CORRESPONDENCE WITH Mr Jerzy Graff – Submitted by IHB

In mid 2008 the IHB received an email from Mr Jerzy Graff of BMT Ltd, UK. Requesting IHB input prior to his submission of a paper to an appropriate hydrographic publication. The IHB had some misgivings about the matters raised in the paper and there followed an exchange of emails between Mr Graff and the IHB. The IHB informed Mr Graff that his paper and comments would be passed to the TWLWG (Tidal Committee at that time).

The collection of correspondence is attached at the Annex to this document and the TWLWG is invited to comment as appropriate.

Jerry.txt

Subject: e-Navigation & operational forecasting
Date: Wed, 23 Jul 2008 19:21:09 +0100
Message-ID: <5706FF88191D5846A802DB1BBD5B437F4BEF3C@bmthp7.bmt.org>
X-MS-Has-Attach:
X-MS-TNEF-Correlator:
Thread-Topic: e-Navigation & operational forecasting
thread-index: Acjs8OE9u1p2QMmkTFqQzGbq2no2Rg==
From: Jerzy Graff <jgraff@bmtmail.com>
To: <info@ihb.mc>
X-Virus-Scanned: by amavisd-new
X-UIDL: [jE"!QF;!!g?"#!C4X!!

President and Directors;

Sirs – I respectfully bring to your attention the impact of climate change on tidal predictions and the implication on accuracy of such information mandated under carriage requirements of SOLAS Ch V/2000 Regulation 27: namely – tide table and tidal stream publications.

I would contend that it is timely to investigate adoption of operational ocean forecasts within context of the emerging IMO e-Navigation strategy with a view to establishing a regulatory framework governing use of (for navigation) next-generation tide and current information.

I attach copy of paper on the topic I presented at last year's TRANSNAV conference in Gdynia. The paper is now slightly out of date and needs updating to include S-100 implication and advances in forecasting.

With appropriate revision I would like to submit the paper to an appropriate hydrographic publication with view to opening public debate; however I would first be grateful to receive IHO comment and advice beforehand.

Regards

Jerzy

Jerzy Graff

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Paper_jgraff_TRANS NAV 2007_Proceedings.pdf

The role of operational ocean forecasting in e-navigation

J. Graff
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ABSTRACT: Advances in ocean modelling have led to improved performance for operational ocean forecasting and the availability of continuously reliable forecast information for certain ocean regions of the world. Although such forecasts are being increasingly adopted into a wide range of services across the maritime industry they have not yet been considered as candidates to supplement or to substitute conventional tide tables for navigation use. The issue is important in the context of climate change and the added uncertainty now placed on the use of conventional tide table for navigation in complex coastal waters. In the context of e-navigation it is timely to begin to explore the issue and examine how such forecasts might be used and adopted. This requires closer connectivity between ocean forecasting and navigation communities and the involvement of overarching organisations such as IMO and I GOOS. This paper raises the issue and opens the debate.

1 INTRODUCTION

Climate change driven by global temperature rise is producing increasing variability of seasonal weather and a marked increase in the frequency and severity of storms. The consequential impact on the oceans is significant, leading to global sea level rise, abnormal coastal flooding and complex behaviour of tides and currents in coastal waters. For navigation, especially in coastal waters, weather forecasts are becoming increasingly important and the need for a navigator to estimate the deviation of true water levels and true currents from those presented in official tide tables is paramount. The accuracy of model generated ocean forecasts has improved substantially over recent years and operational services are becoming increasingly available especially in context of national flood tide warning, marine search and rescue, port approaches and offshore operations. Advances in satellite based internet broadband directly enable web service delivery of data and information which contributes to a new emerging framework for e-navigation that offers possibility for integrating operational ocean forecasts into onboard ECDIS systems. This paper raises the concept of adopting operational ocean forecasts as a formal component of ECDIS and introduces some of the main issues to be considered.

