

The EDA Effect: How Big Data improves Navigation Performance

EDA (E-navigation Data Analysis) of **Totem Plus** was introduced to the market in mid 2016, with the objective of allowing ship owners to have proper information on how their ships are navigated. Analysis of historical data (as recorded in the ECDIS) on a monthly basis, looking for “near accidents” and violations of the COLREGS, proves to be very powerful tool in improving navigation standard onboard. In Fig. 1 and 2 below the results can be seen, showing the decline of Severe Events (mostly violation of COLREGS resulting in very close proximity to other vessels) and the increase of number of ships that had no reported deficiency. The data was normalized to 10 ships per month, for two fleets, as different months had different number of reports analyzed for each fleets. The two figures show clearly that the increase of “no report” is in agreement with the decrease of the number of “severe events” from all the ships.

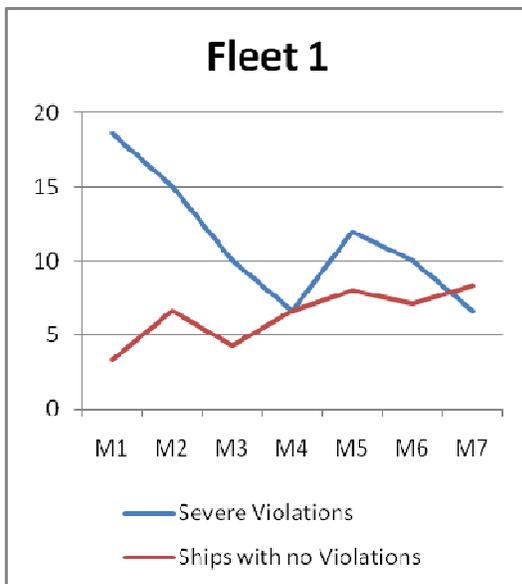


Figure 1: 7 Months EDA for first fleet, tankers

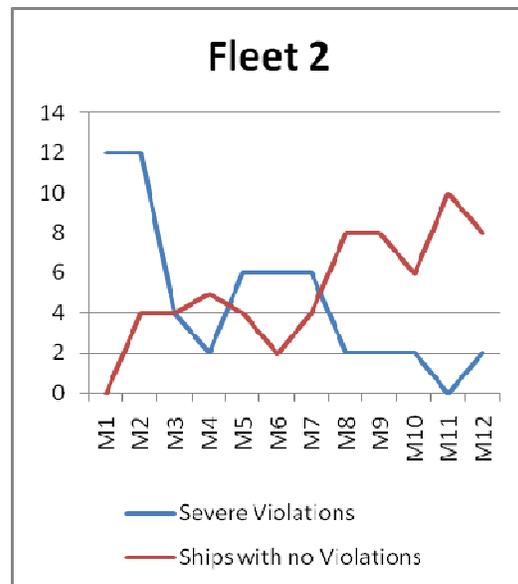


Figure 2: 12 Months EDA for 2nd fleet, car carriers

Decline in violations, increase in Good Performance: data normalized to 10

What is EDA? EDA is a software tool, developed by Totem Plus, that can scan the Big Data recorded by ECDIS or VDR, for any given period such as a full month, and report events considered to be “Near Misses” or “Near Accidents”. EDA can be given as service to ship owners and ship managers that have Totem ECDIS or Totem VDR. “Near Misses” are events that show clear violations of the International Regulations for Preventing Collisions at Sea (COLREGS) or bad seamanship. The definition of a “near miss” is flexible, and in general involves several parameters such as distance, speed, depth etc.. Once such events are detected, they will be brought to management attention. Management, in turn, should convey the observations to the attention of the ship (or the whole fleet), with a clear message that such standard is not accepted in the fleet. The results of the EDA are brought to management attention (and later as feedback to the ships) in order to assist in establishing navigation safety standards onboard company ships and promulgate the company desire to keep such standards. A word of caution should also be said : the incidents found were analyzed based on data recorded by ECDIS and VDR, without any input from the navigators or master or any information on visibility or sea state that may shed different light on the actions taken onboard. Mariners are encouraged to study the reports, and revert when from any reason they think that the event was unavoidable or justified. Experience during the last year showed that such discussions, by themselves, are favorable and raise the awareness to safe navigation practices. Further, it should be pointed out that the purpose of EDA is not to find culprits and punish but to improve standards of navigation.

