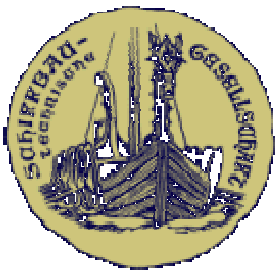**Challenging wind and waves**
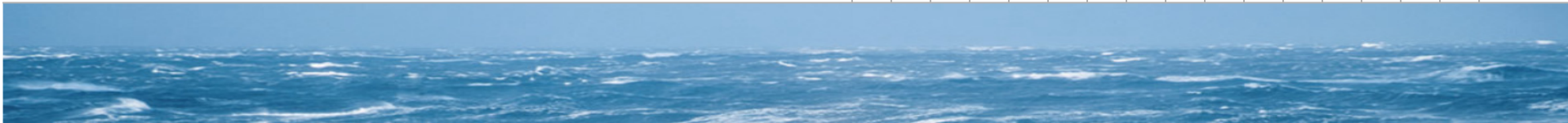
Linking hydrodynamic research to the maritime industry

Ship Service Performance
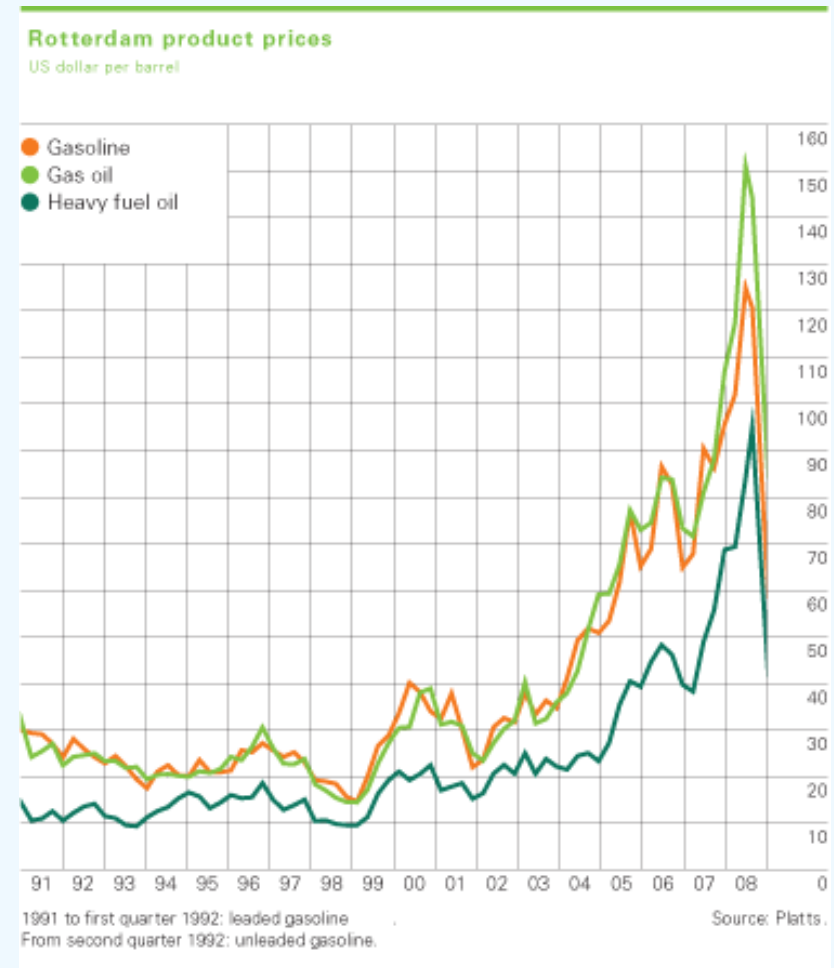## STG Ship Efficiency Conference 2009
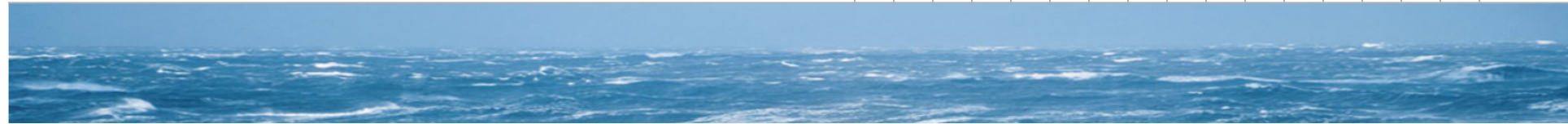
Thijs Hasselaar