2 SEA LEVEL AND CLIMATE CHANGE

According to the forthcoming fourth IPCC report (IPCC 2007 WG1 Release, 2007); “at continental, regional and ocean basin scales, numerous long-term changes in climate have been observed. These include changes in arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones. Global average sea level rose at an average rate of 1.8 [1.3 to 2.3] mm per year over 1961 to 2003. The rate was faster over 1993 to 2003: about 3.1 [2.4 to 3.8] mm per year. Whether the faster rate for 1993 to 2003 reflects decadal variability or an increase in the longer-term trend is unclear. There is *high confidence* that the rate of observed sea level rise increased from the 19th to the 20th century. The total 20th-century rise is estimated to be 0.17 [0.12 to 0.22] m.” The implication for the next century to 2100 suggests that tropical cyclone intensity and extreme sea level frequency will increase and mean sea level will rise 20 - 60 cm.

3 TIDE TABLES FOR NAVIGATION

The SOLAS 1974 Convention governing *Safety of Life at Sea* provides a comprehensive set of regulations made up of XII chapters. Chapter V – *Safety of Navigation*; identifies certain navigation safety services which should be provided by Contracting Governments and sets forth provisions of an operational nature applicable in general to all ships on all voyages. This is in contrast to the Convention as a whole, which only applies to certain classes of ship engaged on international voyages.

Chapter V was updated in 2000 to take account of new digital technologies and evolution of *Electronic Chart Data Information Systems* ECDIS developments.

SOLAS Ch V/1974 *Regulation 20* pertaining to *Nautical Publications* was revised and updated as SOLAS Ch V/2000 *Regulation 27: Nautical charts and nautical publications, such as sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyage shall be adequate and up to date. Regulation 27* is supplemented by an *Annex 3: Nautical Data and Publications* which incorporates *Regulation 19.2.1.4* that specifically lists *Tide Tables and Tidal Stream Atlases* as publications required onboard.

Whereas the SOLAS Convention and its Regulations come under the auspices of the *International Maritime Organisation* IMO, the governance of navigation charts and tide tables comes under the auspices of the *International Hydrographic Organisation* IHO with important scientific input addressing mean sea level and tidal monitoring contributed under the auspices of the *International Oceanographic Commission* IOC.

Tide tables themselves are a responsibility of individual countries that are required to ensure adequate provision of information to ensure safety of navigation in their national waters. The UK Hydrograghic Office has traditionally provided a global coverage of tide table data in addition to that for UK waters only. Nowadays, most countries with extensive coastlines have the capacity to produce their own national tide tables with UK and USA providing greater global coverage. However, whereas tables providing tidal height predictions are easily produced, increasingly accurate and readily available, the same is not true for tidal stream atlases which are still based on rudimentary tidal chart data and increasingly outdated content of the important *Pilot* publications.

Currently, the carriage and usage of tide table and tidal stream atlas data by vessels for navigation seems to be very varied with no overall governance pertaining to use of best available data or guidance as to its interpretation. National hydrographic authorities such as USA, UK, Australia and New Zealand are increasingly making their national tide table predictions available freely over the internet and other internet sites such as www.mobilegeographics.com using XTide software can now be found offering tide table predictions on demand for almost any global locations. However, a quick look at freely available predictions for the same port from three different sources show differences that suggests a need to address the question of compatibility and compliance. In congested coastal regions and major port approaches pilotage is already being facilitated by access to real-time readout from regional tide gauges or current meters. In operational engineering environments sensitive to sea state such as offshore construction or large structure tow-out, the provision of numerical model based sea level and current forecasts, allowing for non-tidal effects, is already an established requirement.

The increasing access to a widening range of *tidal predictions* that may be used for navigation is a situation that has to be recognised as a potential problem and one that has to be addressed.

