NAVAL INTEGRATED BRIDGE SYSTEMS

INTEGRATED BRIDGE SYSTEMS PLAY A MAJOR ROLE IN MANY NAVAL SHIPBUILDING PROGRAMS

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While in the past often equipment from a variety of different manufacturers was installed on navigation bridges to fulfill basic operational tasks, the former generation of Integrated Bridge Systems referred primarily to the integrated approach taken with IMO navigation systems such as radar and ECDIS interfaced to other important systems and sensors aboard the vessel.

However, even if military performance requirements may override IMO compliancy in certain aspects of operation, for Military Vessels the primary focus of Integrated Bridge Systems has remained on interfacing components. In many cases the level of integration often has proven to be an inefficient and sometimes an inappropriate use of resources with functional integration of different navigation systems, sensors or tactical features. Consequently, the ability to achieve a certain level of interoperability and operational efficiency under the control of a single operator, or a small crew, is difficult.

Therefore, over the past years a demand for higher level integrated bridge systems has grown.

IBS – What is needed today?

The deployment scenarios for a naval surface ship are varied and range from coastal protection, search and rescue and police duties through fighting counter smaller and more volatile threats, such as those posed by pirates, warlords or terrorist organizations, to military tasks and combat.

A scalable 'off-the-shelf' solution is required which is standardized to save unnecessary non-recurring engineering costs, but remains flexible enough to accommodate different sensors and systems appropriate for different deployment profiles of the platform or different missions. The IBS should also allow operation by a number of different and even smaller crews.

Of course, with regard to worldwide defense budgets a strong requirement for bridge systems is their affordability. Ideally the IBS should be based on state-of-the-art but commercial-off-the-shelf (COTS) technology, which is adapted only to the required redundancies, tracking requirements, mission profiles, ergonomics, ship characteristics and the mandated shock levels at the individual position.

The use of open architecture solutions eliminates specific hardware requirements. Decoupling of hardware and software also eases upgrades of hardware when new performance requirements need to be fulfilled or refreshed technology is available. In addition, future upgrades, replacements and enhancements of system capabilities are simplified whereas dependency from single vendors is reduced.

Other typical requirements from Navies are easy to operate systems that don't need too much training time, integrated on-board training using the navigation workstations, fault-tolerant user interfaces, more efficient bridge operations through integration of additional applications in existing hardware, standardized and reliable installation procedures as well as central service contacts for immediate attendance and availability.

From an operator's perspective, typically the following requirements arise:

- Easy to understand display with intuitive and standardized operation
- Central access to core navigation and administration routines
- Less workload through automation of routines and automatic performance monitoring
- Less stress through better alert management
- Safety through redundancies

New integrated navigation systems as basis

The trend for new navigation system regulations and the idea of “e-navigation” results from a finding of IMO experts that over 80% of all ship accidents are caused by “human error”. Further investigation confirmed what navigators complain about most: too much and inconsistent information on the bridge, poor presentation of data, as well as a lack of training and insufficient information about local conditions.

Consequently, IMO defined that e-navigation shall improve the integration and harmonization in three aspects: Navigation systems on board (functions, integration, interfaces, HMI), ship-to-ship data exchange and communication, and ship-to-shore data exchange and communication.

The introduction of the integrated navigation system (INS) performance standard MSC.252(83) in 2012 is a major breakthrough for ship navigation, and certainly an important contribution to reduce “human errors”.

First of all, INS brings great improvements for operators including multi-function displays (MFD).

The MFD plays the key role within the new generation Integrated Bridge and can be configured to offer the functions Radar, Chart Radar, (W)ECDIS, Conning, or any combination enabling access to and control of different tasks from any work place connected to the network. Depending on the prevalent task, the operator has available all needed information at a glance, benefits from immediate situation awareness and can take over control from any bridge workplace with a single action only. The new multi-function displays have harmonized HMI, standardized symbology, system-wide identical targets, central dimming, central user settings. As a result, INS is definitely easier to operate than conventional navigation equipment.

Secondly, INS also brought the new Consistent Common Reference System (CCRS) which continuously monitors and checks sensors and always automatically selects the best available source. It can be fed by various GNSS sensors as well as for example the future eLoran-receivers. It uses dead reckoning (by gyro and log) as backup reference. Aiming for a highest degree of availability, the CCRS supports Navy requirements for long periods between overhaul and administration of personnel.

