

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

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ABSTRACT: The economic and social impact of the waterborne sectors in Europe cannot be overstated, employing directly more than 3 million people and generating a turnover of about €250 billion representing more than 1% of the EU's GDP. In order to maintain its leadership and competitiveness, Europe must take advantage of new market opportunities and address these challenges by means of focused research, development and innovation. In recent years the impact of digital technology and relevance of geospatial information has been increasingly felt across the whole maritime community bridging waterborne and coastal activities. The challenge for the maritime and marine science communities is to accelerate the transformation of the maritime sector into one that is able to exploit market-led opportunities and create high value added outputs that fully embraces technological and scientific advances. e-Maritime offers itself as the enabling framework.

1 INTRODUCTION

In the last few years, advances in digital communication, ocean climate modelling and earth observation systems have begun to have an increasing impact across the whole maritime community bridging waterborne and coastal activities.

1.1 *Environment and Security*

In the waterborne sector the demands for improved navigation safety and security have introduced new ship monitoring technologies such as AIS and LRIT and stimulated demand for increased coverage and accuracy of satellite observations. Concern about pollution impact and consequence of oil spills, ballast waters and ship emissions have introduced policy driven information requirements associated with a raft of new compliance legislation arising from; MARPOL (Annexes I, VI), Ballast Waters Management Convention 2004, UK Marine Bill (UK Marine Bill 2008) and the new Integrated Maritime Policy for the European Union (EU 2007) which covers coastal protection and maritime transportation. In the context of climate change there is a growing need to have access to accurate weather and sea state (tides, currents, waves) forecasts as input to data-driven services such as oil spill monitoring, ballast

waters dispersion and global ship routing. These strategic baseline data have been identified as "marine core services" under the European FP7 development programme GMES (Global Monitoring of Environment and Security) which has been ongoing since 2000.

1.2 *Marine Stewardship*

In response to the need for increasing levels of information addressing state and sustainability of the marine environment to support local, regional and national policy the concept of *Marine Stewardship* has in recent years started to take on an important new meaning and dimension (Graff 2006). Although *Marine Stewardship* has a country by country interpretation there is common emphasis on importance of the spatial data domain and a growing recognition that governance, interoperability and information services are key underpinning features. At the European scale the development of a new digitally based geospatial information philosophy is being supported under the European Commission INSPIRE (Infrastructure for Spatial Information in Europe) Directive which in turn is part of a global effort to build commonality across national "Spatial Data Infrastructures" or SDI's (Labonte et al 1998, ESDP 1999). The GMES programme addresses the provi-

sion of end user information services through integration of measurement, modelling and prediction within a geospatial systems environment. Many of these emerging services are *marine policy driven* providing information to support coastal zone governance relating to fisheries, quality of waters, extraction of gravels, protection of marine species and flood protection. In view of the emerging requirement to extend land environment mapping into coastal waters (Land-Marine Workshop 2007) and provide access to these data, efforts to define and develop the protocol and standards for a marine specific SDI are underway (Ng'ang'a 2004, Sutherland 2005, Sutherland & Nicholas 2006). The International Hydrographic Organisation (IHO) has acknowledged the potential importance of a marine spatial data infrastructure and a special IHO workshop on *Marine SDI* was convened during the *Geomatica 2007*, to discuss related issues. The first of five resolutions agreed at the IHO Workshop states;

“IHB to communicate with IOC to cooperate on the development of the spatial data standard S-100, with a view to facilitate marine/hydrographic data exchange”.

This is an important statement that recognizes the need for knowledge exchange and collaboration between the maritime technology and marine science communities to address emerging information needs increasingly relevant to development and welfare of the waterborne industry. The statement reflects earlier calls for such cross sector dialogue made by the author (Graff 2006, 2007).

This has led to formation of a new IHO Working Group on Marine Spatial Data Infrastructure (MSDIWG) which together with the strategic Working Group on Transfer Standard Maintenance and Applications Development (TSMAD - responsible for S-100 development) will provide an important contribution to evolution of the IMO *e-Navigation* vision.

1.3 Marine Transportation

Motorways of the Sea (DGTREN 2005) is a growing concept that aims at introducing new inter-modal maritime-based logistics chains which will bring about a structural change in our transport organisation that will be more sustainable and commercially more efficient. At European scale there are four proposed marine motorway systems linking regional states which are illustrated in Figure 1 and at global scale the Marine Electronic Highway pilot project (Sekimizu et al 2001, Gillespie 2005) in the Malacca Strait being progressed by IMO represents another important first step in prototyping some of these ideas.