4 OPERATIONAL OCEANOGRAPHY

Advances in ocean modelling have led to radically improved performance for operational ocean forecasting and the availability of continuously reliable forecast information of sea levels and currents for certain ocean regions of the globe. In Europe which is well served by its national forecasting agencies work is advanced in moving towards a unified approach for providing operational ocean forecast coverage for regional European Seas and Atlantic waters. Similar capacity exists amongst national forecasting agencies in other parts of the globe such as USA, China, Japan and Australia. Although such ocean forecast data are being increasingly adopted by industry to meet marine operation needs ranging from search and rescue to ship routing and tow-out they have not yet been considered as candidates to supplement or to substitute conventional tide tables for navigation. Part of the reason may be to do with the complex make-up and uncertain positioning of GOOS *the Global Ocean Observing System*, which is a permanent global system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide. Connectivity between GOOS and IMO/IHO is clearly lacking.

The intergovernmental IOC-WMO-UNEP Committee for GOOS (I-GOOS) was initially established by the IOC Executive Council at its twenty-fifth Session (Paris, March 1992) as the IOC Committee for GOOS (resolution EC-XXV.3), to, *inter alia*, replace the Committee on Ocean Processes and Climate. WMO and UNEP agreed to co-sponsor the Committee in 1993.

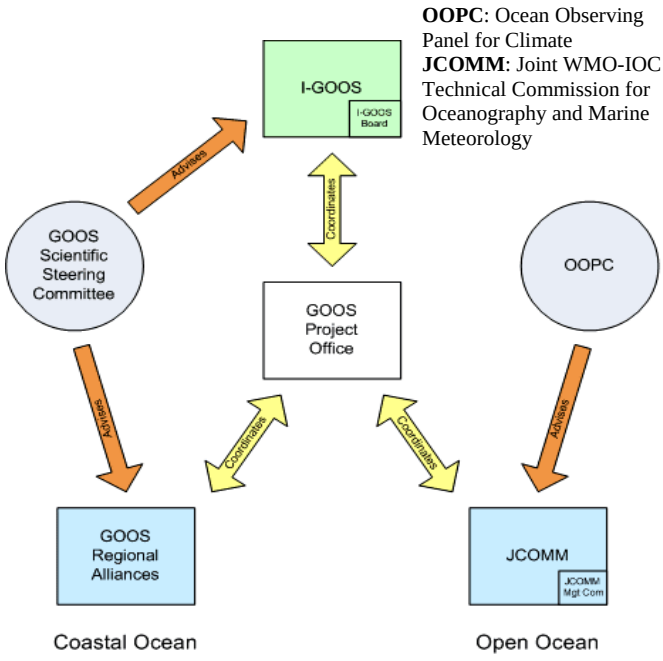
GOOS is not an entity but is a platform for:

- International cooperation for sustained observations of the oceans
- Generation of oceanographic products and services
- Interaction between research, operational, and user communities

GOOS is implemented by:

Member states via their government agencies, navies and oceanographic research institutions working together in a wide range of thematic panels and regional alliances.

The complex structure of GOOS is illustrated in Figure 1 below.



OOPC: Ocean Observing Panel for Climate
JCOMM: Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology

Fig. 1. Structure of GOOS from www.ioc-goos.org

The GOOS Project Office is the organizational and coordination hub of GOOS. The office is hosted within the IOC/UNESCO headquarters in Paris, France and is funded by UNESCO/IOC, USA, UK, UNEP and WMO.

The nature of GOOS implementation mechanism, as highlighted above in italics, together with the dual domain services vision responsibility, for coastal and open oceans, as indicated in Figure 1, creates a highly confusing picture with regard to figuring out - how the national ocean forecast service providers (mainly the Meteorological Offices) should be connected with the IMO SOLAS navigation requirements? In other words – how to create a suitable IMO-I GOOS-IHO partnership that will help to realise modern tidal navigation needs?

5 E-NAVIGATION

The IMO Maritime Safety Committee (MSC) at its 81st session in May 2006 decided to initiate a high priority item on "Development of an e-navigation strategy", with a target completion date of 2008. The aim is to develop a strategic vision for e-navigation, to integrate existing and new navigational tools, in particular electronic tools, in an all-embracing system that will contribute to enhanced navigational safety while simultaneously reducing the burden on the navigator. E-navigation would thus incorporate new technologies in a structured way and ensure that their use is compliant with the various navigational communication technologies and services, such as ECDIS, that are already available, providing an overarching, accurate, secure and cost-effective system with the potential to provide global coverage for all ships.

