**DEVELOPMENT OF AN E-NAVIGATION STRATEGY IMPLEMENTATION PLAN**

**Report to the Correspondence Group**

**Index**

**Chapter 1: Background  
Chapter 2: Terms of reference for the re-established correspondence group**

**Chapter 3: The final gap analysis**

**Chapter 4: Gaps, solutions and Risk Control Options (RCO)**

**Chapter 5: Development of a detailed architecture**

**Chapter 6: Maritime Service Portfolios.**

**Chapter 7: Guidelines for usability**

**Chapter 8: The IMO Human Element Analyzing Process (HEAP)**

**Chapter 9: Development of elements of the final Strategy Implementation Plan**

**Chapter 10: Summary of actions requested by the Correspondence Group**

**Chapter 1:**

**Background.**

1The Maritime Safety Committee at its 85.session approved the Strategy for the development and implementation of e-navigation, and then at its 86.session approved a proposal for a coordinated approach to the implementation of the e-navigation strategy. The proposal outlines a joint plan of work for the NAV, COMSAR and STW Sub-Committees for the period 2009-2012. According to the plan NAV 56 finalized the user needs, the initial system architecture, and completed an initial gap analysis, initial cost benefit and risk analysis, taking into account the recommendations of COMSAR 14.

Working groups for implementation of the e-navigation strategy have been established by the NAV, STW and COMSAR Sub-Committees respectively. These working groups are being assisted by a Correspondence Group (CG).

The purpose of this document is to identify the basis for the upcoming reports from the IMO Correspondence Group on e-navigation to the Sub-Committees COMSAR 16, STW 43 and NAV 58.

**Chapter 2:**

**Terms of reference for the re-established correspondence group**

2NAV 57re-established the correspondence group on e-navigation under the coordination of Norway and instructed it to take into account the joint plan of work for the COMSAR, NAV and STW Sub-Committees for the period 2012-2014, the comments and general views expressed at NAV 57 and, decisions taken by NAV 52 including 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 Analyzing Process (HEAP).

3 NAV 57 invited the Committee (MSC), at its ninetieth session, to:

.3 approve the current overarching e-navigation architecture (paragraph 6.32.1);

.4 approve the proposed way forward for developing a Common Maritime Data

Structure (CMDS) (paragraph 6.32.2);

.5 approve the use of the IHO's S-100 standard as the baseline for creating a

framework for data access and services under the scope of SOLAS (paragraph 6.32.3);

.6 authorize, in consultation with other organizations, the establishment of an

IMO/IHO Harmonization Group on Data modeling and approve its terms of

reference (paragraph 6.33 and annex 5);

.7 agree that for the time being, no further action is required until future uses

of the frequency band of 495-505 kHz are identified for e-navigation,

(paragraphs 6.38 to 6.40);

.8 approve the proposed joint plan of work on e-navigation for the COMSAR,

NAV and STW Sub-Committees for the period 2012–2014 (paragraph 6.41

and annex 6);

.9 note the progress in the development of an e-navigation strategy

implementation plan and the re-establishment of a Correspondence Group

to progress the work inter sessionally (paragraphs 6.37 to 6.42);

4 The Correspondence Group on e-navigation should undertake the following tasks:

.1 using the overarching e-navigation architecture as a framework, further develop the detailed architecture of both the ship and shore sides, as appropriate, taking into account the outcomes of the gap analysis;

.2 consider the development of Maritime Service Portfolios to achieve harmonization, modernization, integration and simplification on board and ashore, taking into account the use of the IHO's S-100 standard, and recommend the approach to be taken;

.3 further develop and complete the gap analysis with a view to finalization at

NAV 58, taking into account the relevant documents submitted in this respect;

.4 further develop the draft Strategy Implementation Plan;

.5 consider the development of guidelines for usability evaluation of navigational equipment during the preparation of the Strategy Implementation Plan, taking into account the information provided in documents NAV 57/6/5,

NAV 57/INF.7 and NAV 57/INF.8 (Japan) and NAV 57/WP.6, and recommend the approach to be taken;

.6 further progress the preparation of cost benefit and risk analysis processes;

.7 submit interim reports to COMSAR 16 and STW 43 raising specific questions, if required, that should be addressed by the STW and COMSAR

Sub-Committees; and

.8 submit a consolidated progress report to NAV 58.

5 The Correspondence Group should also take into consideration views expressed by the Working Group on e-navigation in its report to the Sub-Committee (NAV57/WP.6) on development of an e-navigation strategy implementation plan.

3.37 The Working Group noted with appreciation the significant progress made by the Republic of Korea on filling and completing the gap analysis and invited them to submit this information to the correspondence group for further consideration.

3.38 The Working Group also noted that the initial completed gap analysis was expected to be distributed to all members of the correspondence group during August 2011 for consideration, comments and observations.

3.39 The Working Group further noted that the results of the gap analysis would be the basis for further discussions on cost benefit and risk analysis and recommended encouraging the participation of Member States, organizations and interested parties in its preparation.

3.42 In considering the use of the modular concept to enable scalability and

implementation, the Working Group was of the view that Integrated Navigation System (INS) could be considered to be the dominant factor for the development of e-navigation on board providing a task-oriented approach and offering the possibility to integrate further functionality specified within the e-navigation process.

3.43 The Working Group noted that the preparation of performance standards using overarching approach was an issue that should be further discussed by the correspondence group.

6 At STW 42 INS was a topic. The Sub-Committee also discussed Integrated Bridge Systems (IBS) and the need for familiarization.

The Correspondence Group should take into consideration relevant statements from the Working Group on e-navigation at STW 42, (STW 42/ WP.3):

3.5 The Working Group noted that the Sub-Committee had agreed that, whilst

standardization of bridge design layout would be difficult to accomplish, it would be a welcome development in this context.

3.6 The Working Group also noted that SOLAS regulation V/15 provided Principles relating to bridge design, design and arrangements of navigational systems and equipment and bridge procedures and some shipping companies were already standardizing their bridge design.

3.7 The Working Group was of the view that a distinction should be made between

standards for bridge design and standards for bridge equipment.

3.8 The Working Group recalled that, during the discussion in plenary, the development of a common S-mode for navigation displays had received general support. However, it had been recognized that while this might not necessarily improve the competency of seafarers, it would facilitate training and improve operational safety.

3.9 The development of S-modes and standard operating procedures for equipment would assist in ensuring that a common methodology was pursued by training institutions worldwide but, at the same time, it could freeze innovation and prevent the progress of new technologies. It was, therefore, recommended that the development of a goal-based approach for training should be considered.

The subject is also considered in the Sub-Committees final report to MSC, (STW/14):

On receipt of the report of the working group (STW 42/WP.3), the Sub-Committee

took action as summarized in the ensuing paragraphs.

6.26 The delegation of the Bahamas, supported by others, commenting on paragraph 3.9 of the report of the working group, expressed the opinion that the use of S-modes for navigation displays would facilitate the use of equipment, assist in the familiarization process for pilots and new officers and generally enhance navigational safety. They emphasized that such a

development would neither freeze innovation nor prevent the progress of new technologies.

6.30 The delegation of Italy expressed the view that the need for an "e-navigation" project should be supported, as a useful and indispensable system for seafarers, which would result in the enhancement of safety, security and protection of the marine ecosystem. Furthermore, it was premature to analyze reliability risks of the project without knowing which equipment would form part of e-navigation, however, in the meantime, the development of S-modes for equipment should be considered. In this respect, it would be essential to:

.1 develop a draft model course on e-navigation;

.2 establish a common S-mode for navigation screens and displays to be used in an S-mode Integrated Bridge System (IBS);

.3 develop a simulator that gives the possibility to test the output of an IBS main area of a standard bridge, including at least, at this stage, the interface between Integrated Navigation System (INS) and engine automation;

**Chapter 3:**

**The final gap analysis.**

7 The development of the gap analysis made significant progress thanks to the contribution made by the Republic of Korea, which was presented to the Working Group at NAV 57. The Republic of Korea has followed up on the invitation to submit this information to the Correspondence Group, and has provided a revised version for further consideration. This version is attached, (Annex 1).

8 It is recognized and agreed that e-navigation should be developed based on the user needs from the shipboard, shore based and SAR fields. These user needs may already be fulfilled by current maritime functions and services. If not, there are certain discrepancies between what the users want and the current situation. A discrepancy is identified as a ‘Gap’ which should be filled by practical e-navigation solutions to satisfy the user need.