In addition to conventional navigation aids governing weather and bathymetric charts the evolution of marine motorways will demand increasingly sophisticated products and services to monitor traffic, mitigate accidents and pollution impact and to optimise and improve commercial efficiency of routing and port turn-around. For example, AIS and LRIT are already being adopted as key data carriers to improve monitoring and safety of regional and global vessel traffic and improvements in marine broadband are leading to new types of remote monitoring and information exchange. A service offering that is receiving much attention from several developers is the concept of ship performance monitoring which integrates onboard vessel behavior parameters with prevailing sea state and weather to compute continuous updates of optimal routing advice delivered remotely to the bridge. The IMO e-navigation strategy offers a vision for a web services infrastructure that lends itself to delivery of a wide range of such new added-value marine information services in addition to mandatory ECDIS information.

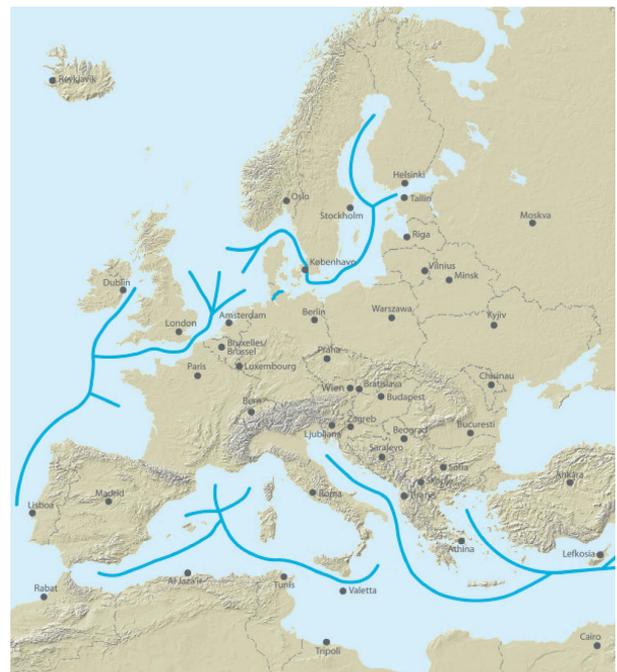


Figure 1. The four proposed European Motorways of the Sea interconnecting regional sea States in Europe.

These initiatives also highlight a particularly important feature namely; the need for convergence between maritime technology and marine science in order to realise the degree of knowledge integration needed to provide the types of sophisticated maritime information services required today.

2 E-NAVIGATION

The *IMO e-Navigation Strategy* was initiated in 2005 with intent on embracing new digital technologies to provide the framework for new digital services adoption across the maritime transport community to support navigation. IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) was charged by IMO with developing the e-Navigation vision and standards (IALA 2007). A definition for *e-Navigation* was agreed at the IALA e-Navigation Committee meeting (e-NAV2) in Southampton in March 2007; 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

In order to have the functionality demanded for delivery and display of mandatory navigation data, e-Navigation has to be supported by an ECDIS.

2.1 ECDIS

A key feature in progressing e-Navigation lies in universal adoption of *Electronic Nautical Charts* (ENC) and the availability of a common approach to the use and display of ENCs and related navigation aid data onboard vessels namely, the *Electronic Chart Data Information System* or ECDIS. In July 2008 draft regulations were presented by IMO to make the carriage of ECDIS a mandatory requirement under SOLAS Chapter V Safety of Navigation. It is anticipated that this will be adopted and thus trigger the universality of ENC adoption and usage.

The role of ECDIS is especially important in view that a new version (S-100) for the digital code structure of ENC's (commonly known as S-57) has been developed (Alexander et al 2008) and is currently being released under test with adoption envisaged in the next few years. The new code is “open standards compliant” which enables the handling of

many other data types, for example, S-100 will support gridded and time series (x, y, z, t) data in support of dynamic ECDIS, marine GIS and web based services. This 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.

However, it also raises questions regarding scope and definition of ECDIS and what influence IHO might have on commercial services development through Working Groups TSMAD and MDSIWG.

3 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 embrace the following criteria:

- 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*. This is important and provides a clear distinction between the two namely.

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 both e-Navigation and e-Maritime components is presented as Figure 2 adapted from work by one of e-Navigation's pioneers Dan Pillich (Pillich 2007).