Why is EDA needed? Marine catastrophes happen all the time. EMSA (European Maritime Safety Agency) reported that in 2014 there were 331 cases of Groundings or Stranding, 378 cases of Contacts and 293 cases of Collisions. More than 250 persons lost their lives and 2000 were injured in those incidents, apart from the financial loss and pollution. The numbers worldwide are definitely higher as EMSA reports only on incidents reported by EU member states. Most important, 67% of the reported incidents were related to Human Erroneous Actions.

The reasons why so many incidents happen because of Human Erroneous Actions is attributed by many to deteriorating standards of mariners and the tendency to employ cheap crews. Complaints about deteriorating level of seafarers are very common, and can be heard of at any marine conference or gathering. Possibly but we do not see that only so-called “cheap crews” are having more than the average number of accidents. Others take a somewhat different approach and blame the “advanced technology as well as the oft-quoted human element” and consequently see the solution (or part of it) by providing the mariners with standardized modes of operation – the so called S-MODE (in other words, the claim is “mariners are not so smart, give them simple systems”). Several high profile incidents, for example the groundings of the Costa Concordia and the Rena, or the two notorious collisions of the US navy with merchant ships, do not agree with both assumptions (two of the three were manned by well-trained European officers). We believe that the reason of those accidents can be attributed to cockiness and over-confidence of the bridge team, and even more so to lack of proper supervision, auditing and feedback. No real action is taken to check the current navigation performance onboard in order to assimilate navigation safety standards. It should be emphasized that the numbers of accidents above are those of real and reported accidents, while at sea there are many more “Close call” incidents. Those incidents are not reported, not analyzed and never learned from. A system of feedback to the navigators is badly needed, one that will make every “close call” incident known, accountable and learned from.

NEAR MISSES In the aviation industry, near misses are taken very seriously and administrations investigate such events in depth. It is possibly easier for the aviation industry because most of the air traffic is supervised by traffic control centers. Ships, on the other hand, still enjoy the freedom of the seas and near misses are not recorded or investigated (most of them). This fact is indeed a violation of the ISM code, which requires auditing of ship performance and recordings of near misses. Class NK Safety Management System, for example, requires ³ “Reporting of Hazardous Occurrence (Near miss) and

Measures to address them - Are hazardous occurrences (Near miss) reported to the company? Are these reports investigated and analyzed by the company? Have these matters, together with preventive measures, been brought to the attention of other ships concerned? ".Unfortunately, in most cases this requirement is not followed, and ends with paper shuffling for the sake of bureaucracy, possibly because up to now there was no adequate tool to find such events. We cannot expect the mariners to report it voluntarily, as it is against human nature for one to incriminate himself, and even honest mariners that experienced a near miss may not always admit that it was indeed a near miss. The definition of what is indeed a "near miss" may vary according to several technical parameters such as ship's type, maneuverability, geographic location etc., but also by the standards of the investigator. One cable distance from a ship overtaken may look safe to one mariner, but not prudent to another. We have different expectations (and tolerance) from an experienced pilot entering a busy harbor than from a junior officer in open waters. Some companies have standards of safe distance and safe clearance below the keel, but those are many times overlooked. We will see below how this obstacle can be dealt with.

Data Source Modern bridge systems are equipped with various recording capabilities, such as a dedicated Voyage Data Recorder (VDR) which should record all navigational data for 30 days, and also with other systems recording their data internally such as ECDIS (and possibly other systems). Analysis of recorded history for near misses is possible today and, as will be shown further, is already available by EDA.