User needs connected to e-navigation may involve the operation of stakeholders, equipment and systems with various technologies, regulations like SOLAS, law of flag states or international standards and training issues to ensure human capability.

Gaps derived from the user needs should therefore be reviewed and indentified as ‘operational’, ‘technical’, ‘regulatory’ and ‘training’. In the spreadsheet of the gap analysis, (Annex 1) the identified gaps are discriminated by these four different aspects.

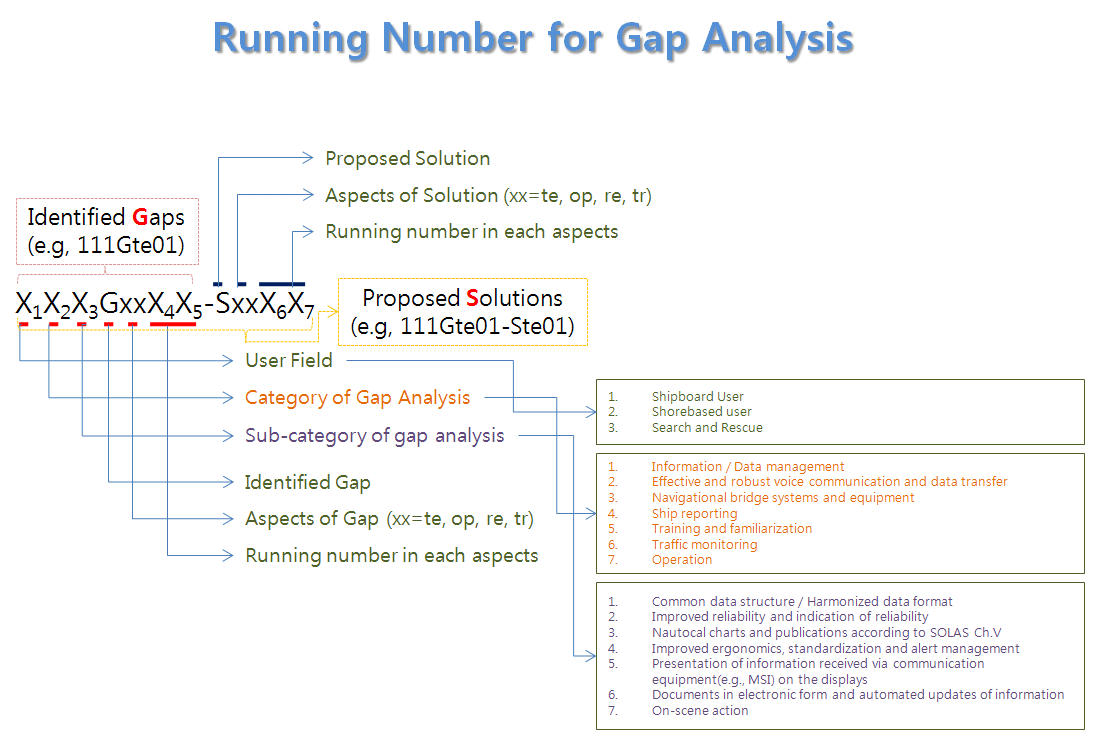
In the yellow columns on the right side of the spreadsheet, (Annex 1) there are proposed practical e-navigation solutions to address identified gaps, applying the four aspects.

In each row the formal origin of a gap as well as the e-navigation solutions that would close it are described.

Each piece of information on a gap is linked to its formal origin:

* Category and sub-category (COMSAR 15/11, Section 36)
* User Needs (NAV 56/WP.5/Rev.1 Annex 2,3,4)
* Key strategic elements (MSC 85/26/Add.1, Annex 20 Sec.9)
* Core strategic objectives (MSC 85/26/Add.1, Annex 20, Sec.5)
* Related functions (NAV 56/WP.5/Rev.1, Annex 1)
* Existing equipment,
* Operational area (COMSAR 15, NAV 57/6)

9 For the reference and traceability, each gap has been given a unique identifier. The detailed structure of the identifier may be illustrated as follows:



**Figure 1.**

10 There remains work to be done for identifying gaps pertaining to effective and robust communications for the promulgation of e-navigation information and distress and safety.

11 The analysis contains a comprehensive presentation of gaps hitherto identified. For each individual gap solutions that would close the gap are proposed.

As the gaps presented are firmly linked to the underlying formal documents, and the system of “identifier” contributes to the monitoring of the continued process, - the document should provide a good base for the further development of e-navigation solutions.

12 The gap analysis, in its present form, may be sufficiently progressed and the next step is to focus on identifying the Risk Control Options (RCO) that will be subjected to Formal Safety Assessment (FSA) including cost effectiveness analysis. The current gap analysis should be applicable to the future process, and might be used as a reference in the solution mining process, and in the solution requirements identification process.

13 **The members of the Correspondence Group are invited to review the quality of the gap analysis (Annex 1), and eventually to propose alternative practical e-navigation solutions.**

14 **The members are also invited to give thoughts to the expected final result set out in the implementation strategy:**

***“A phased implementation schedule along with possible roadmaps”.***

**Which of these practical solutions of the gap analysis should be included in the first implementation phase? And which ones should not?**

**A guideline for this process may be found in the opening address of the Secretary General at the opening of NAV 57:**

***“As intensive work continues on the development and implementation of a global strategy on e-navigation, 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 development of e-navigation and the Scoping exercise of the GMDSS.*

15 At COMSAR 15 the Harmonization of the process of the Scoping exercise of the GMDSS and the development of e-navigation was discussed. In COMSAR 15/16 it was stated that:

11.10 The Chairman of the e-navigation Working Group stated that the Correspondence Group had, amongst others, considered that key discussions on the implementation of e-navigation should include technical improvements to existing GMDSS MF, HF and VHF equipment. The Correspondence Group had identified the urgent need to consider how the process of the Scoping exercise of the GMDSS and the development of e-navigation might be harmonized. In order to make clear how this should be done and, as a consequence, where certain matters needed to be discussed in future, a clear identification of the responsible bodies was needed. Considering that the review of the GMDSS would most likely go ahead, depending on approval by the Committee next year, radio communication requirements for e-navigation would be best brought to the attention of the COMSAR Sub-Committee and be taken into account during the review of the GMDSS. It was adhered to two parallel processes, the e-navigation process could give in the future inputs to the Scoping exercise process and to a possible GMDSS review process.

11.11 The Chairman of the Technical Working Group concurred with the points made by the Chairman of the e–navigation Working Group and stated that it was vital to ensure that the work on e-navigation and the review of the GMDSS proceeded smoothly. This did indeed require certainty on where and how these matters were discussed. He agreed that the most efficient way forward was for the radio communication requirements for e-navigation to be brought to the attention of the COMSAR Sub-Committee, so that these might be taken into account during the review of the GMDSS. In doing so, it would be necessary to be precise on how radio communication systems could contribute to e-navigation, in terms of what information was needed, when and how often it was needed and the associated throughput/bandwidth implications. The nine functions of the GMDSS defined essential communication needs and pathways for distress and safety communications. The inter-related discussions on the radio communication needs of e-navigation and the modernization of GMDSS would benefit from a similar simple exposition of the essential functions envisaged for e-navigation and the means of delivery.

11.13 The Sub-Committee agreed with the summary provided by the Chairman, that:

.1 if approved by the Committee, the review of the GMDSS would go ahead in parallel;

16 Some of the GAPs developed in the e-navigation concept may be closed through the scoping exercise of the Global Maritime Distress and Safety System (GMDSS), as the two systems to some extent might use the same type of equipment to promulgate information.

17 Some issues related to the scoping exercise of the GMDSS might be relevant to the development of the e-navigation, such as, but not limited to:

.1 Should the operational areas in the e-navigation concept (harbor operations, operations in coastal and confined or restricted waters, trans ocean voyages, offshore operations and operations in Arctic, Antarctic and remote areas) be harmonized with the GMDSS Sea Areas?

.2 General communications (SOLAS regulation IV/2) are defined as correspondence other than distress, urgency and safety. To which extent should general communication be defined under the development of e-navigation?

