

Application of Bon Voyage 7.0 (AWT) to programming of an ocean route of post-Panamax container vessel in transpacific voyage Seattle – Pusan 26.08.2015, 1600UTC – 05.09.2015, 2100UTC

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Abstract

The results of testing the Bon Voyage system for an ocean voyage are presented in this paper. The main assumptions of testing were: ETD – 26.08.2016 and ETA – 05.09.2016, as established by the owner. All the data have been obtained from an actual voyage of a post-Panamax shipping container through the North Pacific. Testing was repeated again after completion of the voyage (post-voyage analysis). The data indicate that improved results with respect to fuel consumption could have been achieved using a different moment of second stage testing. Possible problems at planning, programming, and optimizing of the route leading through the ECA (Emission Control Area) zones with the use of onboard routing systems are also presented.

Introduction

Improper weather planning or incorrect execution of a ship's voyage can result in huge financial and operational losses for the ship-owner or charter company. Consequently, there are a number of decision support and optimization tools available on the market to assist the navigator in this task. We present here the practical application as well as the limitations of one of these tools, the Bon Voyage System, in planning and execution of a transpacific voyage.

Description of the ship, the voyage, its planning and optimization

The voyage of the post-Panamax container Vessel from Seattle, USA, to Pusan, South Korea, was planned on the basis of the following weather data:

1. AWT BV 7.0 planning tool and weather products of AWT, applicable in this tool, in particular the 16 days weather prognosis (Applied Weather Technologies, 2014).
 2. Surface analysis weather charts and 24- and 48-hrs surface prognosis charts, 3- and 5-days tropical cyclones track charts, 50 kts winds charts of the JMA (Japanese Maritime Agency).
 3. Standard EGC warnings and information.
- The vessel is a post-Panamax container vessel.
LOA: 335.7 m;
Breadth molded: 42 m;
GT: 97500;
TEU capacity: 8750;
Drafts: Fwd = 13.30 m, Aft = 13.30 m;
DWT: 84711 MT;
Cargo, fuel and ballast: 71 971 MT, 6736 TEU (77%), 3015 MT of fuel, 8340 MT of ballast.
- In accordance with the owner's policy, once the ocean voyage had embarked, the vessel was

additionally assisted in weather routing by AWT. The AWT provided Routing and Monitoring service route recommendation before the commencement of the voyage, as well as constant monitoring throughout the whole duration of the voyage. Therefore, hydro-meteorological analysis and updated route recommendations were regularly provided to the ship. In fact, periodically throughout the voyage, the ship submitted position and weather reports to AWT which enabled the route monitoring and correct routing of the ship.

Symbols and abbreviations used in the paper

ETD – *Estimated Time of Departure*;
 Departure – Point of departure;
 ETA – *Estimated Time of Arrival*;
 Arrival – Point of arrival;
 Troll – vessel's own roll period (transverse) in sec;
 nm – *nautical miles*, route distance;
 Hrs – *hours*, required steaming time;
 T_FO – *Total Fuel Oil*, Total fuel consumption en route;
 HSFO – *High Sulphur Fuel Oil*, consumption en route;
 LSFO – *Low Sulphur Fuel Oil*, consumption en route;
 MDO – *Marine Diesel Oil*, consumption en route;

LSMDO – *Low Sulphur Marine Diesel Oil*, consumption en route;
 SC – *Calm Sea Speed*, ship's speed on calm seas for the optimized route;
 WxF – *Weather Factor*, influence of weather on ship's speed;
 CuF – *Current Factor*, influence of ocean surface current on ship's speed;
 SOG – *Speed Over Ground* for the optimized route;
 Fuel(USD) – Total fuel cost in USD for the optimized route.

Testing before the commencement of the voyage

Preliminary testing of the voyage plan had been started several days ahead of the planned ETD, on August 22nd. It was assumed, according to the coastal schedule that the ETD would be on August 26, 2015 at 1600Z. Required ETA at Pusan pilot station was determined for September 5, 2015 at 2100Z. A preliminary simulation of the voyage was conducted on that day to demonstrate whether the northern route (based on the Great Circle) would be feasible with respect to the current weather conditions. The route and its calculated costs are presented in Figure 1. The method of testing was to consume the least fuel with a fixed ETA (Wiśniewski, 1991).

