

Better Situational Awareness:

INS Improves Safety At Sea

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In recent years there has been a strong innovation surge in ship navigation. New technologies simplify operation and can therefore help to avoid accidents.

We all remember the media reports about the Cruise Liner “Costa Concordia”, the Passenger Ferries “Sewol” and “Norman Atlantic” three years ago. In 2014, again seven passenger ships were lost at sea, as marine insurers reported recently¹⁾. Why do still so many accidents happen? How can navigation systems help to improve the situation?

Reports from marine insurers and accident investigators show, that most of the accidents do not occur on the high seas, but close to the coast and on canals and rivers, where the water is shallow and the traffic is dense. According to information from the marine insurers, half of the damages are caused by navigation errors; the other half are mechanical failures and damage through fire and explosion. The accidents caused by navigation very often involve grounding and collisions, while storm damage is considerably less common²⁾.

In 70-85% of the accidents, according to IMO³⁾, the cause is not technical failure but “Human Error”. False assessment of the situation leads to wrong decisions. Nautical organizations attribute responsibility to several factors: While ships became larger and larger, the global level of qualification of watchkeepers dropped, many have less professional experience. Bridge procedures and “best practices” are often not followed properly and in addition, short harbor periods and tight schedules lead to overfatigue. And finally: Many older ship bridges are not designed and equipped according to newest standards, which is legal, but far away from perfect. Poor arrangement of bridge equipment can lead to errors⁴⁾.

In order to improve navigational safety, IMO has again and again worked out new equipment regulations and the world fleet had to fit many new equipment: VDR, AIS, SAAS, LRIT, ECDIS, BNWAS and more. But all of these new equipment were so-called “stand-alone” units, each with its own display style and own operator button philosophy. For example: the transponder system AIS, introduced in 2002, with its rudimentary “Minimum Keyboard Display”, was hardly of any assistance to a bridge watchkeeper.

Confusing bridges with many individual pieces of equipment are to be found not only on old ships but even on many newbuilds. Many shipowners leave it up to the shipyard to decide about the navigation equipment and have no special wishes of their own regarding functions and ergonomics. Shipyards then buy the cheapest individual components, just sufficient to fulfil minimum requirements.

IMO recognized this problem already in 2006 and therefore started the initiative “eNavigation” with the goal that “Technological advances must be developed in a coordinated and structured manner”. Harmonization and integration of navigation systems on the bridge is therefore the first priority of eNavigation. Another important goal of eNavigation is to improve ship-shore data communication, so that ships can be better supported and monitored by shore based services⁵⁾.

New IMO Standard for Navigation Systems

A first step toward harmonization and ergonomics was the new Performance Standard for Integrated Navigation Systems (INS) MSC.252(83). This Standard defined requirements for uniform multifunction displays, required central sensor management and improved alarm signaling. In 2014 this was followed by a new Performance Standard for the presentation of information in displays. At the end of 2015 a new Standard for Digital Interface Security is to be expected.

The ground work for the new INS Performance Standards came largely from Germany, where, in the framework of the research project “DGON-Bridge“, developers, authorities, classification societies and manufacturers had worked together to set up new principles for uniform displays, sensor monitoring and alarm integration.

In 2012 Raytheon Anschütz, as worldwide first manufacturer, launched a bridge system according to the new standard: the new bridge no longer consists of casually combined individual units. Instead there are five or more identical multifunction displays (MFD) which contain all the important display elements and operating functions.



How can an integrated navigation system help to prevent accidents? The fundamental improvement is that it improves situation awareness. Accidents occur when watch officers are not aware of actual risks. This can result to wrong decisions which finally lead to the accidents. The new displays are not necessarily presenting more information, but better information. Easier to understand at a glance.

Anti-Collision, Anti-Grounding

The multifunction display monitors not only visualize the dangers of collision and grounding but it also monitors its own system performance, especially the availability and quality of the sensor data. For example, if a GPS receiver is faulty, the system automatically switches to a better sensor.