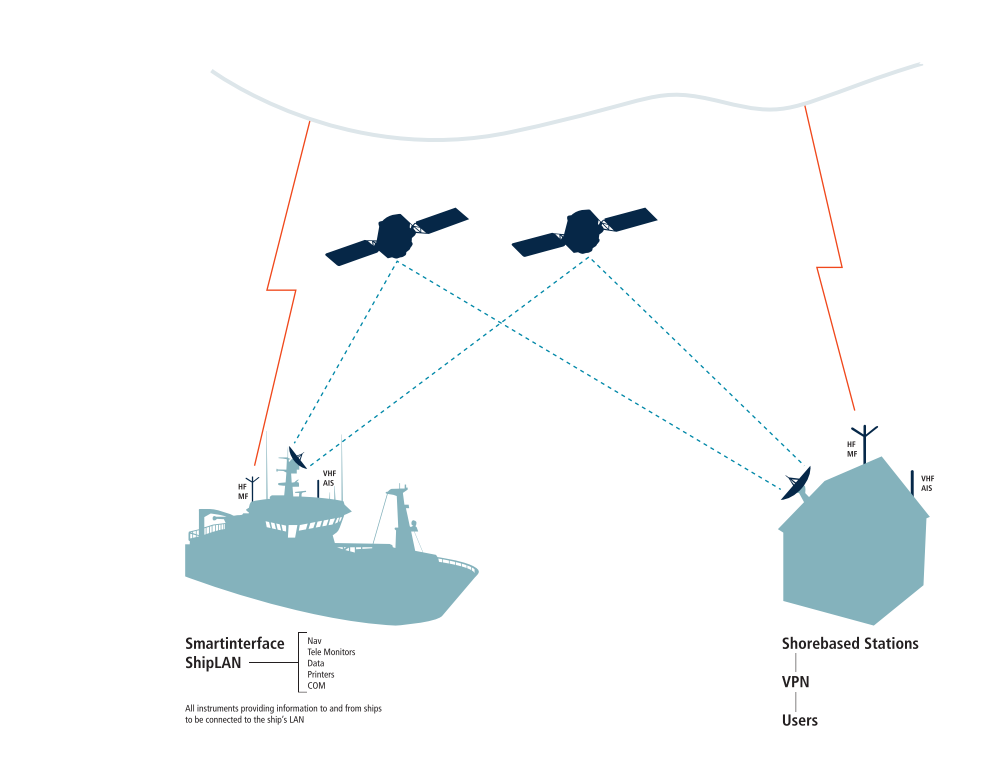
.3 The development of “single window” concept in e-navigation might be essential for SAR purposes. How may this development enhance GMDSS?

.4 Narrow band direct-printing telegraphy (NBDP) is rarely used as a function in the GMDSS. Might these frequencies be considered allocated and dedicated for digital use in e-navigation?

.5 Voice communications are vital for the safety of navigation. Should it be considered to harmonize the development of voice communication for the benefit of e-navigation as well as for GMDSS?

18 The solution of several identified gaps depends on a seamless and automated communication and information systems on board as well as ashore. The equipment providing e-navigation information should be connected to a “smart interface”, capable of expanding, depending on the type of equipment installed. The same principle applies ashore.

The principle is illustrated in Figure 2.



**Figure 2.**

19 **The members of the Correspondence Group are invited to forward their views and give inputs to issues relevant to e-navigation which might be related to the Scoping exercise of the GMDSS process.**

*The further use of the 500 kHz band to support e-navigation.*

20 The Sub-Committee noted that MSC 88, noting the progress made in the development of an e-navigation strategy implementation plan, had endorsed the Sub-Committee's action in inviting the Joint IMO/ITU Expert Group on Maritime Radio communication Matters, at its September 2010 meeting, to consider the further use of the 500 kHz band to support e-navigation; and noted that the group had decided to follow the text in the draft (CPM) report in supporting an exclusive primary allocation to the maritime mobile service in the band 495-505 kHz in all three regions and a co-primary allocation in the band 510-525 kHz in Region 2. The expert group had a detailed debate on the need for making a statement that the existing maritime mobile primary allocation in the band 415 kHz-526.5 kHz should be maintained. This was to fulfill the possible requirement in future for the promulgation of additional security-related information, the implementation of e-navigation and the implementation of the revised elements and procedures of the GMDSS. MSC 88 had also instructed the Secretariat to convey this outcome to the Chairman of the e-navigation correspondence group re-established by NAV 56. NAV 57 agreed that for the time being, no further action is required until future uses of the frequency band of 495-505 kHz are identified for e-navigation.

21 **With reference to the gap analysis, i.e. 135-Gte01 of Annex 1,** t**he Correspondence Group is invited to identify future uses of the frequency band of 495-505 kHz which might be relevant for e-navigation.**

**Chapter 4:**

**Gaps, solutions and Risk Control Options (RCO)**

22 The initial reasoning behind applying gap analyses to the e-navigation concept is found in NAV 53. Here it is stated that the gap analysis is a necessary step in taking the development of e-navigation forward. The gap analysis was expected to provide an overview of current technology, determine the desired e-navigation capabilities and to explore optimal means of bridging the gap. NAV 53 stresses that mature and agreed user requirements must form the basis of the gap analysis.

23 According to NAV 57 the reason for performing the gap analysis is to identify practical e-navigation solutions. A gap analysis can be used as a tool for identification, filtering and mapping of user needs, gaps and solutions.

24 NAV 56 states that risk control options (RCOs) are to be identified based on the gap analysis. An expected output from the gap analysis is to be a set of RCOs. NAV 56 also states that the initial gap analysis is identifying gaps pertaining to the specified user needs, and that solutions in the gap analysis need to be more clearly described, due to them being applied as RCOs, and will be subject to cost and risk analyses. It is evident that one of the objectives of performing the gap analysis was to produce RCOs. Some of the proposed e-navigation solutions presented in the current gap analysis may not be directly translatable to RCO candidates.

25In order to move the e-navigation process forward it is important to focus on identifying RCOs. Planned work on cost-benefit analyses cannot start before such are on the table.

26 The reasoning behind each user need should be investigated. If the reasoning is in line with e-navigation objectives, the user need should be qualified for further analysis. The next step is to identify RCOs or solutions to meet the qualified user needs. A clear and traceable connection between user needs and proposed solutions is important.

27 The following 6 steps are relevant to identify e-navigation RCOs. The gap analysis in Annex 1 has so far focused on steps 1 and parts of step 2. The further process should primarily focus on finalizing step 2 and step 3.

.1 Identify user needs that are relevant to the e-navigation objectives.

.2 Propose relevant e-navigation solutions that have clear origins in user needs, and that contributes to either safety or pollution prevention.

.3 Combine or redefine solutions that coincide or are similar – uphold traceability to solution origin.

.4 Develop solutions further to include infrastructural and regulatory requirements.

.5 Evaluate feasibility of the suggested solutions with regards to regulatory and infrastructural requirements.

.6 Evaluate suggested solutions or RCOs regarding their risk reduction effectiveness – disqualify solutions with low effectiveness.



**Figure3: The proposed risk control option identification process**

28 In addition to the abovementioned steps there might be need for additional steps involving categorization of RCOs with regards to required regulatory and infrastructural changes, scalability and Maritime Service Portfolios. Mapping of coinciding solution requirements will be important input to the cost-benefit analyses, due to shared cost items.

29 The gap analysis is sufficiently progressed, and the next step is to focus on identifying the RCO that will be subjected to FSA including cost effectiveness analysis.

30 **The Correspondence Group is invited to give comments on which of the relevant practical e-navigation solutions that might contribute to either safety or pollution prevention.**

**The Correspondence Group is further invited to suggest how to combine or redefine solutions that coincide or are similar – upholding traceability to solution origin.**

**The Correspondence Group should also bear in mind the needs for further enhancing efficient maritime navigation and shipping traffic.**

**Chapter 5:**

**Development of a detailed architecture.**

31 Using the overarching e-navigation architecture as a framework, the Correspondence Group has been instructed to further develop the detailed architecture of both the ship and shore sides, as appropriate. This topic may be reconsidered at a somewhat later stage, as it will have to take into account the outcomes of the gap analysis. The overarching e-navigation architecture is presented in the report of the Correspondence Group to NAV 57: NAV57/6, paragraph 5-9.