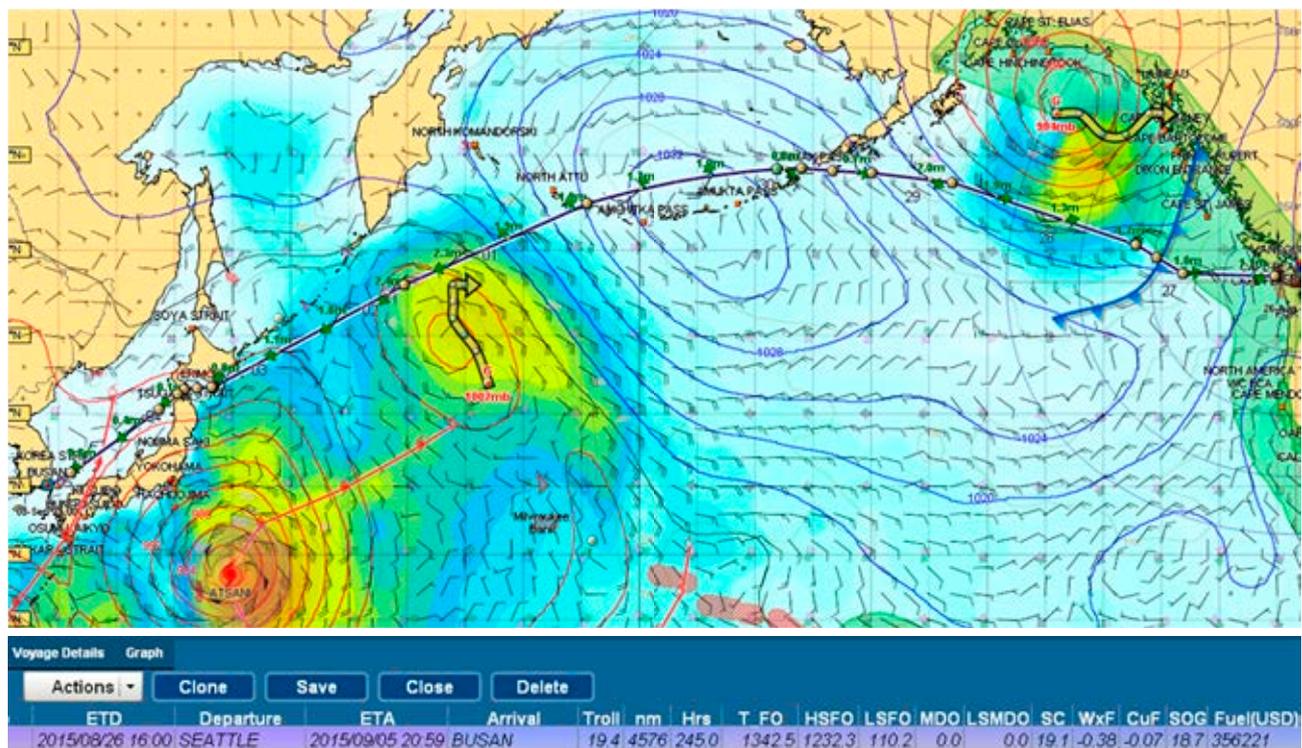


Figure 1. The Preliminary simulation Aug. 22, 2015 – optimization least fuel consumption with fixed ETA and voyage costs

