

# Service Performance Analysis Joint Industry Project

## Fuel saving in service conditions

The world wide economical recession motivates ship owners and operators to reduce operational costs of their vessels. Operational costs can effectively be reduced by reducing the fuel consumption. This is stimulated by the high fuel price up to the summer of 2008 and the prediction that the fuel price will again increase in the near future.

Already in 2006, MARIN in cooperation with leading ship owners, manufacturers of on board equipment and class societies initiated the Service Performance Analysis Joint Industry Project (SPA-JIP) which aims at reduction of fuel consumption by operational measures. The SPA-JIP received 272k€ subsidy from the Dutch government in the SMI program in 2007.

The SPA-JIP focuses on in-service performance analysis of vessels. An earlier JIP at MARIN, the Sea Trial Analysis JIP (STA-JIP), already drafted recommended practice and analysis methods for speed trials. Experience however learns that the vessel does not frequently sail at the contract draught which is of interest during

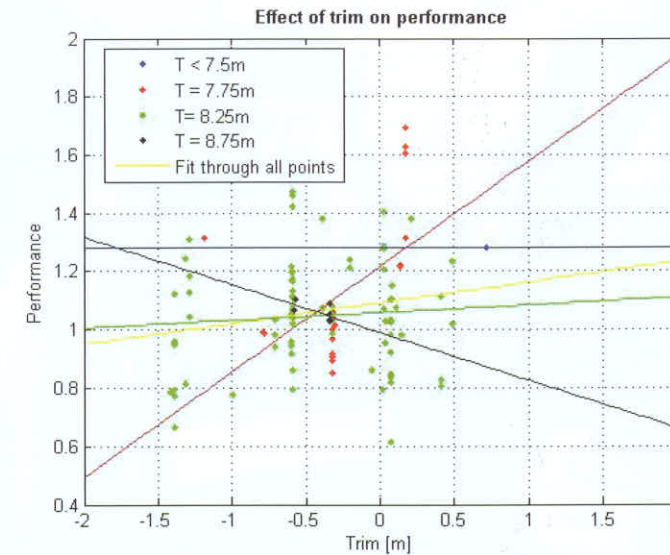
speed trials. In service analysis is therefore interesting for three reasons:

- Validation of expected performance of the vessel
- Validation of building contracts for a certain service profile.
- Using the performance knowledge to improve the performance of the vessel.

For a proper evaluation of the performance of a vessel, corrections have to be made for conditions deviating from time to time. Fleet comparison of sister ships fuel consumption show differences as high as 10%. This implies that there is still a significant amount of fuel to be saved. Thorough fleet analysis gives a perfect insight in the fleet performance, fuel consumption and possible improvements. The analysis consists of corrections for environmental conditions, loading conditions and fouling effects. The research is conducted as a Joint Industry Project which allows participants to join the project and receive all the results. Also participants are invited to actively contribute to the project by providing a vessel for performance monitoring or supplying on board equipment for the monitoring campaigns. Research in a Joint Industry project with a large variety of participants ensures industry wide acceptance of the results. The semi-annual project meetings are planned in the Vessel Operator Forum in combination with project meetings of other JIP's for vessel operators ([www.vesseloperatorforum.com](http://www.vesseloperatorforum.com)).

### Measurements

For real time performance analysis, several essential parameters should be measured. These parameters describe the speed power performance of the vessel including effects which influence the performance as wind, waves, loading condition, water depth and rudder angle. The accuracy of the results is very much dependent on the accuracy of the measurement. Sensitivity analysis of performance monitoring and analysis show great influence of the



Double figure of measurement results and model tests

ship speed through the water on the results of the performance analysis. As many captains and mates can acknowledge, the speed log is regarded as an unreliable instrument for the purpose of measuring the ship speed through the water. This statement is not entirely true since the instrument itself is accurate within 1-2%. The place of the speed log in the hull however imposes the uncertainty since the log measures a local flow speed which is not per definition the same as the ship speed through the water. The local flow is furthermore affected by the local boundary layer which in turn is affected by the degree of fouling on the hull. The second phase of the SPA-project will look closely into the log-accuracy.

