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Development of a Radionavigation Plan for General Lighthouse Authorities of the United Kingdom and Ireland

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This paper reviews the need for the GLAs to develop a strategy for the integration of radionavigation services around the British Isles. After investigating the recent trends and forecasts for shipping and with a view towards the need for e-Navigation, the strategy formation process and initial findings for the development of a radionavigation plan are outlined.

KEY WORDS

1. GLA. 2. e-Navigation. 3. Radionavigation.

1. INTRODUCTION. The General Lighthouse Authorities (GLAs) of the United Kingdom and Ireland are Trinity House, the Northern Lighthouse Board and the Commissioners of Irish Lights. Together, they have the statutory responsibility for the provision of physical (lights and floating) and radionavigation (e.g. DGPS beacons) marine aids to navigation (AtoNs) around the British Isles. Recent GLA publications including "2020 The Vision" (GLA, 2004) have stressed that the future AtoN environment will continue to comprise a mix of physical and radionavigation AtoNs. Looking to the future, the GLAs are facing a number of challenges: changing operations; new technology including modernised GNSS; the changing marine and business environment; and the evolving user-base. At the same time, the emerging e-Navigation port-to-port concept is causing the GLAs and others to reassess the long-term direction of the AtoN mix. As a result, the GLAs are embarking on the development of a strategy for the integration of radionavigation services into the AtoN mix in order to provide a safe, stable, interoperable and cost-effective service around the British Isles. This will support marine transport general navigation operations including the emerging e-Navigation

(enhanced Navigation) port-to-port concept and needs to be in conformity with international and national laws and treaties.

The strategy will consider the period 2005–2025 when expected change will have stabilised and will focus on six facets of integration: institutional, regulatory, commercial, operational, technical and the user. The emphasis will be on delivering a cost-effective AtoN mix to support e-Navigation with due regard to safety and risk. The paper will start by giving an overview of the expected change and then describe the new e-Navigation concept. An overview of the strategy development process and initial findings will then be presented. The paper will conclude by presenting the way forward.

2. THE CHANGING WORLD. De Halpert *et al*. (2006) have given a good summary of current shipping trends. The review of maritime transport reported by the Secretariat of the United Nations' Conference on Trade and Development (UNCTAD Secretariat, 2005) provides the most recent snapshot of the current status of the shipping industry. The highlights, alone, make compelling reading. The headline figures for the development of the world economy and seaborne trade indicate growth:

- in 2004, the world output grew by 4·1% and was predicted to grow by 3·1% in 2005;
- the volume of world merchandise exports grew by 13% reflecting the strong performance in China;
- world seaborne trade reached a record high of 6·76 billion tonnes; and
- total maritime activities in tonne-miles increased by 6·9% to 27 635 billion tonne miles.

The world fleet is growing in response to the market, and the lack of any real spare capacity suggests that this will continue:

- the world fleet expanded by 4·5% in 2004 with a net gain of 38·8 million dead weight tonnes;
- the average age of the world fleet dropped marginally to 12·3 years although 27% of the fleet is older than 20 years; and
- the surplus tonnage continued to decrease to 0·7% of the total merchant fleet.

The headline figures for freight markets suggest that the shipping industry is doing well from this:

- tanker owners had a good year as the overall volume of seaborne crude oil trade increased by 4·2%;
- the improved balance between supply and demand for seaborne shipments of the main bulks resulted in higher rates for both time and trip charters; and
- freight rates on the main containerised routes were generally above the 2003 levels with a 10·6% increase recorded for the westward Asia-to-Europe route.

Ships are getting larger (Figure 1) (MAN B&W Diesel A/S). In 1984, the largest vessels delivered had container capacities of only some 4500 TEU (Twenty-foot Equivalent Unit). By 1996, this had increased to 6000 TEU and in 2003, the first ships

were delivered with capacities in excess of 8000 TEU. Buxton (2004) indicates that 9600 TEU container ships will be delivered in 2006 and 20 000 TEU (Malacca-max) ships are technically feasible. However, container ships over 8000 TEU are less versatile and may show no further economies of scale. With drafts that will be at or in excess of channel approaches, and with ports under pressure to accommodate them and provide outreach craneage to service them, it may be that real economies are likely to be achieved by increasing the size of the smaller ships. (Cullinane and Khanna, (2000), Stopford, (2002)).