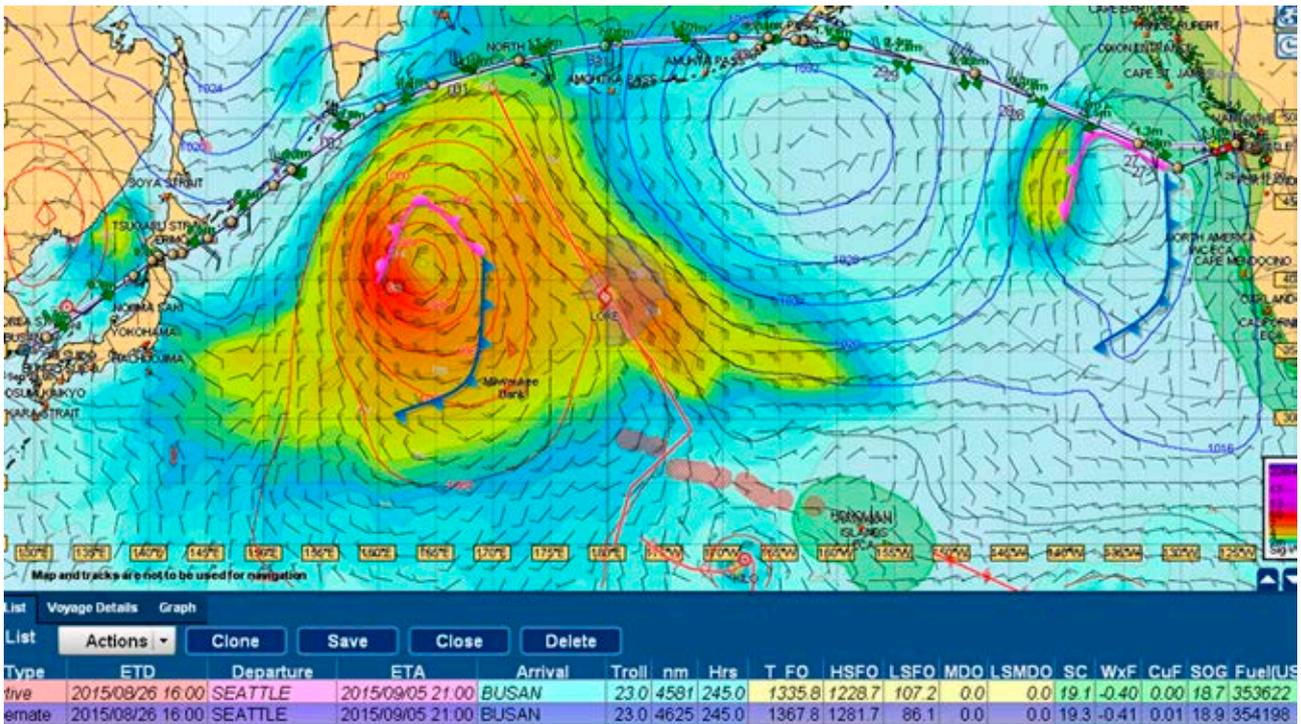


Figure 2. 2nd stage testing from August 26th. Optimization condition of least fuel consumption with fixed ETA. The route created by BVS (bold) and the route corrected manually together with voyage costs of both routes

Testing during the voyage

The 1st stage of route testing and optimizing was conducted on August 26th, 2015. The results of this test are presented on Figure 2. The 2nd stage testing was conducted (after dropping off the vessel's pilot) during the navigation through the waters of Puget Sound and Strait of Juan de Fuca, after the latest weather info had been received. These results are presented on Figure 2. The results for the route created by the BVS are presented as well as for the route created manually. The BVS route contains optimization errors regarding the navigation in ECA zone. They had been corrected in the route created manually. The BVS overall route is more expensive, despite the shorter distance in the ECA zone. Part of that route is presented on Figure 3. The above testing has proven that the choice of the northern route, based on the great circle was correct.

The ship must strictly comply with the voyage schedule. Earlier arrival is in general not viable. Regular liner operators and container operators in particular, operate according to port windows, pre-arranged with port terminal operators. The ship must enter the port, complete the cargo operations, and sail within those port windows' limits. Any changes and amendments to those time frames are generally

not accepted. Noncompliance with the port window may result in the loss of port berth or a fine. Consequently, the ship tries to arrive exactly on ETA as determined in voyage schedule, with minimum possible fuel consumption, so as to not to lose her port window.