Project Manager Trials & Monitoring

Introduction

– Service Performance

  – Fuel costs

  – Limiting fossil fuels

  – Environmental concern

  – New IMO regulations (EEDI, EEOI, green passports)

→ Reduce fuel consumption through optimization

Rotterdam product prices
US dollar per barrel

- Gasoline
- Gas oil
- Heavy fuel oil

1991 to first quarter 1992: leaded gasoline
From second quarter 1992: unleaded gasoline.

Source: Platts.
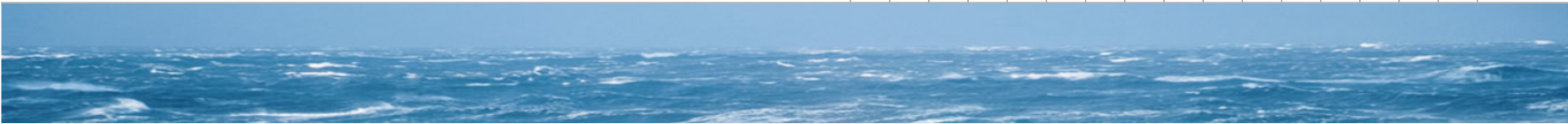
How to improve performance

1. Design ship for service conditions (vs. trial)

2. Optimize propeller-hull interaction (+ESD)

3. Optimize ship performance & operation by analyzing service performance data

Design for trial / Service

– Ships often designed for sea trial, not for service

– Service loading condition, seakeeping & maneuvering not optimized

– Sea Margin accounts for differences trial & service
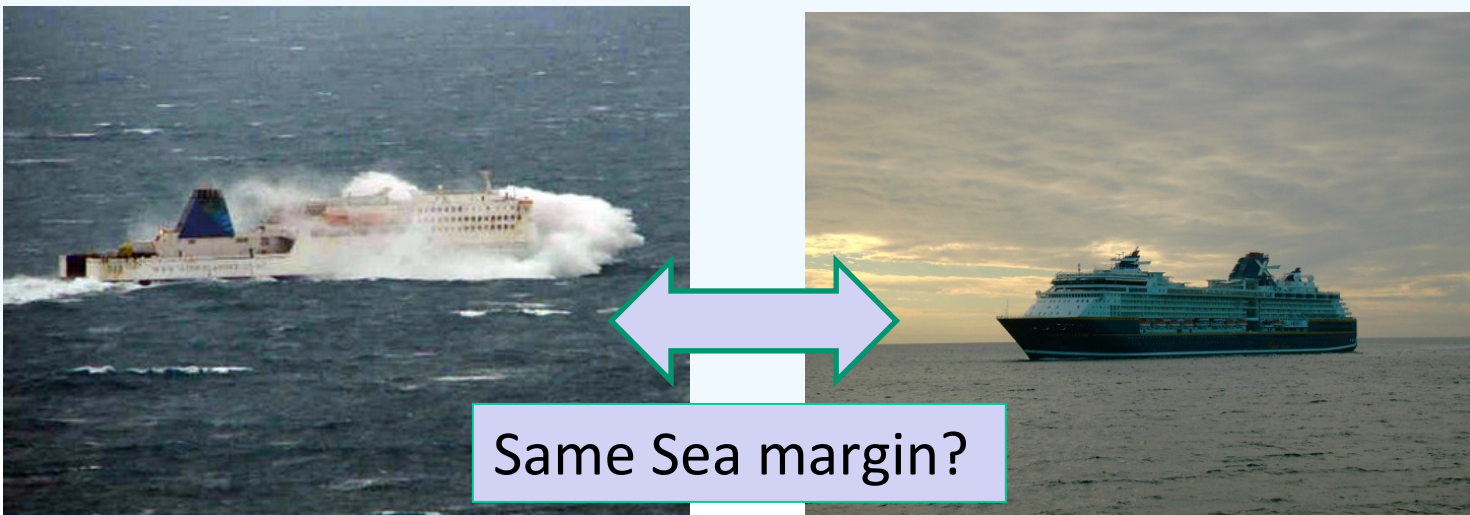
Same Sea margin?