Number three is the new requirement for a “smart” central alert management (CAM), which inhibits unnecessary double alarms and repeated alarms and allows acknowledgement from any CAM display. Overload of bridge alarms has been a major trouble for watch officers during the past years. INS solves this problem and directs attention to the real essential alarms.

Functional integration of sensors and systems

In modern bridge systems the key to a higher degree of integration and interoperability is network-based and task-oriented system architecture as well as the use of industry standards and proven technologies. While the last is to reduce engineering and logistic cost or to allow for simple and cost-efficient upgrades and enhancements, this first is mandatory to achieve functional integration and enhance capabilities.

Navigation systems, which are using standard industrial components and offering central services such as data collection and distribution, together with an appropriate selection and integration of sensors and effectors will make it possible to handle a variety of threat scenarios and missions more efficiently.

For example, when providing required interfaces to the ship's backbone and when in accordance with hardware requirements, the MFD can be scaled up to an Integrated Platform Management System (IPMS).

Another example is integrating a Command and Control (C2) system as part of the multi-function displays to provide the operator with advanced situational awareness and capabilities for detection, identification and tracking of targets of any size and speed in the vessel's environment. If integrated with an electro-optical sensor and a weapon station, the C2 is essentially a dashboard for sensor fusion and weapons control that can be readily adapted and scaled to suit the vessel type and mission.

Capabilities of smaller vessels without requirements for a dedicated combat management system and combat information center can be significantly enhanced without need for additional hardware or cabling effort. Even large smaller vessels can benefit from such a perimeter protection solution during transit or harbor stay. Such a functional integration of navigation and C2 systems is available today, since the German IBS manufacturer Raytheon Anschütz announced the delivery of first SYNTACS systems to new patrol boats end of last year.

Another idea is to move from a traditional "lookout" to "total situation awareness". Why not connect cameras to the radar and move the camera by the radar bearing line controller knob? The camera image can be integrated into the ECDIS screen including zooming and night vision. Other ships could be automatically tracked. Such "track tracer" functions are already available on the base of COTS technology.

Where does it go from here?

Ships are already today increasingly using shore-based services. They are connected to ECDIS chart providers, downloading updated chart information every day. Even weather charts are available for daily downloads. Navtex display in ECDIS is another quite new feature and not known to many navigators yet.

E-Navigation has many stakeholders such as coastal states, authorities, commercial ship owners, navigation manufacturers, service providers, classification and others. They all work on new ideas create additional benefits from ship-to-ship and ship-to-shore data exchange.

As on example, a couple of research projects in different parts of the world are working on "overhead displays", which project navigation data directly on the bridge front window. This supports the idea that watch keepers should concentrate on lookout. Other ships can be graphically projected onto the bridge window at the correct compass bearing, even before they appear visually. Even ship's name and CPA/TCA could be presented additionally. This technology has been used in aviation since many years and can be applied for ship navigation as well.

Another idea under evaluation is using "Wearable Immersive Augmented Reality" (WIAR) glasses, which shows the actual navigation situation depending without being influenced by different viewing angle when moving on the bridge. Or an HMI with situational perspective change-over can be automatically adapted to certain navigation scenarios, such as harbor or channel passages, narrow traffic and low depth areas, low visibility and many more. In future, ECDIS will become a more situational specific display, not limited to show the pure sea chart only but it may also include Radar and CCTV as well as special overlays or colors.

Increasing importance of lifecycle costs

In times of tight budgets also the overall lifecycle cost of an IBS solution become of higher importance. This covers support for logistic and training, mid-life modernization and in-service support (ISS). In particular signing individualized ISS contracts with the industry have proven to be a cost-effective way for navies to maintain a high degree of safety and availability, while being able to reduce own capacities and remaining within the framework of a predictable planned budget.

Typically an ISS contract is compensated until a large extend through performance-based payments and includes defining spare parts packages, stocking spare parts in depots and on board, worldwide maintenance, replacing outdated units (obsolescence management), as well as training and documentation. In this way the industry guarantees that equipment is ready for use and assumes the financial risk. However, knowledge of the systems, continuity, experience in worldwide maintenance and repair as well as existing service infrastructure and supply chain security standards of the industrial partner are keys to make an ISS contract a success. Again, the installation of standardized hardware and the use of COTS components contribute to the industry's ability to serve the ISS contracts efficiently and reliably.