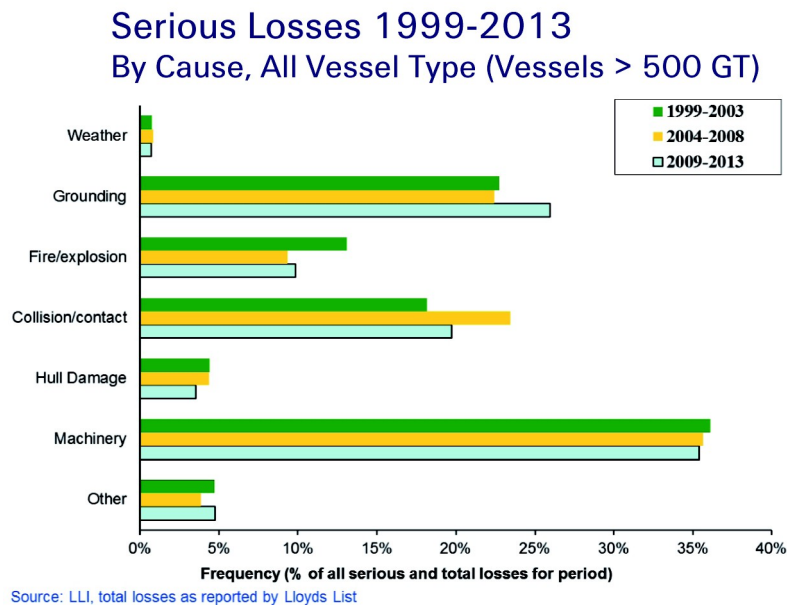
The most common cause of accidents is grounding. The risk can be substantially reduced by using the function “Track Control”. With this the ship is automatically steered along a planned route. From the point of departure to the destination, with fully automatic changes of course at each waypoint and with an accuracy of 20 meters! If a watch officer wants to leave the planned route *intentionally*, this can be done at any time, but it no longer can occur unintentionally. The “Costa Concordia” had this feature, but the captain apparently did not use it.

The second most common cause of accidents is collision. The risk can be considerably reduced if proper information about the ship traffic is available. The new fusion of radar data and AIS transponder data have improved this a lot. Users can not only assess risk of collision but also has intuitive decision support about collision avoidance maneuvers with regard to water depths and traffic zones. Raytheon Anschütz’ unique collision assessment function SeaScout is another valuable tool for graphical visualization of collision risks. The latest feature: All radar and AIS data are centrally managed and monitored, so that identical assessment of the traffic situation is available on all displays. For every ship the ship name is displayed next to the target symbol and it is possible to

exchange text messages with other ships directly from the multifunction display.

Implementation and Future

Is the new INS technology already being used? Will the number accidents consequently decline? Surely, but it will take more time. Until now, the modern navigation systems are only installed on modern newbuilds, but seldom on old ships. The world commercial fleet consists of 65,000, their average age is around 20 years. Old ships are basically allowed to continue traveling with their first equipment as long as it works.



Can an old ship utilize the new technology at all? Yes of course it can. Whenever an old radar or an old ECDIS needs replacement, it should be replaced by a multifunction display, because it just offers more and better functions: radar, chart radar, ECDIS, conning display, central sensor management, better alarms and most of all: Safer and easier operation. As the new INS standard becomes applied to a larger number of ships, the new technology will surely contribute a lot to reduce “human error” and ship accidents.

Sources:

- ¹⁾ Allianz, Safety and Shipping Review 2015
- ²⁾ International Union of Marine Insurers, Hull Fact Sheet 2014
- ³⁾ IMO-Subcommittee STW 39/7/3
- ⁴⁾ Nautical Institute, The Navigator Feb 2014: “ECDIS Errors caused Bulk Carrier Grounding”
- ⁵⁾ IMO MSC 85/26 annex 20, paragraph 4