Design for trial

- Operating profile basis of ship design
- $\rightarrow$ Different loading conditions, speeds & Seastates
- Seakeeping & manoeuvring tests part of design process. Not only for validation
- Incorporate ESD in design stage if required

- ☺ More accurate definition of Sea (service) margin
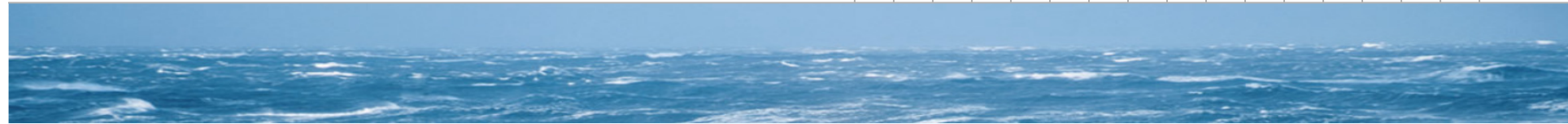- ☺ Optimal sailing in service conditions

Design for Service validation

- Verification required to stimulate yard & owner
- Verify using matrix of sailing conditions for which calculation & tests are done
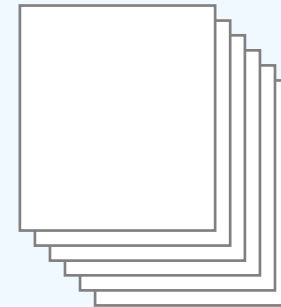
- Full scale trials for 1 or 2 conditions should provide confidence for acceptance
- Improve existing (empirical) calculation methods

Energy Saving devices

- Flow controlling Ducts or fins: accelerating axial flow or generating pre-swirl

- ESDs usually operate at aft part of the ship in a well developed boundary layer, which is determined by viscous effects.

- Performance therefore sensitive to scale effects

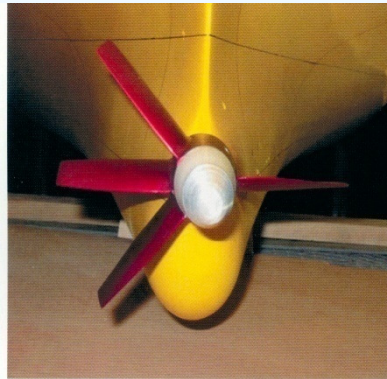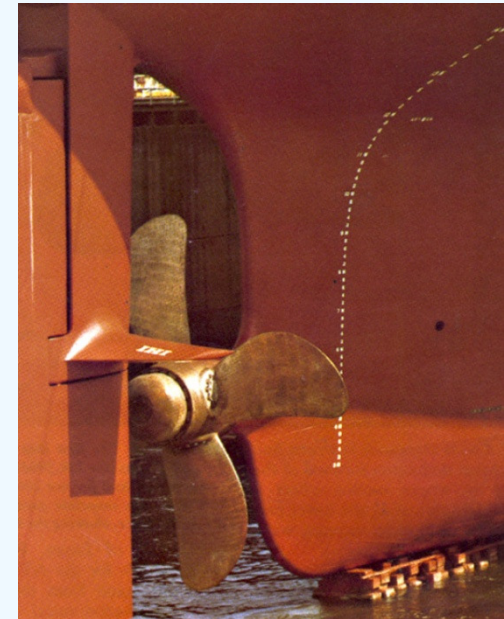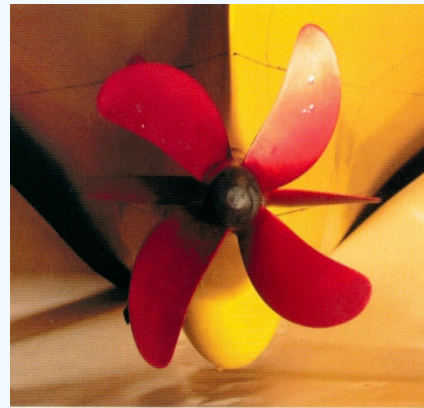- Efficiency of device difficult to predict on full-scale