E-navigation compliments the emergence of the term *Marine Electronic Highway* MEH (Sekimizu et al 2001, Gillespie 2005) and the initiation in 2006 of a key MEH pilot demonstration project in the Straits of Malacca and Singapore. The four-year regional demonstration project aims to link shore-based marine information and communication infrastructure with the corresponding navigational and communication facilities aboard transiting ships, while being also capable of incorporating marine environmental management systems. IMO state that “The overall system - would also include positioning systems, real-time navigational information like tidal and current data, as well as providing meteorological and oceanographic information …”

Development of an e-navigation strategy by IMO is currently under active discussion with responses now in place for reporting back to the IMO NAV53 meeting in July 2007. As of 20th April 2007 there are 66 response documents posted on the IHO web site, one of which; the *IALA Definition and Vision for E-Navigation*, posted 29th March 2007 (IALA 2007) presents a descriptive model for e-navigation that clearly highlights inclusion of oceanographic predictions as input for creating operational navigation information in an e-navigation context. Key applications identified by IALA are route planning, under keel clearance, berthing and SAR response. Bearing in mind the important role played by IALA *the International Association of Marine Aids to Navigation and Lighthouse Authorities* in driving the adoption of key technology applications such as VTS *Vessel Traffic Systems* and AIS *Automatic Identification of Ships*, its contribution highlighting oceanographic predictions, ie., *operational oceanography*, should be treated with great seriousness and should be considered as the opening to develop

inclusiveness of the GOOS community into the e-navigation framework. It is noticeable that amongst the 66 contributing responses on e-navigation posted on the IHO web site that reflect world-wide participation, I could not identify any representatives of the GOOS community.

6 CONCLUSIONS

The maritime community is currently in the process of establishing a strategy for adoption of e-navigation as an enabling framework for integration of new forms of technology and information to aid and enhance safety of navigation world-wide. A key component for safe navigation is the use of best available tide and current predictions. In the context of climate change and its impact on the seas it is necessary to consider how operational ocean forecasts might supplement or replace onboard tidal publications. The global ocean modelling and forecasting community GOOS is advancing and improving capacity to provide operational forecasts. Currently the GOOS community and the maritime navigation community are not closely connected; it is timely that closer connectivity should be encouraged. The following three recommendations are proposed.

1. In view of the increasing availability of tidal predictions over the internet it seems necessary to develop guidelines governing use of these data for navigation.
2. Consideration should be given to the use of operational ocean forecasts for navigation and a strategy should be developed for their adoption and use.
3. Formal cooperation between the maritime navigation community represented by IMO, IHO and IALA and the operational ocean forecasting community represented by I GOOS should be established as a matter of priority.

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Letter from IHB to Jerzy Graff

Dear Jerzy,

Sorry for the delay in replying, but holidays and international meetings have kept the relevant members of the staff apart for several weeks.

Thank you for forwarding your thoughts on the subject of tidal modelling and its practical application. Having studied your paper we have the following comments:

1. Do you have any evidence that there are problems with the current arrangements? Have there been complaints that tidal predictions are inadequate?
2. Our current thinking is that the best way forward in the longer term would be for the transmission, and inclusion within e-navigation, of real time water level information coupled with local water level models where necessary, rather than the provision of another modelled and predicted value. Do you have any thoughts on the pros and cons of this approach?
3. We feel that if there is a problem that needs to be corrected then the best approach would be for you to develop your work further so that it would justify a proposal for a new work programme item, to be considered by our "Hydrographic Services and Standards Committee (HSSC) This is the successor to the CHRIS Committee which is due to have its final meeting in the near future. HSSC could then instruct the Tidal Working Group, and others if appropriate, to address the issues.

We look forward to hearing your views on this.

Best wishes

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Reply from Jerzy Graff

Stephen – sorry for delay in replying but have held back to see outcome of several recent meetings regarding next stage of operational services development for ocean forecasts. My reply comments are inserted against your ones below.