Event Definition The program is flexible and its use is intuitive. The user can define the criteria that he wants to find by using recorded information such as speed, depth, distance from other ships etc.(distance can be calculated from either AIS or ARPA). "Near collision", for example, can be defined as an event where another ship passed at a distance smaller than 0.4 miles, while steaming at speed greater than 15 knots and at a depth greater than 30 meters (see picture 1). Speed and Depth values are so chosen to limit the findings to open sea and to filter out entry to ports etc. Other events (such as near grounding) can be similarly declared. Once the criteria for the search are defined the program will search all available data files to find a possible match. The criteria can also be given a title and be saved for future use.



Figure 3: Search for Near Collision

In the example in figure 3, showing a search for "Near Collision", two events matching the requested search parameters (as defined above) were detected. Replay of the exact data showed that one event is justified, while the other event showed clearly that the ship was violating the International Regulations for Preventing Collisions at Sea.

Findings During the last two years the EDA analyzed more than two hundred ships, and the findings were alarming. Severe COLREGS violations such as not giving way (Fig.4), steaming against the traffic flow in traffic lanes (Fig. 5), turning to port on ships crossing from portside and more were clearly observed as well as (although much less) passing in full speed over bars with very little below keel clearance. A movie showing a severe violation of COLREGS and possibly imminent collision (in a real case) can be watched in <https://www.youtube.com/watch?v=m2VWhUPS00I&feature=youtu.be>.

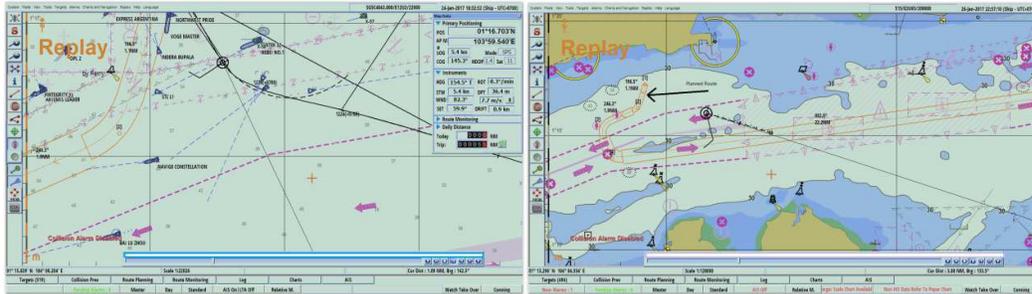


Figure 4: Turning to port on port crossing, 0.5M Figure 5: On the wrong side of traffic lane.

Once the EDA findings were given to the management and promulgated to the crew, a significant trend was observed. As can be seen in figures 1 and 2, the percentage of ships with “no violation” has increased from 0% (40% in the 2nd fleet) in the start of the analysis to 80% in both fleets during December 2017. Similarly, the number of incidents considered to be termed “violation found” (on all analyzed ships together) was reduced from 12 to 2 in one fleet and from 18 to 7 on another, again a significant trend. The statistics from the above two fleets show clearly that proper auditing of navigation practice onboard is lacking, and if done properly can improve the standard of navigation and increase safety at sea. Further information can be found in www.totemplus.com/EDA.php.

Summary Big Data analysis from two fleets during a prolonged period showed surprising and remarkable results. The analysis showed that without EDA Near Miss analysis, the **majority** of the ships (between 100% to 60%) had severe violations of COLREGS. After one year of EDA reports, the number of ships with violations was dramatically reduced to about 10%-20% of the ships analyzed. It should be noted that, while assisting management to insist on good standards of navigation, EDA can further contribute to better marine Training and Education, which will be gaining from reported cases of Near Accidents and the possibility to discuss them. EDA can be the long awaited tool to minimize human errors and increase safety at sea.