32 **The Members of the Correspondence Group are invited to further develop the detailed architecture of both the ship and shore sides, as appropriate, taking into account the outcomes of the gap analysis, using the overarching e-navigation architecture as a framework.**

**Chapter 6:**

**Maritime Service Portfolios.**

33 Maritime Service Portfolios (MSP) are presented in the report of the Correspondence Group to NAV 57: NAV57/6, paragraph 23-26.

A Maritime Service Portfolio defines and describes the set of operational and technical services and their level of service provided by a stakeholder in a given sea area, waterway, or port, as appropriate.

It should be recalled that the user needs with regard to the e-navigation concept identified and adopted different MSPs corresponding to the needs for services and communication in different areas and for different operations, and it was agreed that the areas could be divided into:

.1 harbour operations;

.2 operations in coastal and confined or restricted waters;

.3 trans ocean voyages;

.4 offshore operations; and

.5 operations in Arctic, Antarctic and remote areas.

34 **For the development of MSP to achieve harmonization, modernization, integration and simplification on board and ashore, the Correspondence Group is invited to give its general inputs and recommend the approach to be taken.**

**Chapter 7:**

**Guidelines for usability.**

35 NAV 57 noted with appreciation the information provided by Japan

(NAV 57/INF.7) on preliminary draft guidelines for usability evaluation of navigational

equipment, which could be used as a basic document for the consideration by the

Sub-Committee in the future. These preliminary draft guidelines were developed on the

basis of Japan's study on methodologies for assessing the usability of equipment in the other

sectors which have already established such methodologies, taking into account the unique

characteristics in the maritime sector. In the process of the development of the preliminary

draft guidelines, they were applied to actual equipment of ARPA and Navigational Intension

Exchange Support System (NIESS) and were improved based on experiences obtained.

36 Taking into account the information provided in documents NAV 57/6/5, NAV 57/INF.7 and NAV 57/INF.8 (Japan) and NAV 57/WP.6, the Correspondence Group has been tasked to consider the development of guidelines for usability evaluation of navigational equipment.

37 **The members of the Correspondence Group are invited to give their recommendations on the development of guidelines for usability evaluation of navigational equipment and on the approach to be taken.**

**Chapter 8:**

**The IMO Human Element Analyzing Process (HEAP) background.**

38 NAV 57 noted with appreciation the information provided by Australia

(NAV 57/INF.5) on a research project. Potential areas of investigation that would be covered

by the research include the extension of the Human Element Analyzing Process (HEAP),

by assessing the measurement tools within the scope of e-navigation. Within the simulated

environment, or from the observational studies on board ships, the data collection would

need to consider the human element with regard to the usability of e-navigation applications

and devices such as Electronic Chart Display and Information System (ECDIS) and

Integrated Navigation Systems (INS). An important element of this research would be to

explore successive iterations of e-navigation systems and to define the principles applicable

to the extension of the HEAP.

39 Within the context of e-navigation, NAV 56/8 advised to use HEAP as a checklist in the gap analysis.

Following discussions on this issue at the session of the Working Group at NAV 57, Australia has provided a document concerning HEAP in general and also related to e-navigation.

The document is presented in Annex 2.

40 **Within the specific context of the e-navigation gap-analysis, and with reference to Annex 2, - the practical and theoretical limitations of the actual HEAP lead to pose the following questions:**

**.1 Is it possible to define a specific list of human elements to consider in the development of guidelines and regulations at the technical, operational, training and regulatory level?**

**.2 Once the association between the identified gaps and human elements to consider for the development of solutions is carried out, how to verify that solutions are effectively addressing the management of human error?**

**Topics related to HEAP will have to be integrated in the further process of finalizing the gap analysis and identifying RCOs. The members of the Correspondence Group are invited to give their comments and inputs.**

**Chapter 9:**

**Development of elements of the final Strategy Implementation Plan:**

**Public relations.**

41 Paragraph 7 of the mandate for the Strategy Implementation Plan (SIP) reads:

*“Proposals on public relations and promotion of the e-navigation concept to key stakeholder groups.”* (MSC 86/23/4, Annex)

In order to achieve the aim and objective, it will be important that all stakeholders are identified, and that all stakeholders have sufficient knowledge, obligation and enthusiasm about e-navigation.

The Correspondence Group should consider the first outline and framework for a communication strategy that will have to be revised and included in the final implementation plan.

42 As stated in NAV 57/6, Annex 3:

*“At the outset the knowledge of e-navigation as an international effort is low or absent among the practical users. Throughout the development the promotion of e-navigation has been difficult, as it was hard to demonstrate the practical consequences to users and stakeholders.*

*The final Strategy Implementation Plan will build on the gap, risk and cost-benefit analyses, which in themselves are based on specific issues of practical consequence. MSC 86/23/4 describes several expected outcomes of the gap analysis, like:*

*.1 technical gap analysis that should result in “a program of development work that needs to be done to provide technology solutions to user requirements in their entirety”.*

*.2 regulatory gap analysis that should serve as a basis for “any institutional reform that is needed should be proposed for implementation”.*

*E-navigation should be more easily promoted if the Strategy Implementation Plan meets the expected requirements. “A stable and realistic implementation plan will create forward enthusiasm and momentum for e-navigation across the maritime sector.” (NAV 54/25, Annex 12.)”*

43 The aim of the communication planning and implementation is to enhance the knowledge of the e-navigation concept and supporting efforts.

Some crucial communication objectives are:

.1 Create necessary enthusiasm

.2 Establish a ground for sufficient participation, and that the concept is known by organizations, states, industries and stakeholders

.3 Create a common understanding of the current situation and challenges today

.4 Create a common obligation to participate for the sake of something bigger than the stakeholder itself

.5 Create a convergence of initiatives, reduce sub-optimization and parallel initiatives

.6 Attract stakeholders

.7 Let communication create momentum in the process, not obstacles

44The main principles for the communication parts of the strategy are that the communication must be simple, have some key selling points and must be able to answer and communicate the following:

.1 Situation and common ground.

Describe the current situation and the drivers for developing the e-navigation concept. The key element is to give a short and precise description of the situation with accidents, higher costs, development of technology, need for harmonization and the need to reduce human related errors to ships, goods and the environment. The objective is to ensure that the stakeholders have a common understanding of the challenges today.

.2 To-be situation.

Describe a to-be environment where navigation and monitoring are integrated

and new technology harmonized to a common open architecture system that

provides mariners on/off shore with better sources for decisions that reduces the risk for accidents and threats to ships, material and environment. The objective is to draw up a future picture that can attract stakeholder interests.

.3 Concept and efforts.

Clearly describe the e-navigation concept as an effort to achieve the to-be

situation and target the challenges in the as-is situation. The objective is to

present the goals and objectives of e-navigation to provide a common

understanding of what e-navigation aims to achieve, and how e-navigation will

be the best solution for achieving the to-be environment.

.4 Profit and costs.

All the people, companies, organizations, governments (stakeholders) that might be affected by e-navigation will be interested in the profits, gains and effects this will have, and also the expected efforts, practical consequences and commitment required. The objective of conducting a stakeholder analysis, will be to tailor communication to the different segments of stakeholders. When the cost/benefit analysis is completed, it will be more easy and effective to communicate effects and consequences.

45 Important attributes of an effective communication strategy are:

.1 Identification of the target audience (stakeholder groups).

Who will affect or be affected by the e-navigation project, and how?

.2 Communication of the appropriate or key messages.

Communication will need to be built on a selection of key messages. It is

important that the key message is easy to understand. The key messages should have different emphases in different stakeholder groups.

.3 Use of appropriate communication tools.

Decide on the appropriate communication tool relevant for the different

stakeholder groups and key messages.

.4 Appropriate timing of communications.

The communication plan must be well coordinated and a bit ahead of other

initiatives. The final communication plan must be integrated with the total

implementation plan.

.5 Identification of appropriate communication roles.

The final communication plan will have to identify and describe the different

roles and responsibilities, and who will have what roles in communicating with

the different stakeholders.

46 Moving on to stakeholder analysis, a stakeholder is any person, organization, industry or state, who can be positively or negatively impacted by, or cause an impact on the actions of a company, government, or organization.