The true route chosen by the captain shows the gain of 44 Nm and 32 MT of fuel in comparison to the route created by BV, despite the 21 MT higher consumption of ULFSO in the ECA zone (107.1–86.2). This route, compared with the route from the preliminary testing simulations, is similar in terms of distance and leads partially through the

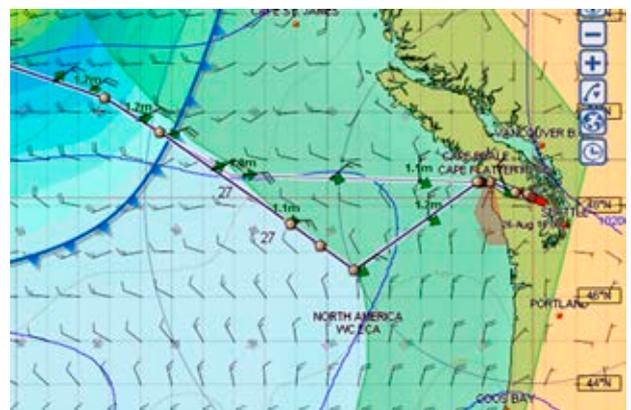


Figure 3. The Part of the route leading through ECA zone, optimized by BVS (bold) and true route

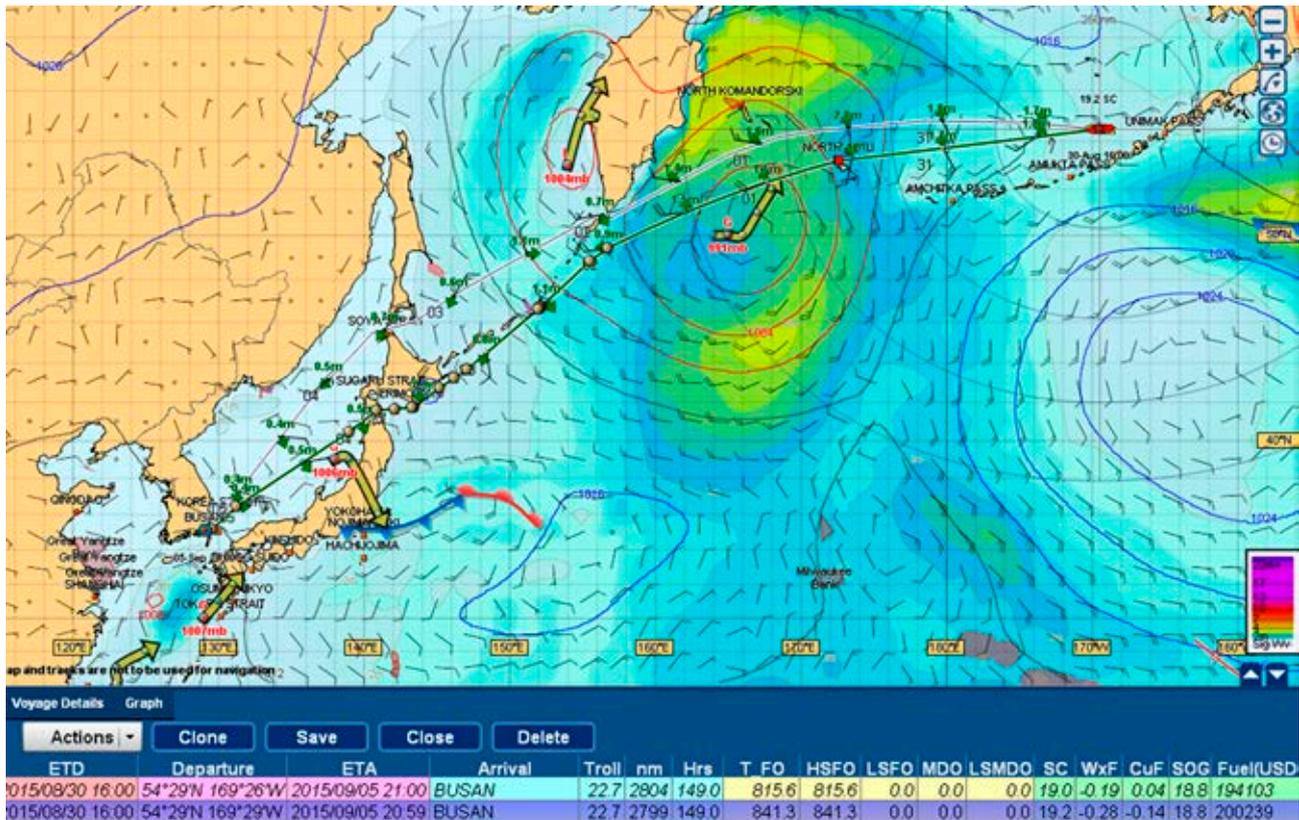


Figure 4. The 3rd stage testing, optimization east fuel with fixed ETA – August 30th

Bering Sea. However, this testing shows that the weather conditions worsen, i.e. two low pressure systems at 40°N/160°E and 39°N/180° (Figure 2) intensify.