Ships are also getting faster. (Figure 2 shows the average speeds of vessels of various sizes (MAN B&W Diesel A/S). The large new container ships, carrying the equivalent of more than 6000 containers, travel at some 25 knots. This is nearly twice the average speed of their smaller predecessors. The same trend is seen in passenger vessels. A super-fast ferry such as the SuperSeaCat is more than 100 metres long, carries 800 passengers plus 175 cars, and operates at 38 knots.

Against this background, the role of the AtoN service provider is increasingly important, particularly where there are obvious choke points like the English Channel where one ship passes through the Dover Straits every three minutes. AtoN service provision can be modelled in terms of the level of service provided, the cost of service provision and the associated risks. This triangle is under pressure:

- there is the challenge to provide improved levels of service both in terms of performance and safety;
- administrations do not want the cost of service provision to increase; and
- risk management is increasingly important in a more litigious society.

Over the next twenty years the AtoN service provision environment is going to change significantly (de Halpert *et al.*, 2006), bringing its own challenges:

- a changing operational environment including the growth of marine leisure activities, the proliferation of high-speed and larger vessels and changes in traffic patterns;
- the arrival of new technology (widespread reliance on global navigation satellite systems (GNSS) especially the Global Positioning System (GPS) in the short term, new technology radars, integrated bridge systems) that may in itself encourage a level of false confidence; and
- the growth of offshore and coastal industries.

There are other challenges over this time period:

- institutionally, implementing and introducing new technologies requires a much closer working relationship between the International Association of Martine Aids to Navigation and Lighthouse Authorities (IALA), the International Maritime Organisation (IMO) and the International Hydrographic Organisation (IHO);
- certification and standardisation of more involved safety critical systems;
- commercially, ever increasing fuel costs;
- operationally, the service provider will only contribute part of the overall integrated solution and may have little or no control over key GNSS components; and

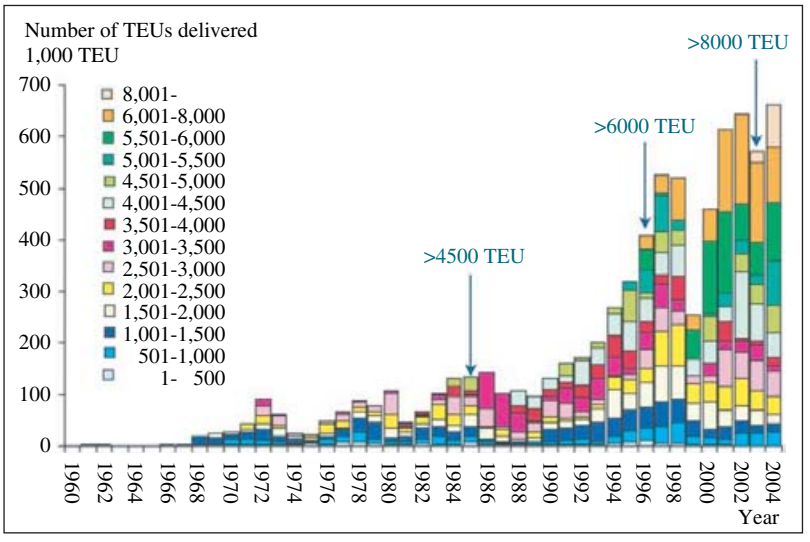

Figure 1. Ship size (TEU) from 1990–2004.

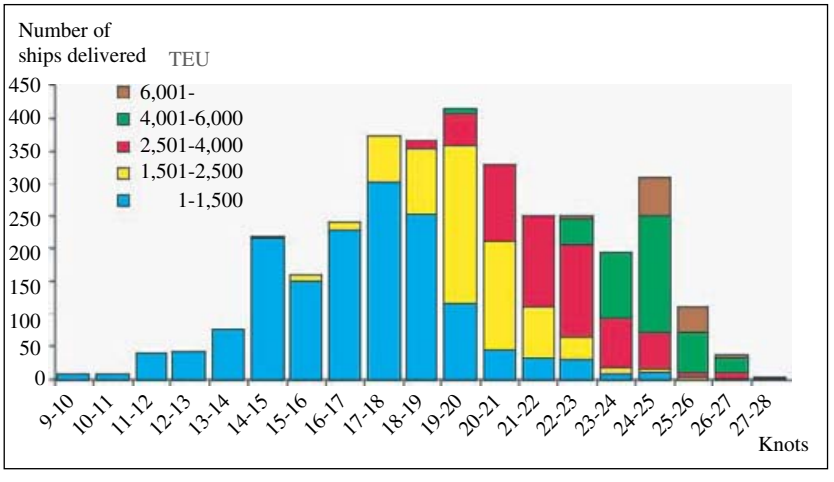

Figure 2. Average container ship speed by TEU.