Examples of energy saving devices
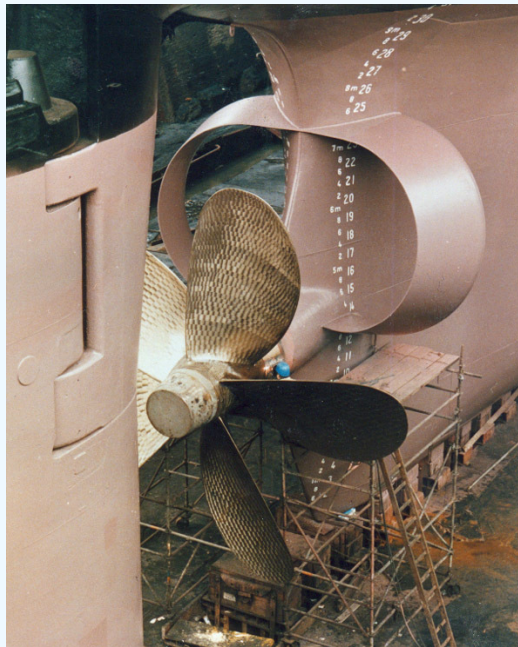
Pre-swirl stator

Schneekluth duct

Post-swirl stator

Examples of energy saving devices

Propeller Boss Cap Fin

Fins and spoilers
(Grothues)

Mitsui duct
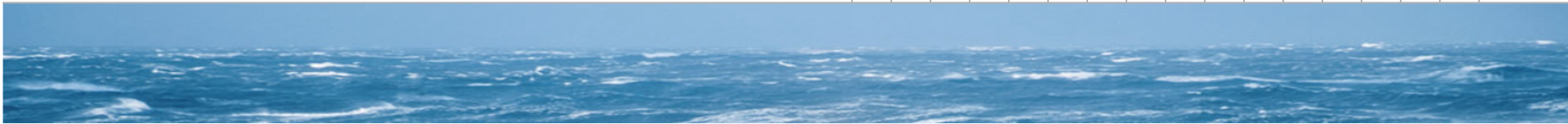
ESD Design challenges

- Effectiveness on bad designed ships generally higher,

- Often affected by speed & loading

- An ESD well-aligned on model scale might be miss-aligned on full scale (see next slide)

→ Perform combined CFD calculation (model and full scale) & model test programme to design the ESD