As I note in my final comment below – I would be very happy to assist.

Regards

Jerzy

From: pah [mailto:pah@ihb.mc]
Sent: 24 August 2008 12:26
To: Jerzy Graff
Cc: 'ihb'
Subject: e-Navigation & operational forecasting

Dear Jerzy,

Sorry for the delay in replying, but holidays and international meetings have kept the relevant members of the staff apart for several weeks.

Thank you for forwarding your thoughts on the subject of tidal modelling and its practical application. Having studied your paper we have the following comments:

Do you have any evidence that there are problems with the current arrangements? Have there been complaints that tidal predictions are inadequate?

I don't believe that the issue of gathering evidence of problems with current arrangements is really relevant. Bearing in mind that current SOLAS regulations for carriage of tide table data are unchanged over many years while science and technology progress is unabated I do believe that it is time for a serious review of the status of onboard tide prediction requirements and how best these might be delivered within an IMO-IHB strategy framework. I agree with your following point that that such information has to be delivered within e-Navigation but the exact form of data and information to be delivered has to be carefully examined to ensure that accords with real needs and equally accords with the science and technology advances available. For example we have to take into account:

- Increase in global storminess and changes in weather pattern have a direct influence in modifying certain tidal constituents that reflect measures of these effects namely; Sa, Ssa, Mn, Msf as well as the appropriate mean sea level or mean current speed offset required for tidal table prediction. It will take several years of concerted data monitoring effort and their analysis to identify the scale of variation and consequential impact on tide table integrity. This issue merits appropriate action.
- In tropical monsoon regions climate change effects can be highly magnified and transitory leading to inadequacy and inappropriateness of conventional tide tables - especially in strategic choke points areas such as Malacca Strait. A more immediate solution for some form of improved forecast of sea levels and currents is required. This issue merits appropriate action.
- Currently there is a large open source of global tide table predictions available freely over the internet that cover both official providers and unofficial providers. In some cases the provider (e.g., XTide) is understood to use prediction method and harmonics compatible with official tide table providers such as UKHO charge based EasyTide. In other cases highly credible tide prediction software is made available to users. Comparison shows that predictions from different providers for same port locations can differ. No formal restrictions prevail governing use of available tide predictions and no guidance exists governing interpretation of predictions. With increasing internet access and competitiveness for tide information service provision it seems necessary to review and re-assess the whole issue of tide table production and usage for navigation.

- The European EU Integrated Maritime Policy action plan highlights the importance of integration and cross-over between marine science research and maritime technology as key to innovation and crucial for the sustainable development of sea based activities. In this context we include; maritime transport, port and maritime security, coastal and marine space stewardship, and the interchange of data and information amongst them. This lends itself to adopting e-Maritime (see my attached article) as the framework for integrating marine science derived services such as ocean forecasts (a unified European operational core service nearing completion to support downstream maritime information needs – see next bullet below) with formal IMO e-navigation services in a structured way. Bearing in mind that the issue of operational forecasts have already been identified by IALA as being part of the IMO e-navigation strategy – the European EU-IMP plan presents a timely action with which IMO-IHB might wish to align. Considerable benefits from such an alignment could arise.
- As result of climate change concerns the development of operational ocean forecasting has progressed rapidly in recent years and very advanced capabilities exist variously in USA, Europe and Japan. Coordination of emerging core services is being encouraged by JCOMM (WMO-IOC joint initiative http://www.jcomm.info/) and supported within the I-GOOS framework. Europe is playing a key role in developing a global approach to ocean forecasting and since 2003 under the EU GMES (global monitoring of environment and security) programme some 50M€ has been invested in creating a unified European core service for provision of operational ocean forecasts. The programme is now entering its final 2 yr phase of service implementation under the 25M€ MyOcean (part of GMES) project in readiness for uptake by downstream service providers to the maritime industry. The players in the programme (e.g., MyOcean) include the principal marine science institutes responsible for underpinning tide prediction research used for producing tide tables (e.g., POL, IFREMER) as well as national forecasting agencies (e.g., UK Met Office, MeteoFrance).
- More importantly:- On 16 September 2008, the United Nations World Meteorological Organization (WMO) and the International Organization for Standardization (ISO) signed an agreeement to cooperate in **setting international standards for meteorological and hydrological data, products and services.** This highlights the importance of the emerging scenario and need for urgent alignment by IHB.

