The Implementation of e-Navigation

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BIOGRAPHIES

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ABSTRACT

The IMO Maritime Safety Committee will consider a strategy for the implementation of e-Navigation at its meeting one month after this conference. If it is approved that will set in train an evolutionary process towards the future, digital vision for the maritime sector.

e-Navigation's foundations are global communications, electronic navigation charts and electronic positioning and timing. Its pillars are communications, navigation and situational awareness. The man/machine interface is critical to delivering the long-term benefits and human factors will require careful attention.

The e-Navigation concept is based on a distributed information technology system using fixed and mobile telecommunications that links the main stakeholders: national administrations, public maritime service providers, third-party service providers, commercial shipping and leisure users.

This paper will explain the motivation for e-Navigation and the progress from the initial e-Navigation concept to the likely implementation plan. It will go on to describe how e-Navigation may be realised in practice and the benefits to the different stakeholders.

The necessary developments in the key supporting technologies will be assessed, in particular position-fixing and communications. The need for redundancy in position-fixing is recognised, but it is too early to decide on specific systems. The present communications infrastructure will need to be considered and some projections made about the directions needed for future systems to underpin e-Navigation.

A number of application areas will be explored from the e-Navigation perspective, including Vessel Traffic Management, collision avoidance and a risk-based approach to aids to navigation planning.

Finally, some projections will be made as to how the implementation program might progress.

KEYWORDS: e-Navigation; position-fixing.

INTRODUCTION

The IMO definition of e-Navigation is "the harmonised collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment"

The e-Navigation concept is based on robust and redundant positioning, navigation and timing systems, distributed information technology systems using fixed and mobile telecommunications and availability of electronic navigation charts world-wide.

A number of developments are necessary to achieve these essentials and these will be described in this paper, together with some projections as to how the implementation program might progress.

IMO STRATEGY FOR IMPLEMENTATION

At its 54th Session in June 2008, the IMO Sub-Committee on Safety of Navigation agreed a Draft Framework for the Implementation Process for the e-Navigation Strategy [1].

This would include developing an architecture, gap analysis, cost benefit analysis and the creation of a detailed implementation plan. A structured and phased approach would be required to capture evolving user needs, making use of the existing agreed methodology. The strategy implementation plan should include priorities for deliverables and a schedule for implementation and the continual assessment of user needs. The deployment of new technologies should be based on a systematic assessment of how the technology can best meet defined and evolving user needs within the e-navigation concept. The first step in the implementation process, identifying the initial user needs, has been completed.

The architecture, including hardware, data, information, communications technology and software, should be based on a modular and scaleable concept and cater for continued development and enhancement. The initial architecture should be ready for a coordinated review by 2009 and should be completed by 2010.

The initial gap analyses should focus on technical, regulatory, operational and training aspects and be completed by 2010.

Cost-benefit and risk analyses should be used to support strategic decisions as and when certain functions need to be enabled. The analyses should address financial and economic aspects as well as assessing the impact on safety, security and the environment. This should be completed by 2011.

Implementation of the e-navigation plan could begin in 2012 and should include: identification of responsibilities to the appropriate organizations/parties; transition planning; and a phased implementation schedule along with possible roadmaps to clarify common understanding necessary for the implementation.

MOTIVATION

The IMO Sub-Committee also identified [2] the motivation for e-Navigation as "a clear and compelling need to equip shipboard users and those ashore responsible for the safety of shipping with modern, proven tools that are optimized for good decision making in order to make maritime navigation and communications more reliable and user friendly. The overall goal is to improve safety of navigation and to reduce errors." The dangers of an uncoordinated approach were also recognised, "if current technological advances continue without proper coordination there is a risk that the future development of marine navigation systems will be hampered through a lack of standardization on board and ashore, incompatibility between vessels and an increased and unnecessary level of complexity."

BENEFITS

Presenting a convincing cost benefit argument for e-navigation will be crucial to its early introduction and acceptance. Safety is the area in which the most obvious benefits can be foreseen, with reduced groundings and collisions, improvements in accident investigation and effectiveness of search and rescue. Efficiency of operation could be improved with reduced waiting times, lower fuel consumption and better tracking and utilisation of assets. Security will be enhanced, again because of improved tracking and monitoring. Environmental benefits will arise indirectly from the reduction of accidents and more efficient operation of counter-measures.