47 Stakeholder analysis is the process of identifying the individuals or groups that are likely to affect or be affected by the proposed action, and sorting them according to their impact on the action and the impact the action will have on them. This information is used to assess how the interests of those stakeholders should be addressed in the strategy implementation plan. Stakeholder analysis is a key part of stakeholder management.

Stakeholder analysis is a term that refers to the action of analyzing the attitudes of stakeholders, in this case towards e-navigation. Stakeholder analysis can be done once or on a regular basis to track changes in stakeholder attitudes over time.

48 The goal of the stakeholder analysis is to develop cooperation between the stakeholder and the concept, assuring successful outcomes of the e-navigation project. It is important to identify all stakeholders for the purpose of identifying their success criteria and turning these into quality goals.

49 From a communication perspective, not all steps in the process will be of equal interest to all stakeholders. The stakeholders’ interest will be focused on effects and consequences of e-navigation, and especially on operation, training, regulation and technical consequences.

50 When using different communication channels, it will be important to focus on the effects that will be achieved and the vision of the concept. The effects that can be achieved are strongly linked to the gap-analysis and cost/benefit process. Actions that are identified in the gap analysis that do not have a positive net present value from the cost/benefit analysis will not be relevant to communicate.

51 It will therefore be important to have an iterative process in communication and development of a communications strategy.

52 **The Correspondence Group is invited to consider and to give its comments to this first outline and framework for a communication strategy that will have to be revised and included in the SIP.**

**Funding.**

53 Point 8 of the SIP concerns identification of potential sources of funding for development and implementation, particularly for developing regions and countries and of actions to secure that funding. (MSC 86/23/4, Annex)

54 Funding is briefly commented on in NAV 57/6, Annex 3:

*“World Bank and Regional Development Banks could be relevant institutions, provided member countries within the relevant regions are actively cooperating in the process. As an initial step it may be useful to get an overview of existing investments in the sector. There will be a need to separate funding of project development and funding of project implementation such as investments and operating cost. The cost may be related to maritime states; flag States, coastal States or port States. Further, the cost could relate to original equipment manufacturers or to ship owners/operators as detailed in NAV 53/13, and may include needs as well on board as ashore.”*

55 Funding Objective & Funding Principle: Benefits and stakeholders.

The e-navigation project aims at ensuring the utilization of modern navigation technology, in order to improve the global situation of maritime information and communication practice and thereby contribute to:

.1 More efficient protection of human life.

.2 More efficient protection of the marine environment.

.3 More efficient protection of vessels.

.4 More efficient maritime transport, based on globally improved interaction between vessel and port.

.5 Reduced number of shipping disasters, and thereby improved standing for the industry

56 The e-navigation program has an objective of securing coordinated and effective realization of benefits from continuing innovation in modern navigation technology. This implies that possible answers in relation to funding also will have a dynamic character, and that the concept of e-navigation relates to a complex situation involving a matrix of different stakeholders including:

.1 States, in particular flag States, coastal States and port States

.2 International governmental or non-governmental organizations, in particular those with marine and environmental focus

.3 Ship-owners and shipping companies

.4 Chartering agencies and operation pools

.5 Insurance companies

.6 Oil spill responders

.7 General maritime industry and maritime industry organizations

.8 Communication technology developers

57 Cost and responsibility.

The issue of funding is essential in order to secure the global implementation necessary to fully achieve the potential benefits from the e-navigation project. A clear understanding of the benefits and a credible explanation of the potential positive outcome will be a central motivating factor in order to secure funding commitment.

58 The e-navigation program cannot be fully realized with the participation of only a limited number of States, organizations, institutions or private parties. The common cause of the project implies a common funding, and in order to secure the funding it will be necessary to secure a common commitment. A common objective and a common cause demands committed and coordinated action. But the division of cost coverage would have to consider the economic means of the involved parties, since the project involves stakeholders with variable ability to contribute to covering the cost.

59 A clear understanding of the benefits and a credible explanation of these will be a central motivating factor in order to secure funding commitment. This addresses the issue of communication, and emphasizes the need for priority with regard to communication, including elements such as:

.1 What are the negative effects which the e-navigation concept should reduce?

.2 What are the potential benefits? Use of “Best case scenario” for illustration purposes.

.3 How will this be implemented to secure the realization of benefits?

60 Potential sources for funding of development and implementation must be identified.

IMO has broad experience concerning initiation of international projects aimed at reduction of accidents. As with the e-navigation project, such projects often involve elements with regard to issues such as operational, technical, training and regulatory questions. Furthermore, such projects normally raise a question of funding with regard to development and implementation.

61 Examples of IMO’s past experience include:

.1 Broad experience concerning bilateral and multilateral partnership arrangements for the funding of specific programs involving States, private and public institutions, industry organizations and other private parties. Examples of such coordinated funding include activity/response centers (Marine Electronic Highway project office in Indonesia, Regional Marine Pollution Emergency Centre for the Mediterranean Sea in Malta, Regional Activity Centre for Marine Pollution Emergency Information and Training for the Wider Caribbean Region on the Island of Curaçao in the Netherlands Antilles and Marine Environmental Emergency Preparedness and Response Regional Activity Centre in the Republic of Korea).

IMO also has established over 60 partnership arrangements for its technical cooperation activities, involving Global Environmental Facility (GEF), Global Industrial Alliance (GIA), International Bank for Reconstruction and Development (IBRD), International Transport Workers' Federation (ITF) and United Nations Industrial Development Organization (UNIDO).

.2 IMO’s Technical Co-operation (TC) Fund.

The TC Fund plays an important role concerning delivery within the Integrated Technical Co-operation Program (ITCP). The (TC) Fund is of particular importance with regard to assistance for developing regions and countries, including implementing actions such as training and institutional implementation. This involves the objective of securing the effective implementation with regard to the implementation of global maritime standards adopted by IMO.

.3 Multi-donor Trust Funds (MDTFs) are established to promote funding with regard to specific issues, and are used to support specific technical co-operation programs with regard to these issues.

.4 Cash donations, for example directed at specific delivery from the ITCP.

62 Funding by Public-Private Partnerships (PPPs) have by the EU been referred to as “forms of cooperation between the public and private sectors for the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service.” (Commission 2004 Green Paper on Public-Private Partnership)

Standard & Poor’s definition of a PPP is “any medium-to-long term relationship between the public and private sectors, involving the sharing of risks and rewards of multi sector skills, expertise and finance to deliver desired policy outcomes”.

PPPs could particularly be relevant in the implementation phase, concerning practical implementing activities necessary to fulfill requirements concerning technical upgrading of port facilities.

These questions need to be examined in further detail at a later stage of the project. The option still adds positively to the possibility of practical benefits realization, and information about this will therefore also add value to the implementation planning phase.

63 As an outcome of the ongoing gap analysis the topics for the risk and cost/benefit analyses will be identified. The end result of these analyses will in turn give input to the Strategy Implementation Plan (SIP). Having identified the issues for the SIP, the details of the funding for development and implementation will equally become more specific. This illustrates how the process will have to be iterative.

66 **The members of the Correspondence Group are invited to give their comments on these first general outlines for the funding.**

**Chapter 10:**

**Summary of actions requested by the Correspondence Group:**

.1 **The members of the Correspondence Group are invited to review the quality of the gap analysis (Annex 1), and eventually to propose alternative practical e-navigation solutions. (§13)**

.2 **The members are also invited to give thoughts to the expected final result set out in the implementation strategy:**

***“A phased implementation schedule along with possible roadmaps”.***

**Which of these practical solutions of the gap analysis should be included in the first implementation phase? And which ones should not?**

**A guideline for this process may be found in the opening address of the Secretary General at the opening of NAV 57:**

***“As intensive work continues on the development and implementation of a global strategy on e-navigation, 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”.* (§14)**

.3 **The members of the Correspondence Group are invited to forward their views and give inputs to issues relevant to e-navigation which might be related to the Scoping exercise of the GMDSS process. (§19)**

.4 **With reference to the gap analysis, i.e. 135-Gte01 of Annex 1,** t**he Correspondence Group is invited to identify future uses of the frequency band of 495-505 kHz which might be relevant for e-navigation. (§21)**

.5 **The Correspondence Group is invited to give comments on which of the relevant practical e-navigation solutions that might contribute to either safety or pollution prevention.**

**The Correspondence Group is further invited to suggest how to combine or redefine solutions that coincide or are similar – upholding traceability to solution origin.**