The 2nd stage testing had been conducted on August 30th, on the Bering Sea. The results of this testing are presented in Figure 4. The route created by BVS is slightly longer than the finally chosen route, however fuel-wise it is more favorable. This route would have led through Okhotsk Sea, Soya/La Perouse Strait and Sea of Japan to Pusan, through the Piervyj Kurilskij Proliv pass (a waterway leading from the Pacific), to the Okhotsk Sea between Kamchatka Peninsula and the first island in the Kuril Archipelago. The more southern pass, through Chetvertyj Kurilskij Proliv is safer (UK Hydrographic Office NP41, 2014; UK Hydrographic Office NP136, 2014) and it was considered as optional route. The route created by BVS in the 2nd stage of testing, leading through the Pervyj Kurilskij Proliv was not accepted due to navigational considerations and, moreover, the fuel gain on route leading through the Chetvertyj Kurilskij Proliv pass was negligible. Finally, the original route from the 1st stage of testing, leading through Tsugaru Strait between the Japanese Islands, was chosen.

Post-voyage analysis

Post-voyage analysis, using the true weather data had been conducted after the completion of the voyage. It was then compared with the true route. Both routes are presented on Figure 5. This analysis showed that the route leading south of Aleutian Chain would have been more favorable, both cost-wise and weather-wise. This leads to a conclusion that weather forecasts at that time could have been wrong and that the date of the 2nd stage testing had been chosen incorrectly. Weather conditions and the ship's position in the Gulf of Alaska along the true route and along the route programmed on the basis of true weather data on August 28th are presented on Figures 6 and 7. They show unequivocally that the route should have been amended to a more southern one in this particular moment. The 2nd stage testing was, however, greatly affected by the tropical system TS LOKE and its forecasted track (see Figure 2). It seems that a several stage testing was viable in this particular voyage. 1st stage testing should have taken place in Seattle, 2nd stage testing on departure from the ECA zone, 3rd stage testing in Unimak pass, 4th stage testing on the meridian 180 and 5th stage testing on the meridian 160 E. Errors in planning and programming the route were also greatly influence