Values can be put on these benefits, in particular on efficiency of operation. However, such analysis requires resources and these may not readily be forthcoming from the international organisations themselves.

RISK ANALYSIS

IALA is developing methods of planning aids to navigation and other maritime services using risk analysis. Such methods could probably be broadened to encompass e-Navigation.

The European 6th Framework Project MarNIS has also taken a risk-based approach to traffic monitoring and management, proposing that vessels be given a risk rating based on the vessel history and ownership, cargo and distance from coast, related to weather conditions. This rating would be used to raise alerts and plan intervention.

The e-Navigation initiative could use lessons learnt from these studies and build on the work already carried out.

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DEMONSTRATION APPLICATIONS
There are many potential applications for e-Navigation, but proving the principles of operation and demonstrating the benefits will be most effective if concentrated on a few test-bed applications. One obvious area in which to provide such demonstrations would be the Malacca Straits, where the Marine Electronic Highway Project can be seen as a prototype for e-Navigation. The Straits of Dover would be another location in which the benefits of such innovations as Virtual Aids to Navigation could be most effectively demonstrated. Vessel Traffic Management would also have its most obvious benefits in such busy waterways.

NEXT STEPS
The report of the Sub-Committee on Safety of Navigation and the implementation strategy it contains are subject to approval by the IMO Maritime Safety Committee at its 85th Session in late November 2008. The sub-Committee agreed to invite the Committee to request other international organizations to participate in the implementation of e-navigation. IALA has played a significant part in the development of the strategy and is likely to continue to contribute in those areas where it has particular expertise, such as the architecture of the shore-side infrastructure, positioning, navigation and timing systems and communications.

SHORE-SIDE ARCHITECTURE
Considerable progress has already been made on developing a model for the shore-side infrastructure. This work has been carried out within a working group of the IALA e-Navigation Committee and is expected to result in a new IALA Recommendation in 2009/10. An object-oriented approach has been taken, based on the Unified Modelling Language and recognising the importance of application-to-application information flow .

POSITIONING, NAVIGATION AND TIMING
PNT is being dealt with a by another working group of the IALA e-Navigation Committee, which is formulating a World Wide Radio Navigation Plan (WWRNP), encompassing all candidate systems.
This WWRNP is being developed by IALA to assist in defining the position-fixing systems required to support e-Navigation. One key concept in this Plan is the separation of the generation of correction data from the means of transmission, to facilitate broadcasting by a variety of methods. This could lead to the integration of terrestrial systems (DGNSS beacons, eLoran, AIS) to provide shared data channels and common correction sources, as well as additional ranging signals, contributing to a redundant position-fixing solution, complementary to, but independent of GNSS.
This Plan is expected to be completed by the end of 2009 and will include recommendations on the systems and combinations of systems that could best meet the e-Navigation key strategy element, based on the user requirement for position-fixing systems that meet user needs in terms of accuracy, integrity, reliability and system redundancy in accordance with the level of risk and volume of traffic.

COMMUNICATIONS
A third IALA working group is just starting work on the preparation of a communications plan to support e-Navigation. This is intended to meet the key strategy element of identifying communications technology and information systems to meet user needs. This may involve the enhancement of existing systems or the development of new systems. The IALA work will start by identifying existing and future systems, then drawing on the user requirements already identified, will assess the information flows and the data channels needed. It is expected that a working plan can be achieved by the end of 2009.

IMPLEMENTATION PROSPECTS
The expectation is that IMO MSC will approve the implementation strategy proposed by the NAV Sub-Committee. The timescale for an implementation plan by 2012 appears to be quite realistic, given that IALA expects to provide viable proposals for PNT and communications by 2010 and that IHO reported to NAV 53, "There would be adequate coverage of consistent ENCs by the time any further mandatory carriage requirements were likely to be adopted by IMO".

The work on an architecture for the shore-side is well advanced and the results of this work will be available to assist with development of the ship-borne architecture.
There will be a need to work out a method of carrying out and funding the cost-benefit and risk analyses, but the actual work should not present any insuperable problems.

CONCLUSIONS
Development of the implementation strategy for e-Navigation is progressing well in IMO.
Work on several of the key supporting elements is underway in IALA and will be completed in time to meet the proposed timescale.

REFERENCES
1. IMO Sub-Committee on Safety of Navigation, Report of the 54th Session, Annex 13, June 2008.
2. IMO Sub-Committee on Safety of Navigation, Report of the 54th Session, Annex 12, June 2008.