-Ste03 135-Gte01-Sre07

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
S4.1.3	Provide mapping of specific services (information available) to specific regions (e.g. maritime service portfolios) with status and access requirements					260-Gtr02-Sop01 260-Gtr02-Ste01
S4.1.4	Provision of system for automatic source and channel management on board for the selection of most appropriate communication means (equipment) according to criteria as, band width, content, integrity, costs					120-Gte03-Sop01 120-Gte03-Sop02 120-Gte03-Ste01 120-Gte03-Ste02 120-Gte03-Sre02 120-Gte03-Sre03 120-Gte03-Sre04
S4.1.5	Routeing and filtering of information on board (weather, intended route, etc.): i. Develop of SW/HW (module (S)) for processing, filtering and transfer/routeing of information exchanged via communication equipment to the appropriate applications on board, e.g. navigation, other bridge applications (safety, security) and other onboard applications ii. Provide functionality as part of INS to process and filter exchanged information received via communication equipment for relevance to					111-Gte01-Sop01 135-Gte01-Sop04 111-Gte05-Sop01 111-Gte05-Ste01 111-Gte05-Ste02 111-Gte05-Sre01 135-Gte01-Sop02 135-Gte01-Ste07 135-Gte01-Ste12

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
	vessel, route, and conditions, ensuring delivery (routeing) and presentation of safety relevant information on INS tasks (displays) iii. Provide an administrative HMI interface in INS task concept for identifying updates and setting of presentation rules based on route plan, vessel characteristics, INS tasks supported and other user-selected priorities					
S4.1.6	Provide quality assurance process to ensure that all data is reliable and is based on a consistent common reference system (CCRS) or converted to such before integration and display					See solutions S1.6 and S3.3

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
S4.1.7	Implement harmonized presentation concept of information exchanged via communication equipment including standard symbology and text support taking into account human factors and ergonomics design principles to ensure useful presentation and prevent overload					113-Gre01-Ste01 113-Gre01-Ste02 113-Gre01-Sre01 135-Gte01-Sop01 135-Gte01-Sop03 135-Gte01-Sop05 135-Gte01-Sop07 135-Gte01-Ste04 135-Gte01-Ste05 135-Gte01-Ste08 135-Gte01-Ste10 135-Gte01-Ste11 135-Gte01-Sre01 135-Gte01-Sre06 135-Gte01-Sre09
S4.1.8	Develop a holistic presentation library as required to support accurate presentation across displays					135-Gte01-Ste01 135-Gte01-Ste02
S4.1.9	Provide alert functionality of INS concepts to information received via communication equipment and integrated into INS					111-Gte01-Sop02 135-Gte01-Sop06
S4.1.10	Harmonization of conventions and regulations for navigation and communication equipment					120-Gre02-Sop01 120-Gre02-Ste01 120-Gre02-Ste02. 120-Gre02-Sre02 135-Gte01-Sre01 135-Gte01-Sre02 135-Gte01-Sre05 135-Gte01-Sre10

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
S5	**Information management**					
S5.1	Improved display of status of available data and indication of available updates	Automated updating of baseline data and documents	Shipboard user		Suboptimal performance or accident due to overburdening/out of date navigational documentation	136-Gte01 136-Gop01
S5.2	Automated and timely updating of Electronic navigational charts (ENCs), nautical publications and other documentation	Automated updating of baseline data and documents	Shipboard user	Provision of information to vessels	Suboptimal performance or accident due to overburdening/out of date navigational documentation	136-Gte01
S5.3	Electronic information to be searchable to the appropriate shipboard user	Effective and robust communications	Shipboard user	Improved ergonomics	Suboptimal performance or accident due to not applying available information/ overburdening	136-Gte01
S5.4	Task-based information management	Effective and robust communications	Shipboard user	Improved ergonomics	Suboptimal performance or accident due to not applying available information	136-Gte01
S6	**Improved access to relevant information for Search and Rescue**					
S6.1	Automated network for communication and data coordination/distribution among SAR stakeholders	Effective communication and information sharing	SAR user		Failure to mitigate accident due to poor SAR operation coordination	320-Gte01
S6.2	Automated SAR information collection	Effective communication and information sharing	SAR user	Access to relevant information within the e-nav domain	Failure to mitigate accident due to poor situation awareness/lack of information	310-Gte01 310-Gop01 310-Gop02 330-Gte01