Our current thinking is that the best way forward in the longer term would be for the transmission, and inclusion within e-navigation, of real time water level information coupled with local water level models where necessary, rather than the provision of another modelled and predicted value. Do you have any thoughts on the pros and cons of this approach.

- Essentially this is an OK proposition but it has to be examined within the context of operational forecast (tide prediction) capability and governance that exists for the location in question. For example there has to be some sort of governance of standards in place (as proposed recently by WMO-ISO) that will approve use of models for coastal navigation aid. Such models can vary from full scale operational forecasts provided by national agencies that assimilate coastal tide gauge data into the modelling procedure - to locally specific forecast models that combine conventional tide predictions with reference TG water levels using a site specific predictor algorithm. Either way – a scientific judgment has to be made to approve the use of a method that replaces or supplements official tide prediction data. It is not appropriate to leave such decisions to be made by individual port or coastal authorities or shipping bodies – guidance has to be initiated at IHB-IMO level.
- The case of currents is different altogether – they are highly sensitive to changes in weather and climate change is creating a major and serious impact. Existing tidal current prediction data and tables are extremely varied and generally outdated, unreliable and wholly inadequate for use by shipping today. Yet the need for accurate current predictions is becoming increasingly important for safe movement of tankers and large carriers in shallow coastal waters. On a global scale there is need to look at mapping seasonal residual flow field derived from ocean climate models to provide guidance for navigation. In coastal regions the problems are different but nevertheless currents lend themselves quite easily to local prediction schemes that assimilate reference data in various ways; the results computed locally/regionally can then be routed for transmission to ships within an e-navigation frame. The issues here revolve around the question – are current predictions to be mandated by IMO ? are they to be considered part of e-navigation or a separate e-maritime service?

We feel that if there is a problem that needs to be corrected then the best approach would be for you to develop your work further so that it would justify a proposal for a new work programme item, to be considered by our "Hydrographic Services and Standards Committee (HSSC) This is the successor to the CHRIS Committee which is due to have its final meeting in the near future. HSSC could then instruct the Tidal Working Group, and others if appropriate, to address the issues.

- There are problems and new issues to be addressed rather than corrected. I have tried to indicate some of the issues that are arising and highlight the rather dynamic situation that is underway. I do believe that there is a need for IHB-IMO to reassess the whole situation of predications for navigation and to put in place an appropriate programme that will be in keeping with the issues I highlight above and fit into the e-navigation/e-maritime frame.

  I am extremely well connected across all the modern issues mentioned above and have maintained my interest in tidal science since heading up the UK responsibility for global tidal table production back in the early 1970's (1973-81 head of tidal computation division at IOS Bidston Observatory) and I would be very happy to become involved in helping to develop an appropriate IHB initiative.

e-Maritime – An Enabling Framework for Knowledge Transfer and Innovative Information Services Development Across the Waterborne Transport Sector.

Jerzy Graff BMT Group[1]