**The Correspondence Group should also bear in mind the needs for further enhancing efficient maritime navigation and shipping traffic. (§30)**

.6 **The Members of the Correspondence Group are invited to further develop the detailed architecture of both the ship and shore sides, as appropriate, taking into account the outcomes of the gap analysis, using the overarching e-navigation architecture as a framework. (§32)**

.7 **For the development of MSP to achieve harmonization, modernization, integration and simplification on board and ashore, the Correspondence Group is invited to give its general inputs and recommend the approach to be taken. (§34)**

.8 **The members of the Correspondence Group are invited to give their recommendations on the development of guidelines for usability evaluation of navigational equipment and on the approach to be taken. (§37)**

.9 **Within the specific context of the e-navigation gap-analysis, and with reference to Annex 2, - the practical and theoretical limitations of the actual HEAP lead to pose the following questions:**

**.1 Is it possible to define a specific list of human elements to consider in the development of guidelines and regulations at the technical, operational, training and regulatory level?**

**.2 Once the association between the identified gaps and human elements to consider for the development of solutions is carried out, how to verify that solutions are effectively addressing the management of human error?**

**Topics related to HEAP will have to be integrated in the further process of finalizing the gap analysis and identifying RCOs. The members of the Correspondence Group are invited to give their comments and inputs. (§40)**

.10 **The Correspondence Group is invited to consider and to give its comments to**

**this first outline and framework for a communication strategy that will have to be**

**revised and included in the SIP. (§52)**

.11 **The members of the Correspondence Group are however invited to give their**

**comments on these first general outlines for the funding. (§66)**

**ANNEX 2.**

**The Human Element Analyzing Process (HEAP) in e-navigation.**

1 MSC/Circ.878 MEPC/Circ.346, Nov 1998 define the HEAP a practical tool designed to address the human element, to be used for consideration of maritime safety and environmental issues at IMO. The steps outlined in the flowchart list a series of questions that should be considered to appropriately address the human element in the regulatory development process.

2 The circular states also that the guidelines are intended to facilitate trial applications of the HEAP and they should remain interim as long as it is necessary to gain experience. Such trial applications were expected to lead to a greater understanding of HEAP by all parties, and identify improvements to the process. Member governments were invited to carry out trial applications of HEAP and to submit the results to IMO.

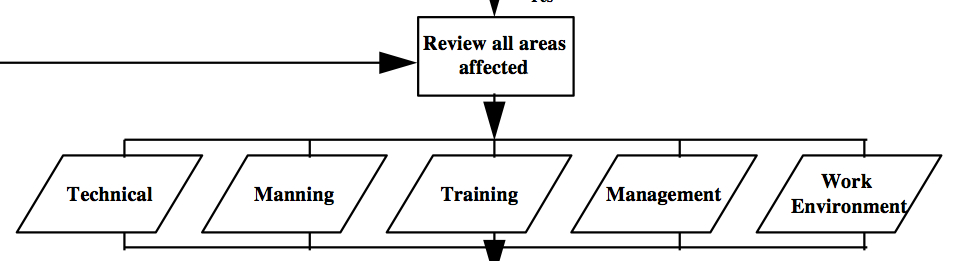
3 According to MSC/Circ.1022 (Guidance on the use of Human Element Analyzing Process and Formal Safety Assessment in the IMO rule making process), the HEAP "is a method developed by IMO for the use of IMO and should be seen as a practical and non-scientific checklist to assist regulators in ensuring that human element aspects related to the ship and its equipment, training, the master and the crew, management ashore and on-board and work environment conditions have been taken into consideration when introducing or amending IMO instruments.

4 The e-navigation Working Group established at COMSAR15 adopted a template for identifying practical e-navigation solutions based on operational, technical, regulatory and training aspects of the gap analysis. It was agreed that the Correspondence Group on e-navigation would endeavor to develop practical e-navigation solutions for gaps taking into account the human element.

5 Yet HEAP has not been used during e-navigation Working Group sessions. To explore HEAP applicability to the gap-analysis, a list of possible limitations follows.

6 The HEAP is designed to assist regulators in ensuring that human element aspects are taken into account across different areas only from a ship-borne perspective. Hence no consideration is given to the ship-shore integration and harmonization which are the basis of the e-navigation concept.

7 In order to “review all areas affected” a classification of human elements is provided at the technical, manning, training, management and work environment level, therefore not consistently with the four levels of the e-navigation gap analysis: technical, operational, training and regulatory.

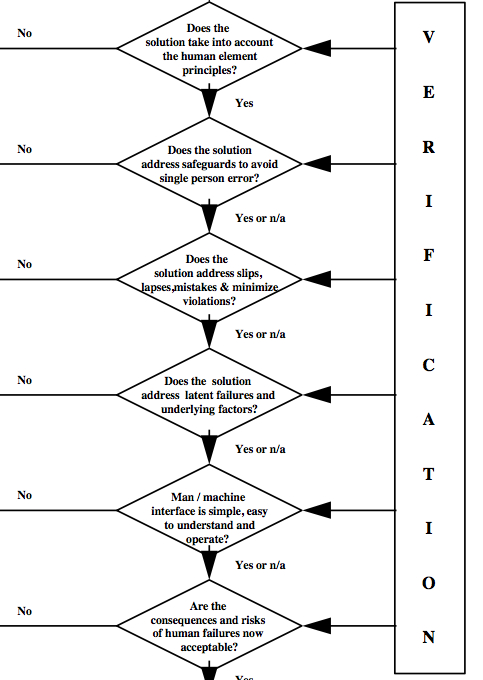


| Technical  (The vessel and/or its equipment) | Manning  (Master and crew of the vessel) | Training  (Ashore and aboard) | Management  (Ashore and aboard) | Work Environment / conditions  (aboard ship) |
| --- | --- | --- | --- | --- |
| Design  Ergonomics  Manufacture  Construction  Installation  Initial and periodic testing  Approval  Maintenance  Repairs  Modifications  Renewals  Expected marine environment  Operations | Qualifications  Number of crew members  Composition of crew  Culture3  Working  Language  Medical  Conditions  Competence | Basic Safety Training  Familiarization  Drills  Extended safety training  Training of personnel ashore | Policy  Safety culture  Motivation  Communication links  Responsibility  Authority  Work planning  Contingency planning  Emergency response  Manuals  Procedures  Instructions  Work methods  Checklists  Education and Training | Hazardous materials  Man-machine interface  Personnel protection  Physical hazards  Hours of work  Hours of rest  Fatigue  Estimated workload  Actual marine environment  Living conditions |

Note: Table created using the list of elements provided by MSC/Circ.878 MEPC/Circ.346 par. 4 (HEAP Human Element Checklist).

8 In the verification phase, where the HEAP user is asked to verify that the safety concerns identified in the original issue were addressed. HEAP proposes also a series of questions designed to ensure that the solution is considering aspects that contribute to unsafe acts and accidents, yet neither a classification of unsafe acts and accidents nor any measurable criteria are provided.

The criteria are to refer to derive from the Assembly resolution A.850-20 (Human Element principles adopted by the organization) according to which *“consideration of human element matters should aim at decreasing the possibility of human error as far as possible”*.