### Results

By measuring the ship speed and shaft power, the speed power relation of the vessel can be determined. Plotting this shows a significant amount of scatter which is caused by deviations in environmental conditions and ship speed. By correcting these measured speed power points for added resistance due to wind and waves, the scatter is already reduced significantly. Changes in ship draught furthermore increases the scatter, this is therefore also a parameter which should be taken into account in performance analysis.

From the speed power curve, a performance index can be determined to give a quality value to the actual performance of the vessel. An important criterion for the performance index is that it contains information about the actual performance of the vessel independent of environmental conditions. The performance index should provide information about the effectiveness of the vessel. The performance will deteriorate over time due to increase of hull and propeller fouling and damage to the hull. Cleaning of the hull and propeller, with the ship either in dock or in the water, will regain a part of the lost performance. The exact effect of the cleaning for most ships will be between 5 and 10%. This results in a saw tooth graph of the performance over the years of monitoring. SPA

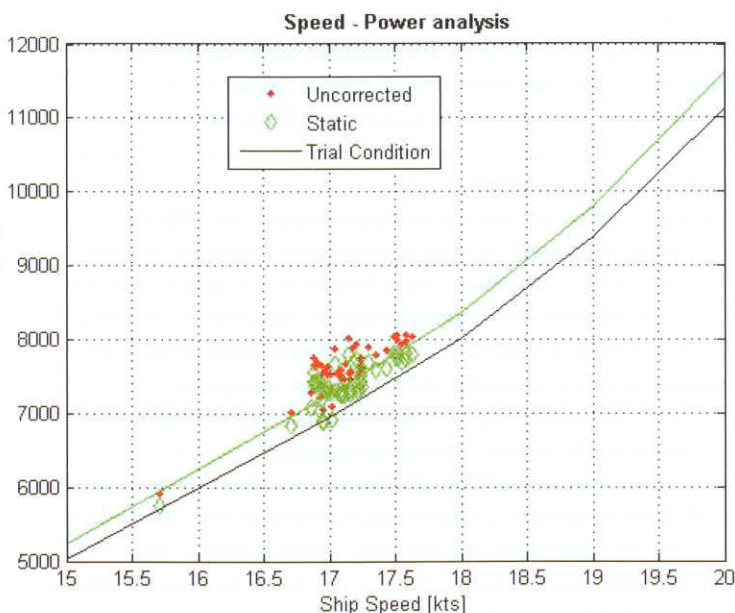
monitoring campaigns on board four test vessels in normal operation deliver knowledge on the performance of the vessel under different trim conditions. This historical information can be used to advise on optimal operation of the vessel. The figure shows the results of the trim variations for different mean draughts. This shows a great dependence of the effect of trim on the mean draught. The trim is furthermore a function of the ship speed. This is shown in the right hand side of the figure below by the different slope of the speed power curves which are determined from model testing of the vessel at different draughts. Potential fuel savings can be reached by using the measured and analysed data to improve the performance of the vessel. This performance improvement is reached by optimising the loading condition of the vessel based on the experience and comparison of previous results. Comparing the performance of previous trips at the same displacement will help the captain optimise the trim of the vessel for optimal performance. For most vessels with a bulbous bow, a trim by the bow is regarded as optimal. Often the crew is reluctant to do so because it is their opinion that this jeopardises the manoeuvring capabilities of the vessel. Testing results have however shown this decreasing manoeuvring capability is only slight and on long ocean voyages absolutely not significant.

### Conclusions

From the SPA-JIP the following, preliminary, conclusions can be drawn:

- Comparison of sister ship performance indicate potential fuel savings as high as 10% through improving the use of the vessel.
- The ship speed through the water is the most sensitive parameter in performance analysis and monitoring.
- Results of ship performance analysis lead to ship specific advice of optimum trim, auto pilot setting and hull and propeller cleaning schedules.

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Speed power curve with and without scatter