- technologically, there is a potential single point of failure with both the navigation and surveillance functions of future systems relying largely on GNSS.

3. e-NAVIGATION. e-Navigation is the direction for the future and is intended to make safe navigation easier and cheaper and to support new applications including the Marine Electronic Highway (also known as Motorways of the Sea). It is now being actively explored by the leading maritime nations, for a wholly

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integrated electronic navigation concept to transform shipping safety and is high up on the agendas of both IMO and IALA:

- at IMO, the United Kingdom, with the active support of Japan, the Marshall Islands, the Netherlands, Norway, Singapore and the United States of America, has proposed to the Maritime Safety Committee that it adopt a work programme to achieve the e-Navigation goal; and
- at IALA, it has been proposed that a new e-Navigation committee should replace the Radionavigation (RNAV) and Automatic Identification Systems (AIS) committees following the IALA conference at Shanghai in May 2006.

In an ongoing process, e-Navigation is currently best defined as "*The cost-effective collection, integration and display 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 will be based around radionavigation (principally GNSS underpinned by fail-safe supplementary signals). These will be displayed in an intelligible and comprehensively integrated electronic chart display information system (ECDIS) on board ship and replicated on shore with shore-based monitoring and intervention capability. This will be linked to information and alarm management and prioritisation.

4. THE STRATEGY DEVELOPMENT PROCESS. The GLAs have followed a structured process for developing a radionavigation plan that will support the delivery of their strategy outlined in "2020 The Vision". Starting with a workshop, the GLAs identified requirements, road-mapped a number of scenarios, undertook a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis for a preferred scenario and linked this to an action plan. The decision was made to look twenty years ahead to 2025 because this is when currently known change is expected to have stabilised. In the first instance, there are two key states of service provision:

- an intermediate state based on the introduction of new services in 2015; and
- an end-state in 2025 when AtoN service providers and the shipping industry have had an opportunity to deliver and take-up the services.

5. INITIAL FINDINGS. When considering the potential future e-Navigation environment, it is clear that GNSS, and particularly GPS in the short-term, will play a key role enabling future services. GPS is already the primary radionavigation sensor for marine navigation as well as underpinning situational awareness based on AIS where it is used for timing and positioning in shipborne and shore-based stations. GPS is also used for timing synchronised or sequenced lights to improve conspicuity in light-polluted locations. This reliance on GPS is a matter of concern because it is vulnerable to intentional and unintentional interference.

The introduction of e-Navigation technology will be accompanied by the introduction of new e-Navigation operational concepts to take advantage of improved safety and cost-efficiencies (e.g. the use of virtual AtoNs for the early warning of

wrecks or obstructions before they are marked physically with wreck marking buoys). Reverting from e-Navigation to physical AtoNs is likely to become less straightforward as time progresses. Over time, like other transport sectors, we are likely to see "democratisation" of positioning and navigation from the skill-based professional, through the process-driven technologies, to the product-driven consumer used to computer games. The logical endpoint is that fewer skilled professionals working in a more demanding operational environment with faster and larger ships will be less able to respond to unplanned and unexpected outages. Under some circumstances, navigational safety might actually worsen

A second, complementary and dissimilar, multi-modal independent Position, Navigation and Timing (PNT) service is needed to realise the full benefits of e-Navigation. In their document "2020 The Vision" the GLAs identified Loran as being the only terrestrial radionavigation backup currently operational that has the potential to fulfil these requirements. This is driving the GLAs' current Loran activity that looks towards the provision of an international, globally-standardised eLoran PNT multi-modal service, based on interoperable multi-regional components both as a complement to GNSS and as a stand-alone backup in case of failure.

6. THE WAY FORWARD. Following the development of a preliminary draft radionavigation plan in May 2006, a definitive radionavigation plan will be produced in the fourth quarter of 2006. The GLAs' Research and Radionavigation Directorate will continue to assess the performance, safety and economic benefits of Loran in order to secure the important GNSS benefits for e-Navigation and AtoN service provision.

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