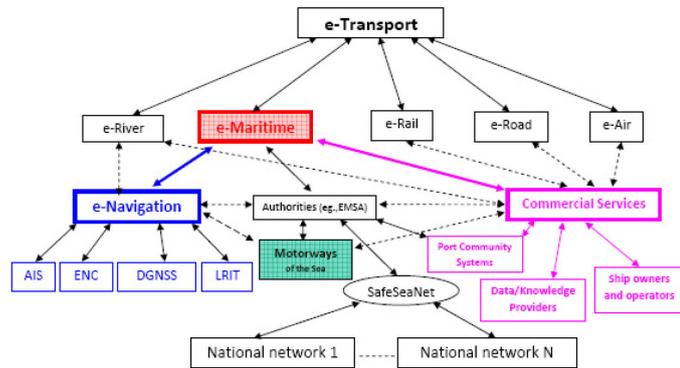


Figure 2. e-Maritime and e-Navigation shown in the broader context of e-Transport information services provision.

The diagram highlights the role and the complementarity 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.

However, as has already been noted under 2.1 above, it is not yet clear what the IMO vision framework for e-Navigation will embrace and where conflicts with commercially driven e-Maritime services will arise.

4 INTEGRATION AND INNOVATION

The EurOcean 2007 conference produced the “Aberdeen Declaration”, calling for an integrated European Marine and Maritime Science, Research, Technology and Innovation Strategy which should enable:

- foresight activities to identify new and emerging scientific challenges and opportunities;
- cross-sectoral, multinational and interdisciplinary research partnerships;
- co-operation between research, industry and other stakeholders to enhance knowledge and technology transfer and innovation;
- development of scientific and technology capacity to strengthen the knowledge economy;
- shared use, planning and investment of critical infrastructure on a Europe-wide basis.

This stirred considerable interest and support at European level and a *Post Aberdeen Task Force* was established made up of representatives from Marine Science and Maritime Industry interest groups including ICES, ESF Marine Board, ETP Waterborne

and EuroGOOS. This was deemed relevant as a vehicle for providing a *representative response* from the European marine and maritime communities to the EC actions calling for initiatives to demonstrate science and technology crossover and innovation.

From a personal perspective, I would argue that the representation on the *Task Force* is far too heavily marine science research biased with the WATERBORNE consortia representing industry, having a shipbuilding focus. Consequently, there is a gap in the key new crossover area that is framed in e-Science (Hey & Trefethen 2003, Env e-Science 2008) and ICT technology applications, namely *e-Maritime*, that are enabling a dramatically new data-driven approach to marine science and technology.

Curiously, there is little or no recognition in the current EC discourse on European maritime strategy of the emergence of e-Maritime, or indeed e-Science, as an important enabler of new information services and driver for innovation and integration across marine science and maritime technology research outputs. Why?

Perhaps the answer lies in some of the prophetic key recommendations identified more than a decade ago in the seminal UK Marine Foresight Panel study 1994-97 report (UK Marine Foresight 1997) chaired under the late David Goodrich namely;

3.3 High priority areas for wealth generation

- **Information Technology:** For acquisition and processing of increasingly large volumes of data, the development of intelligent information systems and GIS-based data management systems is needed, linking satellite remote sensing, GPS navigation, monitoring networks (data buoys, commercial vessels) and hazard databases. Also required is development of a marine information service backed by data acquisition.

3.4 Actions for implementation

- The opportunities to apply **Digital Information Technology** to the marine environment are many and varied. Industry should lead this initiative in consultation with academia and government. The Panel recommend the setting up of a user led interest group and a LINK programme for the application of Digital Information Technology to the marine environment.”

5 CONCLUSION

It is eminently clear that digital information technology is driving a whole new agenda for change in the waterborne sector and we are at the onset of seeing a new industry emerge designing and delivering innovative marine information products and services.

This offers challenge and opportunity but demands integration and innovation across marine science and marine technology sectors and uptake of new enabling technologies such as e-Science. The new enabling framework for marine informatics is proposed as *e-Maritime*.

Awareness of the underpinning technologies defining e-Science and e-Maritime and understanding their innovative integration potential seems to be lacking across marine and maritime communities. This has to be remedied urgently if Europe is to become a player in the emerging global information services market. Europe has the potential to lead.

Finally, I would reiterate, now ten years on, a single recommendation adapted from the 1997 UK Marine Foresight Panel report namely;

- The opportunities to apply **Digital Information Technology** to the marine environment are many and varied. Industry should lead this initiative in consultation with academia and government. I recommend the setting up of a user led interest group for the application of Digital Information Technology to the marine environment under the aegis of *e-Maritime*.

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