Transitioning from traditional aids to navigation

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The transition to eNavigation has been going on for almost 40 years, and affects all areas of ship operation. The next level of transition may well be from analogue to digital, or visual to virtual. The IMO states that eNavigation is intended to establish an integrated information environment for the maritime community. This environment will of necessity reach beyond the ship itself, and will affect the provision of aids to navigation and waterway management services.

The transition to eNavigation has been going on for several years. As so often in the maritime industry, it sometimes takes an accident to act as the catalyst to progress and additional regulations. In January 1971, two tankers collided near the Golden Gate Bridge in San Francisco in near zero visibility, spilling 800,000 gallons of oil into San Francisco Bay, while Coast Guard watchstanders at the experimental Harbor Advisory Radar Project (HARP) looked on, unable to contact either ship on VHF-FM.

The National Transportation Safety Board (NTSB) report eventually led to legislation mandating setting aside channel 13 (156.65 MHz) for exclusive use by the navigation team and giving the Coast Guard authority to establish and operate Vessel Traffic Services.

That legislation can be seen as a significant milestone in the transition to eNavigation in the US. As with all areas of technology, the pace of delivery is quickening and the number of new tools is increasing. At the same time, there is pressure to reduce costs in all areas, meaning that the question of how to manage an increased or, at best, steady, navigational risk with decreasing resources becomes increasingly pressing.

In order for a smooth and efficient transition to eNavigation, regulations and technology will have to advance together, and of course economics will always have a role. But, as we proceed and progress, we must also transition the user to the next level.

Aids to navigation

The navigational challenges of the future will be addressed through an integrated system of visual, electronic, and regulatory measures based on existing technology, but able to readily adapt to new technology and new competencies. An integrated aids to navigation system will be asked to do more than simply impart positioning information, and it will have to be operated in conjunction with existing rules, regulations and restrictions, without having to rely – too much – on regulatory change.

This is a lot to ask for, and unfortunately, we will always have to deal with legacy systems at the same time that technology is moving forward. So what does this mean in practical terms?

Visual references

First of all, visual references – for example, buoys and lights – will be with us for a long time to come. An integrated aids to navigation system will have to contain visual references in sufficient quality and quantity to operate independently of any electronic system. Virtual aids to navigation or electronic positioning systems cannot impart the same information as a fixed or floating visual aid. And there will always be some users that are not able, not willing or not equipped to use more sophisticated tools. What's next for visual aids is:

- Augmented information through the use of electronic means that provides, for example, the health of the aid or more detailed identity information;
- Improved optics that produce more light and better sector definition and that consume less energy;
- Interlinked aids with synchronous flash;
- Interactive aids such as user activated sound signals;
- Better conspicuity through better coatings;
- Better station keeping for floating aids in exposed locations.

It is vital that changes in the aids to navigation system should always be made with user involvement. This is the same whether it be discontinuing a sound signal, changing the effective range of a light or deploying new and untested technology. For example, when the US Coast Guard deployed their first set of synchronised flashing buoys in the San Francisco Bar Channel, they first used the California Maritime Academy's simulator to test the buoys with the Bar Pilots in a laboratory environment before deploying them in the field.

Virtual aids to navigation

Most modern mariners have heard about virtual aids to navigation. The topic has been getting increased attention lately, some of which can be attributed to increased attention being placed on Arctic navigation and the obvious difficulty we would face in trying to maintain physical aids to navigation in that environment. Virtual aids have also been mentioned as a less expensive alternative to floating aids. While I do not condone this latter argument, economics drives a lot of decisions.

Virtual aids have a place where it is not possible to establish physical aids due to either time pressures – such as the need to alert mariners to a newly created hazard such as a wreck – or environmental conditions. But their use need not be limited to these situations. Could virtual aids be used to mark a navigable channel in a river in which the water level, and consequently the channel width, frequently and rapidly changes faster than the buoy tender can adjust the buoys? We have the technology to transmit a polygon that depicts a certain depth contour. This can be displayed on the bridge and the navigator need only keep his vessel within the polygon. The US Coast Guard is already looking for a laboratory to test this concept with mariners' involvement. This is a drastic transition from placing traditional visual references along the route to using other visual references in the wheelhouse.