Introduction

In the last few years the impact of digital technology and relevance of a marine spatial data infrastructure has began to be increasingly felt across the whole maritime community bridging waterborne and coastal activities. In the waterborne sector the demands for improved navigation safety and security have introduced new monitoring technologies such as AIS and LRIT and stimulated demand for ocean-wide web service access for supporting data and information which can be integrated with electronic navigation charts ENC and displayed using onboard electronic chart data information systems ECDIS. This is especially important in the context of climate change and need to have access to accurate weather and sea state (tides, currents, waves) forecasts; identified as "marine cores services" of the programme GMES (Global Monitoring of Environment and Security). A new version (S-100) for the digital code structure of ENC's which is "open standards compliant" now paves the way for a new generation of ECDIS systems that can exchange data with coastal GIS databases and operational forecasting centres and provide a gateway for other decision-support information services. In the European context this provides the framework to begin building a structured approach to marine stewardship which extends the INSPIRE Directive into the maritime zone, connects more closely with coastal navigation and integrates with GMES. The Marine Electronic Highway MEH pilot project currently being implemented by the International Maritime Organisation IMO in the Malacca Strait represents an important first step in prototyping some of these ideas which were first mooted in the MEH vision in 2001 (ref. 1,2). The EC development initiative "Motorways of the Seas" MOSS for Europe (ref. 3) which is also now under way is an important parallel to the IMO MEH initiative. The evolution of e-Maritime from e-Navigation offers a new embracing framework for ICT knowledge transfer and innovation across the WATERBORNE Strategic Research Agenda addressing the VISION 2020 targets.

e-Navigation

In recognition of the need to embrace new digital technologies the IMO embarked in 2005 on developing an e-Navigation strategy by 2008 that will provide the framework for new digital services adoption across the maritime transport community (ref. 4). IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) was charged by IMO with developing the e-Navigation standards. The latest definition was agreed at the IALA e-Navigation Committee (e-NAV2, 19-23 March, 2007 in Southampton). It reads:

"E-Navigation is the harmonised collection, integration, exchange and presentation 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"

E-Navigation is underpinned by 7 points that have to be considered in an integrated fashion.

1. Electronic charts and weather information
2. Electronic positioning signals
3. Electronic information on vessel route, course, manoeuvring etc.
4. Transmission of positional and navigational information
5. Display of information
6. Information reporting, prioritisation and alert capability
7. Transmission of distress alerts and maritime safety information

e-Maritime

Although conceived to improve the safety and security, e-Navigation also has a potential to increase efficiency and performance of ship operations, which is the main consideration for ship-owners, operators and their service providers e.g., minimise fuel consumption and mitigate emissions.

In 2006 the EC started considering e-Navigation in parallel with IALA and tasked the FP6 MarNIS (Maritime Navigation Information Services) project with developing an e-Navigation vision. The MarNIS e-Navigation Task Force meeting (Oslo, 18.09.2006) revised the concept of e-Navigation to address:

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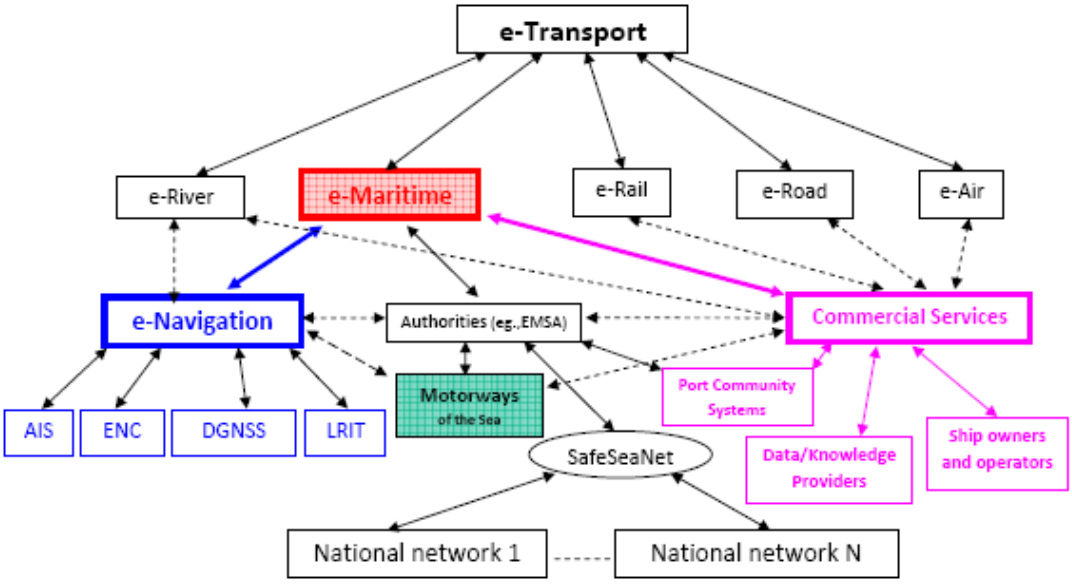
- to minimise navigational errors, incidents and accidents;
- to protect people, the marine environment and resources;
- to improve security;
- to reduce costs for shipping and coastal states; and
- to deliver benefits for the commercial shipping industry

The last two points extend e-Navigation into a system termed e-Maritime. There is an important and provides a clear distinction between the two.