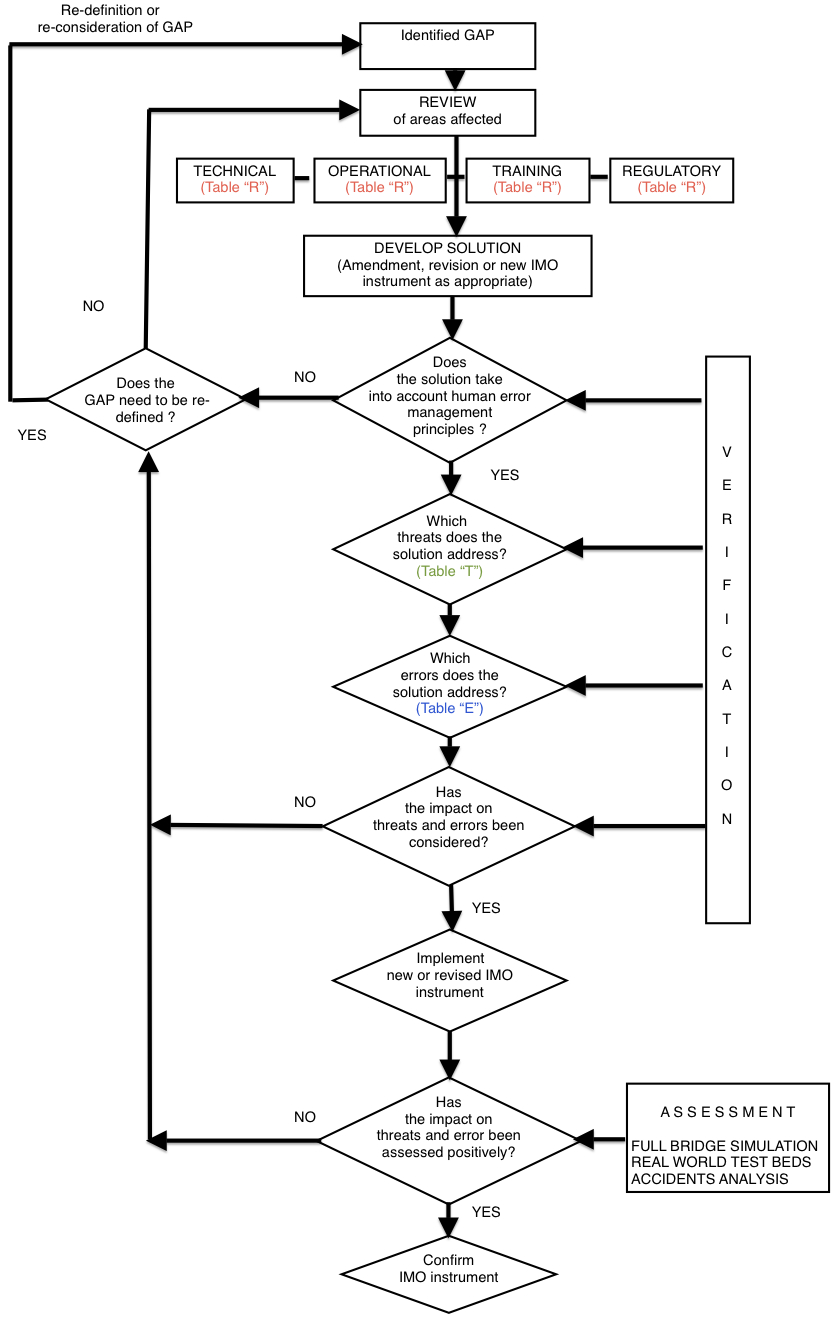
9 This principle is not in line with latest research developments driven by the aviation industry in the area of human error management (not “reduction”) strategies. Historically, safety analyses have considered human error as an undesirable and wrongful manifestation of human behavior. Recent operational research for the aviation industry has provided a different perspective proving that human error is a normal component of human behavior. Human error is inevitable, ubiquitous, impossible to be completely eradicated and can potentially generate negative consequences. Countermeasures to error, including training interventions, should not be restricted to avoiding errors, but rather to making them visible and trapping them before they produce negative consequences. This is the essence of error management: *human error is unavoidable but manageable* (ref. ICAO Line Safety Operation Manual, 2002).

In fact latest generation CRM training intends crew behaviors as countermeasures against errors and strategies to mitigate the effect of their negative consequences.

**HEAP and e-navigation**

10 HEAP applied to e-navigation may be seen as an extension of the actual HEAP.

The flow diagram below exemplifies how the “HEAP e-nav” concept might be summarized:



.1 HEAP e-nav proposes a table of specific human elements to consider while developing guidelines and regulations related to practical e-navigation solution. New elements are introduced in the area of the ship-shore integration. In order to clarify the under laying principles of each element of the table, a short definition will be provided as well.

| Table “R” | | | |
| --- | --- | --- | --- |
| OPERATIONAL LEVEL  interactions between humans and the operational environment | TECHNICAL LEVEL  human-technology interaction | REGULATORY  regulatory style | TRAINING  human-element oriented training |
| OPR1 - Human attention  OPR2 - Mental workload  OPR3 - Decision Making  OPR4 - Situation Awareness Lev 1 (Perception of external cues)  OPR5 - Situation Awareness Lev 2 (Understanding of current state)  OPR6 - Situation Awareness Lev 3 (Projection of current state in future)  OPR7 - Cooperation (Team work)  OPR8 - Language differences (communication breakdowns)  OPR9 - Others (specify) | TCH1 - Software ergonomics  TCH2 - Hardware ergonomics  TCH9 - Others (specify) | REG1 - Prescriptive  REG2 - Performance based  REG3 - Deregulated  REG4 - Industry self regulated  REG9 - Others (specify) | TRN1 - Bridge Team  Management training (BTM)  TRN2 - Shore-based Team Management training (STM)  TRN3 - Bridge-Shore Teams management (BSTM)  TRN4 - Skill-based training  TRN5 - Knowledge-based training  TRN9 - Others (specify) |

Note : a description of the elements of the table “R” is provided at the last page of the present document.

.2 HEAP e-nav offers a classification of threats[[1]](#footnote-1) (table “T”) and errors[[2]](#footnote-2) (table “E”) inspired to the theories of human error management implemented by ICAO within the LOSA (line Operation Safety Audit) system. The lists provided in the tables have been adapted for the use in the e-navigation domain but it is not exhaustive.

The correlation between a set of practical e-navigation solutions and a set of threats and errors could allow the verification of the effectiveness of the HEAP e-nav process. How well a solution is addressing a gap from a human element perspective will depend on the impact the solution has on the successful management of threats and errors to be assessed through:

* *real world test beds;*
* *full bridge simulations and;*
* *accident analysis.*

This approach addresses NAV57/6/2 which states that *“simulation might be used to evaluate the development and usability of e-navigation applications. A procedure has to be developed for testing how to evaluate the various concepts and applications”.*

A sample of possible application of the HEAP e-nav tables to the gap analysis template is shown below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | e-navigation SOLUTIONS | | | |
| OPERATIONAL  Human Element  (Table R) | TECHNICAL  Human Element  (Table R) | REGULATORY  Human Element  (Table R) | TRAINING  Human Element  (Table R) |
| IDENTIFIED GAP  Threats and Errors addressed by the identified set of solutions  T -- (from table “T”)  E -- (from table “E”) | .......  OPR -- (from table “R”) | .......  TCH -- (from table “R”) | .......  REG -- (from table “R”) | .........  TRN -- (from table “R”) |

| **Table “T” - Threats**  Events that originate outside the influence of the bridge team but requires active management to maintain safety | | | |
| --- | --- | --- | --- |
| **Threat categories** | **Definitions** | **Sub-categories** | **Codes** |
| Environmental threats | Situations generated by environmental uncontrollable factors | Adverse Weather and sea conditions  Restricted visibility  High traffic density and restricted waters  Ice conditions  Other ships non-compliant with COLREGs  Piracy  Other environmental threats | T1  T2  T3  T4  T5  T6  T9 |
| Own Ship threats | Situations generated on board own ship but beyond the control of bridge team | Bridge equipment ergonomics (hardware and software)  Integrated Navigation System and sensors malfunction  Radio Communication malfunction  Engineering malfunction  Cargo / Passengers issues  Other ship threats | T11  T12  T13  T14  T15  T19 |
| Operational threats | Situations which generate operational pressure on the bridge team by external and internal influences | Internal management and commercial pressure  Operational information overload  Unfamiliar port  Change of voyage plan  Nautical Charts and Publications accuracy and updates availability  Other Operational threats | T21  T22  T23  T24  T25  T29 |
| Shore support threats | Situations generated by shore parties errors or by the interaction between bridge teams and shore parties | VTS error  Radio communication congestion  Mooring operators error  Tug boat issue / error  Port Authorities error  Other Shore support Threats | T31  T32  T33  T34  T35  T39 |