No.	Short description	Primary user need	User type	Other user needs	Hazard description	Origin
S7	**Improved reliability, resilience and integrity of bridge equipment and navigation information for shore-based users**					
S7.1	Shore monitoring of quality/integrity of navigation systems, quality of onboard information and effectiveness of communications	Quality assurance	Shore-based user	Improved reliability	Suboptimal performance or accident due to navigation or communication equipment failure/poor onboard navigation documentation	260-Gte03 260-Gte07
S8	**Improved and harmonized shore-based systems and services**					
S8.1	Integrated system for improved and harmonized presentation of domain awareness	Management of information	Shore-based user	Improved target detection	Suboptimal performance or accident caused by poor situation awareness	235-Gop01
S8.2	Standardized and unified symbology for relevant shore equipment	Management of information	Shore-based user		Suboptimal performance or accident due to equipment symbol misinterpretation	235-Gop01
S9	**Improved communication of VTS service portfolio**					
S9.1	Improved communication of VTS service portfolio	Provision of information to vessels	Shore-based user		Suboptimal performance or accident due to not applying available information	260-Gtr02

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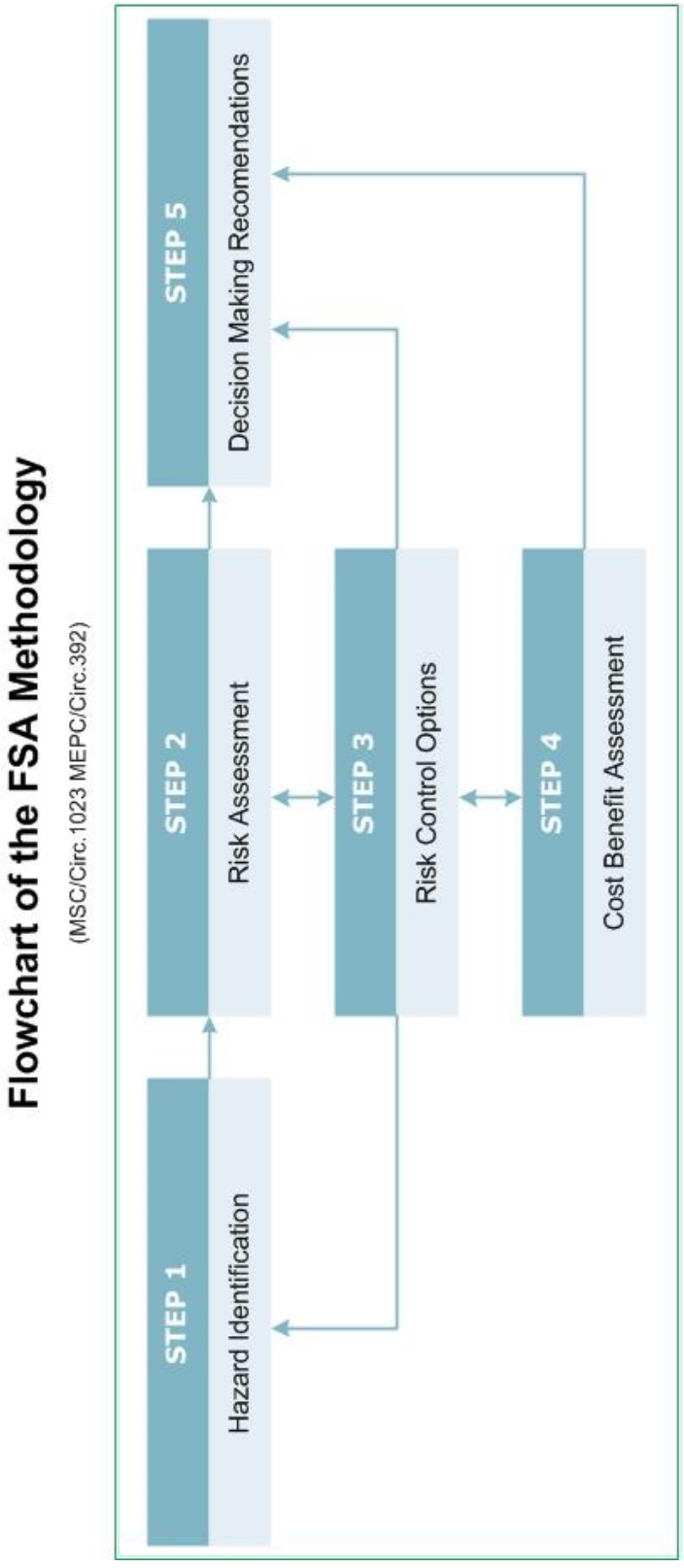
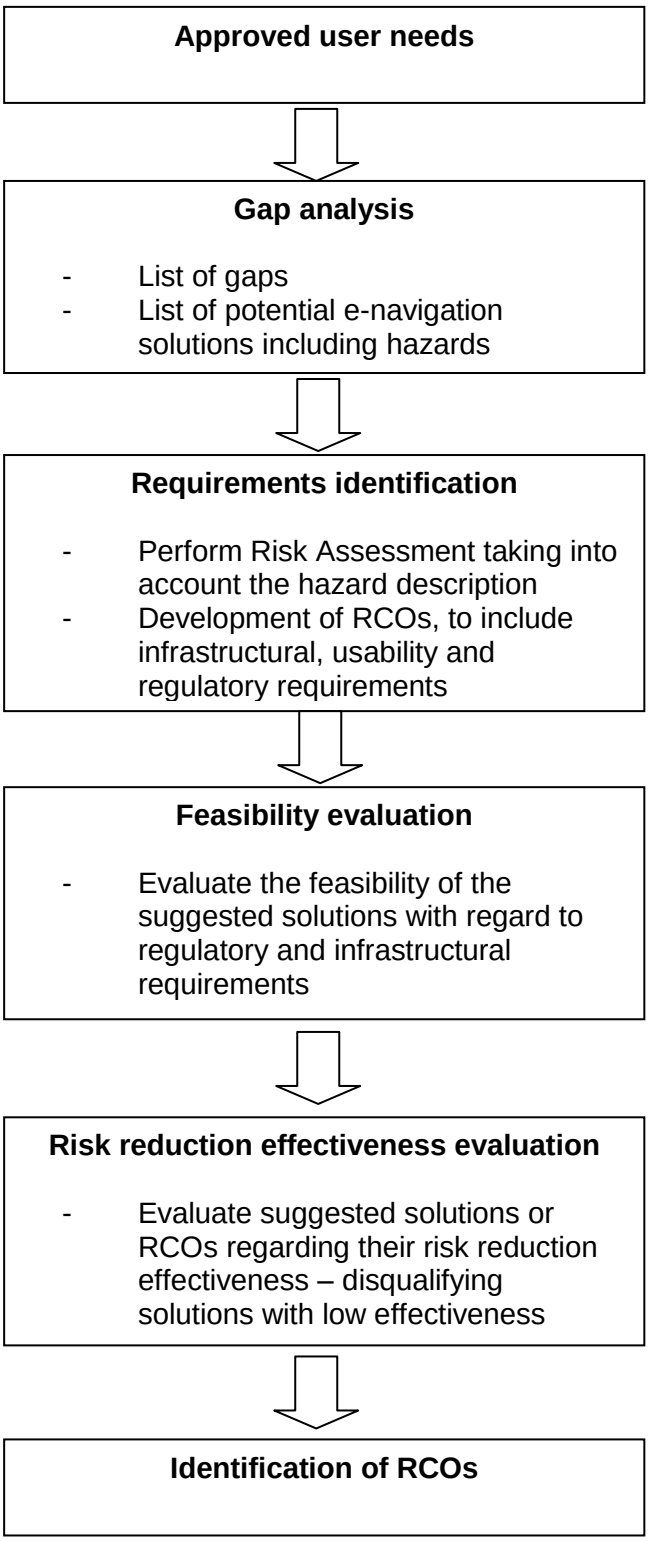
ANNEX 3