E-Navigation (protocol oriented) is to ensure provision of navigational data and information, also from / to Aids to Navigation etc., in a standardised/harmonised way to facilitate common interpretation of said navigational data and information.

E-Maritime (system oriented) is the promotion of the use of all maritime data and information, and the distribution thereof, to facilitate maritime transport and provide value added services to improve the profitability of shipping.

The aim of e-Maritime is to deliver benefits to the public, transport consumers, public authorities and the maritime community, by means of ICT and to offer a framework for commercial services. A schematic of the e-Transport overview showing e-Navigation and e-Maritime components is presented below adapted from the 2007 Pillich paper (ref. 5).



The diagram highlights the role and complimentarity of e-Maritime as an important overarching framework that brings together a diversity of technologies to enable Motorways of the Seas, namely waterborne transport, with the benefit of latest advances in ICT and marine science knowledge.

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4. IALA 2007. The IALA Definition and Vision for E-Navigation. e-NAV2-output 11, 2007.
5. Pillich, B. 2007. Developing e-Navigation, the early stages. U.S., Hydro Conference, 2007.

Reply from the IHB

Dear Jerzy,

Thank you for the extensive reply to our questions. Whilst accepting some of the points you raise we still have concerns that this is an answer looking for a problem. We would make the following observations:

- SOLAS V/9/2.2 requires contracting governments to provide tide tables to satisfy the needs of safe navigation.

- SOLAS V/9/3 requires contracting governments to ensure the greatest possible uniformity in charts and nautical publications, and in a footnote refers to the resolutions and recommendations of the IHO.

- SOLAS V/19 requires ships to carry these publications appropriate to the intended voyage.

- IHO resolution A2.5 adopts LAT as chart datum and says that this should be used for tidal predictions where tide is appreciable. The resolution also sets out the basis for establishing the value of LAT and this is based on long term data in order to remove the variable effects of meteorological conditions. Many HOs have or are in the process of converting their charts and tidal predictions to LAT.

- Tidal predictions are not perfect; they of course depend on the quality, and time span, of the observations from which they are computed. However given average meteorological conditions they are generally reliable. As we said in our earlier reply we are not aware of any complaints about the current status of tidal predictions.

- "Operational Forecasting" is another prediction method. Has it been demonstrated that this can provide better long term results that the current tidal predictions? Whilst most would accept that meteorological forecasts have improved significantly over recent years they are still far from perfect, especially in a temporal sense. Consequently there will be issues with the prediction of water levels and flow based on these forecasts.

Our view remains that tidal predictions, on the understanding that meteorological conditions cause some variation, are appropriate for safe navigation. Ideally in the future those more critical areas, e.g. the Malacca Straits, will be covered by real time water level monitoring and transmission. Notwithstanding these views we will ensure that your comments and paper are brought to the attention of the Tidal Committee. We are keen to keep our minds open to technological developments that will improve safety of navigation and protection of the marine environment.

One final comment on the paper, in the section on e-navigation you say "IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) was charged by IMO with developing the e-Navigation standards." This is not true. The IMO Maritime Safety Committee (MSC) recognising the need for an e-navigation strategy tasked its Sub-Committee on the Safety of Navigation (NAV) to develop a strategy for e-navigation. This NAV has done and a draft strategy and proposal to develop an implementation plan will be considered by MSC later this year. IMO has acknowledged the input and contributions made on this matter by both IALA and IHO but at no time has IMO tasked IALA to develop standards.

Regards
Steve