Another type of environmental condition that might preclude the establishment of physical aids to navigation is quite the opposite of arctic ice. It's tropical coral. The Endangered Species Act will not allow us to establish aids to navigation on top of endangered coral or in any area or habitat that could support the growth of endangered coral. This has already prevented the US Coast Guard from servicing long established aids in the Gulf Coast. Are virtual aids to navigation a workable solution in this case? Only if they are augmented by two things: improvement and growth in electronic signals and improved navigation displays in the wheelhouse.

eNav onboard

There's been a lot of discussion about over reliance on electronics and eNavigation influenced accidents when seafarers forget to look out of the window. But nobody has counted the number of accidents that have been avoided through the much improved voyage planning, precise positioning and better informed collision avoidance that improved displays and, by extension, eNavigation can deliver.

eNavigation improves situational awareness and decision making at sea and ashore. When used in conjunction with other communications and display systems it enables shore organisations to deliver more timely and relevant information to the mariner. And through its many levels of sophistication and scalability it can embrace all levels of system users from recreational craft to the largest and most modern commercial vessels.

However, one drawback of eNavigation is that it requires a new level of sophistication and equipment on the part of the system users. This in turn requires new levels of user training and certification. Systems and procedures cannot be imposed overnight, they will have to transition gradually.

Space management

In the not too distant past, aids to navigation were placed to enable a mariner to determine his or her position, determine a safe course to steer or to avoid unseen dangers. A few visual aids and the COLREGS were all that anyone needed. Not any more. The aid mix of the future will be asked to do much more. It will define sea lanes and exclusion areas. It will support security as well as waterway efficiency. It will not only serve the navigator, but its benefits will be extended to a host of shore based users in government and commerce.

The aid mix of the future will also support regulatory efforts as sea space that was once the exclusive domain of the independent navigator becomes parcelled into areas for aquaculture, minerals extraction, renewable energy etc. The term for this phenomenon is Coastal Maritime Spatial Planning. This will be a challenge. In the US, as in many areas around the world, it's already taking place, with 12 Wind Energy Areas being considered for the Atlantic Coast, forcing the Coast Guard to devise a system of Traffic Separation Schemes and fairways around the structures.

Coastal Marine Spatial Planning in many ways is similar to airspace management. The aviation community is rigorous in ensuring that the activities in any given piece of airspace are all compatible. They would never allow a tall building at the end of a runway or hang glider to enter the airspace of a busy international airport. Yet we happily allow VLCCs, fishing boats, recreational craft, jet skis and wind surfers to all compete for the same channel with nothing to keep them apart except the COLREGS.

This trend is only going to increase, and the available sea room is shrinking. The numbers of Particularly Sensitive Sea Areas and Areas to be Avoided increases each year. The aid mix of the future will have to consider and support these trends.

If the waters under our jurisdiction are divided into single use or limited access areas, we will have to find a way to define these limits and inform all waterway users of the bounds. Supporting and enforcing these regulatory efforts can be done by either physical or electronic measures, but it will need to be done.

Reducing the burden

Similar regulation of ship traffic movement has been going on for many years. But, through AIS and LRIT, shore based authorities can already track and monitor cooperative shipping anywhere in the world. It is, I believe, only a matter of time, before participation in a berth to berth reporting and tracking regime is mandatory for ships on international voyages. This in turn will lead to attempts by the shore authority to influence the traffic in some way. It is essential that shore authorities employ this new capability to reduce the burden on the ship's master through some form of integrated reporting and tracking and information processing. eNavigation principles, when properly applied, should benefit all participants and not redistribute, or worse, increase the burden on the mariner.

eNavigation could bring all information services that affect shipping into a cohesive package. This includes not only navigation services but all other government and commercial activities that impact shipping, and this should be done globally, without regard to national boundaries.

eNavigation will, as is intended, start to bring about an orderly evolution in shipboard display and communications systems and a better ship to shore connection. It will deliver a considerable portion of the aid mix of the future and it will improve the safety and efficiency of shipping. The transition will not happen overnight but it will happen. It's already started.

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