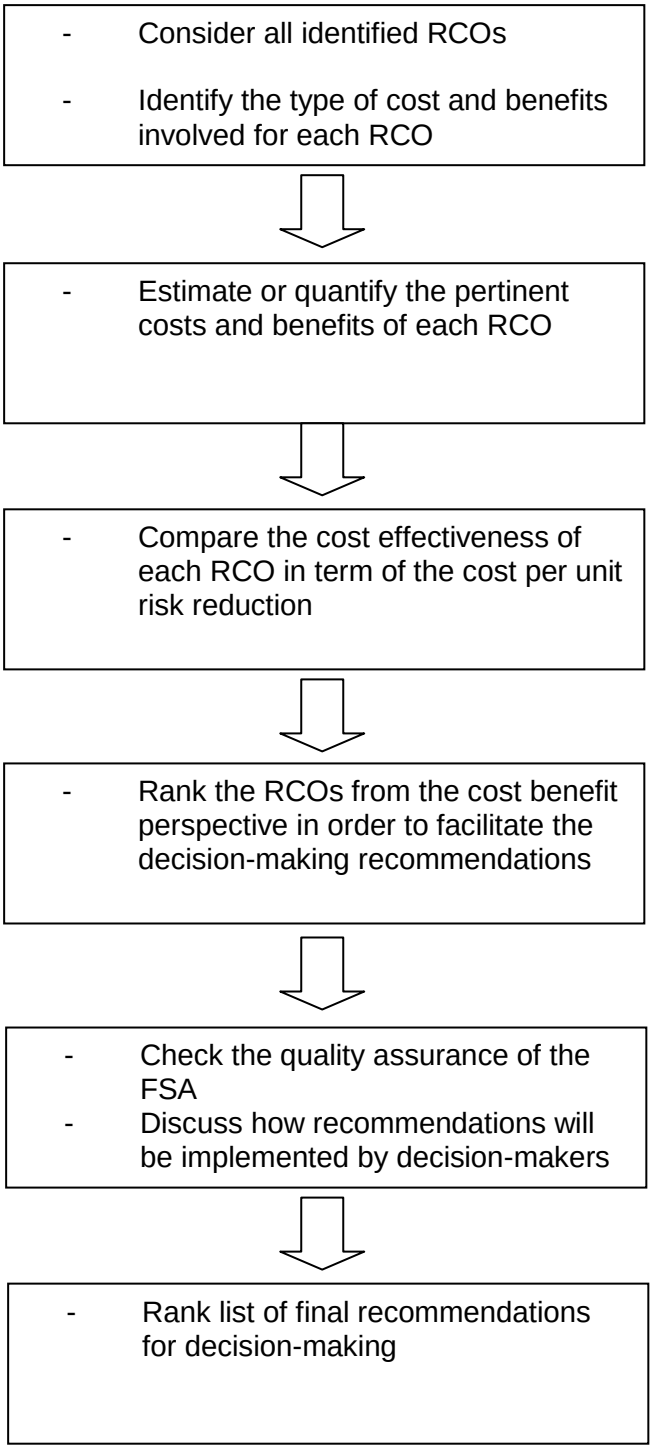
FORMAL SAFETY ASSESSMENT METHODOLOGY



How to identify Risk Control Options (RCOs)



Undertake a Cost Benefit Analysis based on identified RCOs



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ANNEX 4

DRAFT TERMS OF REFERENCE FOR THE CORRESPONDENCE GROUP

Taking into account the revised joint plan of work for the COMSAR, NAV and STW Sub-Committees for the period 2012-2014, as approved by MSC 90, the Correspondence Group on e-navigation should:

.1 review the preliminary list of potential e-navigation solutions (NAV 58/WP.6, annex 2) and, if necessary, prepare additional potential e-navigation solutions in order to address all gaps identified in annex 1 to NAV 58/WP.6;

.2 finalize the Cost Benefit and Risk Analysis, with a view to final approval by NAV 59, using as input documents namely, the final list of gaps and the preliminary list of potential e-navigation solutions that would cover all the identified gaps and taking into account the Formal Safety Assessment process and the Methodology of the Human Element Analysing Process (NAV 58/6, annex 3);

.3 further develop:

.1 the detailed ship and shore architecture;

.2 the concept of Maritime Service Portfolios; and

.3 the draft Strategy Implementation Plan;

.4 consider documents NAV 58/6/1 and NAV 58/6/3 (Germany) and provide comments and recommendations, as appropriate;

.5 consider the issue of software quality assurance, taking into account document NAV 58/6/4 (Republic of Korea), and provide comments and recommendations, as appropriate;

.6 progress the development of draft Guidelines for usability evaluation of navigational equipment and its harmonization with the HEAP, taking into account documents NAV 58/6/6 and Corr.1, NAV 58/INF.12 and NAV 58/INF.13 and Corr.1 (Japan) and NAV 58/INF.10 (Australia);

.7 progress the development of draft Guidelines for the harmonization of test beds, taking into account document NAV 58/6/8 (Republic of Korea);

.8 submit reports to COMSAR 17 and STW 44 raising specific questions, as required, that should be addressed by the STW and COMSAR Sub-Committees; and

.9 submit a consolidated progress report to NAV 59.