| **Table “E” - Errors**  Failures, by the bridge team, of planned actions to achieve their desired outcome | | | |
| --- | --- | --- | --- |
| **Error categories** | **Definition** | **Sub-categories** | **Codes** |
| Procedural error  (intentional) | willful deviation from regulations and/or operator procedures | Company checklists  Company bridge procedures  Captain standing orders  Voyage plan  Implicit rules  Other (intentional) procedural error | E01  E02  E03  E04  E05  E09 |
| Procedural errors  (non-intentional) | deviation in the execution of regulations and/or operator procedures. The intention is correct but the execution is flawed. This category also includes errors where a team member forgot to do something | Company checklists  Company bridge procedures  Captain standing orders  Voyage plan  Implicit rules  Other (non-intentional) procedural error | E11  E12  E13  E14  E15  E19 |
| Communication errors | Miscommunication, mis-interpretation, or failure to communicate pertinent information or intentions within the bridge team or between the bridge team and an external party | VTS interaction  Pilot interaction  Interaction with other ships  Bridge team closed loop  Engine control room interaction  Other communication errors | E21  E22  E23  E24  E25  E29 |
| Proficiency errors | Lack of knowledge or psychomotor skills | Collision avoidance  Alarms management  Automation misuse (autopilots and track keeping devices)  ECDIS misuse  Ship-handling  Other Proficiency errors | E31  E32  E33  E34  E35  E39 |

| Code | Element | **Table “R” - OPR codes description** |
| --- | --- | --- |
| OPR1 | Human attention | It refers to the process by which humans can purposefully direct their sensory apparatus towards specific environmental stimuli (not only visual) and direct the focus of their perception. It is commonly accepted that the are three major forms of attention (Sanders & McCormick, 1987):   * selective attention: involves selective scanning the environment and directing the focus of our perception at a number of sequential cues; * focussed attention: involves maintaining the focus of perception on a particular subject; * divided attention: involves “sharing” attentional resources between two or more concurrent tasks. |
| OPR2 | Mental workload | Mental workload can be see in terms of the amount of mental resources available to a person and the amount of mental resources demanded by a task or situation (Sanders & McCormick, 1987). Mental workload is a function of a number of interacting elements of information processing. These include among others:   * attentional demands: whereby the demands of having to pay attention to increasing amounts of information increase overall workload; * multiple competing tasks: whereby increasing the number of concurrent tasks that are required to be performed increase overall workload; * expertise: whereby tasks undertaken by a novice requires significantly more mental resources than the automatized tasks undertaken by an expert.   High workload and complex tasks can be source of psychological stress, as well as sub standard workloads and lack of complexity in a task. Consequently, all can contribute to decrease in performance (Wickens, 1998).  If level of arousal is low and coupled with a complex task, the resulting performance will be poor. Similarly low arousal coupled with a simple task, such as a vigilance task, can be problematic, as evidenced by much research that has found low-arousal environments to be as prone to human error as high workload circumstances (Wickens, 1998). |
| OPR3 | Decision Making | Decision Making is a mental process which involves the selection of an action from a number of alternatives, with a given set of available information and knowledge, a timeframe in which consideration of alternatives is possible, and where the choice is associated with some uncertainty (Wickens et al. 1998). |
| OPR4 | Situational Awareness \*  Level 1 (Perception) | It refers to the perception of the elements in the environment. The first step in achieving SA involves perceiving the status, attributes, and dynamics of relevant elements in the environment (Endsley, 1995). |
| OPR5 | Situation Awareness \*  Level 2  (Comprehension) | Comprehension of the current situation. Comprehension of the situation is based on a synthesis of disjointed Level 1 elements. Level 2 situation awareness goes beyond simply being aware of the elements that are present to include an understanding of the significance of those elements in light of the operator's goals (Endsley, 1995). |
| OPR6 | Situation Awareness \*  Level 3  (Projection of current state into future) | Projection of future status. It is the ability to project the future actions of the elements in the environment, at least in the near term, that forms the third and highest level of situation awareness. This is achieved through knowledge of the status and dynamics of the elements and a comprehension of the situation. both Level 1 and Level 2 SA (Endsley, 1995). |
| OPR7 | Team work | It refers to shipborne and shore-based teams internal cooperation along with the ship-shore cooperation dynamics.  Examples of good behaviours for an effective team work can be categorized in 4 main categories:   * team building; * considering others; * supporting others; * conflict solving. |
| OPR8 | Language differences | Language differences can potentially trigger both communication breakdowns within operators in a team or between different teams while managing routine or contingency response operations. |

|  |  |  |
| --- | --- | --- |
| **Code** | **Element** | **Table “R” - TCH codes descriptions** |
| TCH1 | Software ergonomics | It refers to general ergonomic principles which apply to the design of dialogues between humans and information systems (ISO 9241-110, 2006):  - suitability for the task,  - suitability for learning;  - suitability for individualization;  - conformity with user expectations;  - self descriptiveness;  - controllability; and  - error tolerance. |
| TCH2 | Hardware ergonomics | It refers to anatomical and physiological characteristics of operators interacting with a workstation in their environment (bridges and operating rooms).  Among the physiological characteristics the following should be taken into account when designing bridge or operating rooms layouts:   * human vision: It refers to human visual capacity from the center of the visual field. Color depth perception and visual attention varies with the angle from the the center of the visual field; * hearing: It refers to human capability to detect auditory stimuli from workstations and external environment. Audibility, background noise and intelligibility of sounds should be taken into account as well when considering human hearing capabilities. * tactile senses: it refers to the ability to feel the differences between knobs, dials, controls and buttons. These differences play an important role when visual senses are limited or in high stress/urgency conditions (Grech 2005).   Notwithstanding the human capabilities and limitations of humans, the bridge and operating room layouts should reflect the operational procedures of teams. |

|  |  |  |
| --- | --- | --- |
| **Code** | **Element** | **Table “R” - REG codes descriptions** |
| REG1 | Prescriptive | It specifically refers to carriage requirements, international conventions or any other obligation to comply. |
| REG2 | Performance based | It refers to minimum performance standards and a set of functional requirements for equipment. |
| REG3 | Deregulated | The deregulated approach refers to the removal or simplification of relevant organizations rules that constraint the operation of market forces. |
| REG4 | Industry regulated | The industry regulated approach is based on the principle that spontaneous association of enterprises control their collective action, and propose itself as an alternative to institutional regulations. |

|  |  |  |
| --- | --- | --- |
| **Code** | **Element** | **Table “R” - TRN codes descriptions** |
| TRN1 | Bridge Team  Management training (BTM) | BTM training is concerned not so much with the technical knowledge and skills required to navigate a ship but rather with the cognitive and interpersonal skills needed to manage the navigation within a bridge team.  With reference to IMO STCW code table A-II/2, Annex 2 (“Controlling the operation of the ship and care for persons onboard at the operational and management level”) the competence should be expressed in terms of:  Knowledge and ability to apply effective resource management:  - allocation, assignment and prioritisation of resources;  - effective communication onboard and ashore;  - decisions reflect consideration of team experiences;  - assertiveness and leadership, including motivation;  - obtaining and maintaining situational awareness.  Knowledge and ability to apply decision-making techniques:  - situation and risk assessment;  - identify and consider generated options;  - selecting course of action;  - evaluation of outcome effectiveness. |
| TRN2 | Shore-based Team Management training (STM) | STM training is intended to follow the same concepts of BRM training (see TRN01) and to deliver to shore-based teams working in operating rooms and interacting with bridge teams at sea.  IALA has developed standards for training and certification of VTS personnel (IALA recommendation V-103, Ed.2). IALA recommends that VTS Manager should be able to initiate, lead and implement change and continuous improvements, and to demonstrate leadership skills and management experience. |
| TRN3 | Bridge-Shore Teams Management training (BSTM) | BSTM hypothesizes a new form of integrated training involving joint simulations of ship bridges and shore-based teams (pilots, VTS operators, tug masters).  The most advanced simulation facilities are already integrating these concepts into their BTM courses, yet no formal requirements has been expressed by relevant institutions. |
| TRN4 | Skill-based training | It refers to a training aimed to enhance technical skills which will then develop in “automated” behaviour with little conscious processing of information, problem identification, diagnosis or decision-making involved. It typically reflects the needs of novices approaching new workstations. |
| TRN5 | Knowledge-based training | It refers to a training aimed to enhance the understanding of system characteristics. This involves analysing the information present at a conceptual level, in order to choose the correct action. This level of training will develop operators’ conscious control of navigation systems. |

1. A threat is an event that originates outside the influence of the bridge team but requires active management to maintain safety [↑](#footnote-ref-1)
2. An error is a failure, by the bridge team, of planned actions to achieve their desired outcome [↑](#footnote-ref-2)