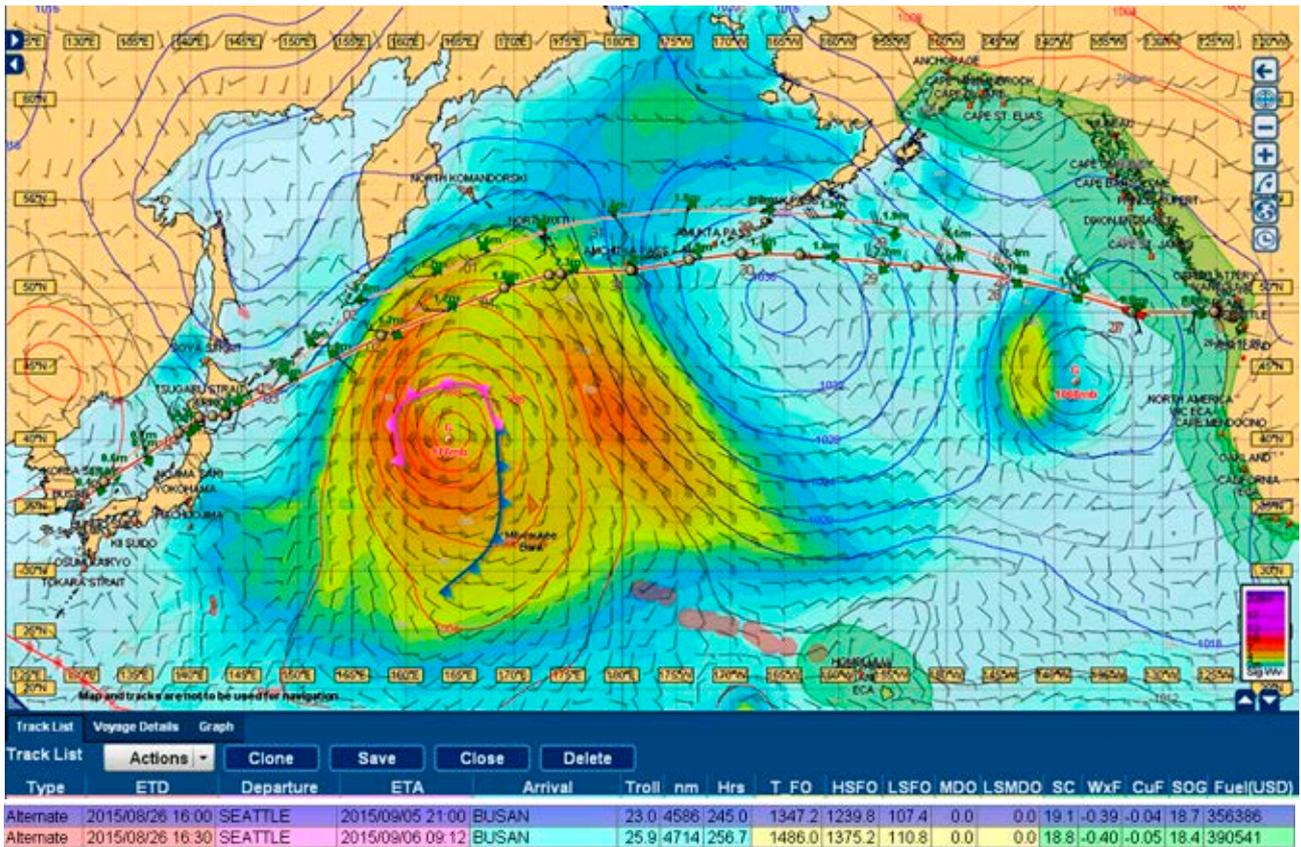


Figure 5. After voyage analysis – least fuel optimization (bold) and true route

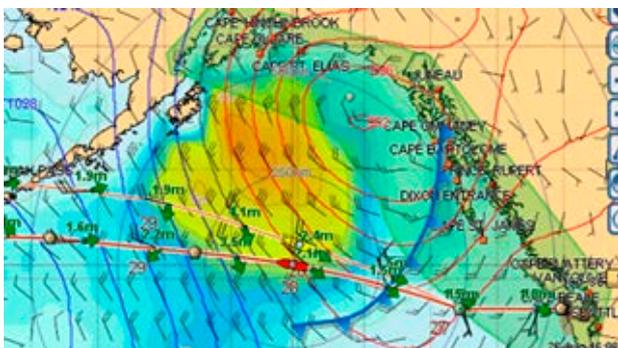


Figure 6. Weather conditions and ship's position in the Gulf of Alaska on Aug 28th. True route and after voyage optimization (bold)

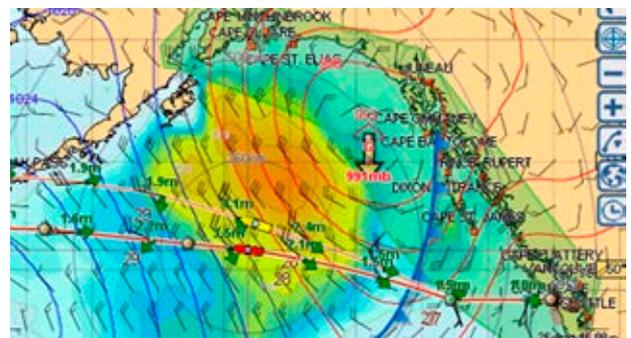


Figure 7. Weather conditions and ship's position in the Gulf of Alaska on Aug 28th. True route and after voyage optimization (bold)

by numerous amendments to the voyage schedule and required ETA.

Conclusions

A practical application of an onboard routing system Bon Voyage 7.0, a vessel route optimization and programming tool has been presented. Planning, programming, weather and operational optimization, as well as post-voyage analysis of the vessel route has been discussed, with the use of a true trans-pacific voyage of a post-Panamax container vessel. Onboard routing systems, like Bon Voyage, can be

a huge asset for a navigator in carrying out the task of safe and economical, planning and programming of the ocean route for a ship.

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