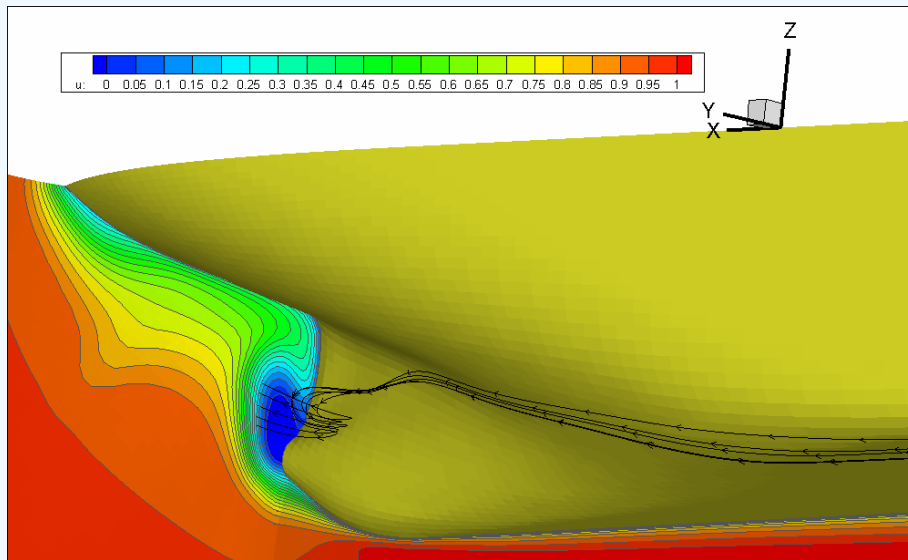- Requires validation at full scale & in service conditions
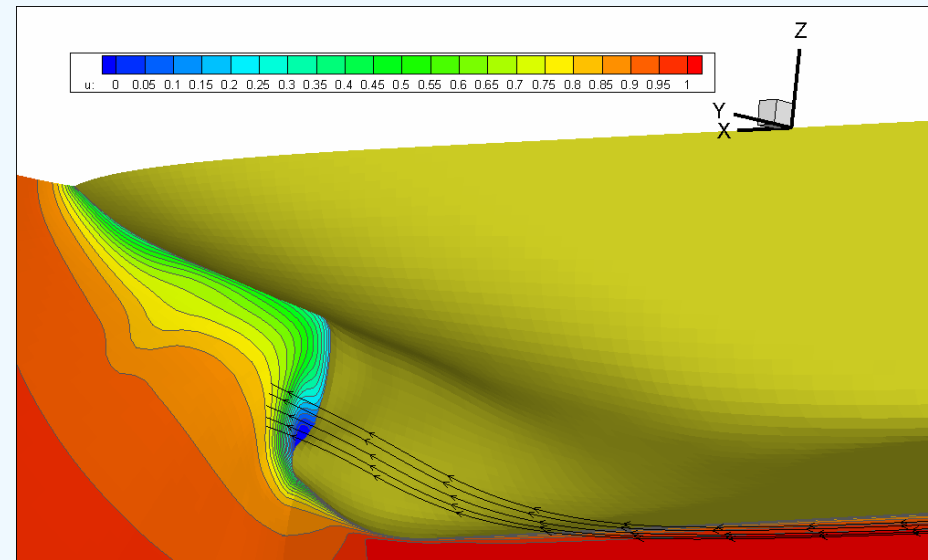
ESD: The necessity of CFD calculations

Full block bulk carrier with flow separation at gondola

Model scale

Full scale

- Streamline tracing from propeller plane upstream to locate correct position of vortex generator
- Huge scale effect on position (especially in case of flow separation) ➔ CFD work at full scale necessary, model tests might give incorrect results
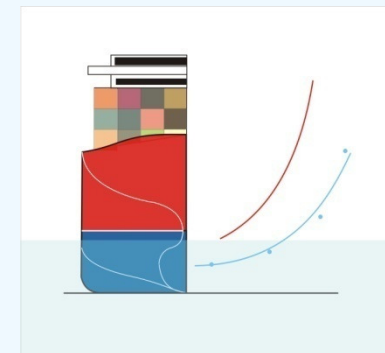
Performance optimization in service

- Optimize & validate:
    - Trim, weather routing, hull/propeller cleaning, pitch alteration, autopilot settings, ESD's
- Requires accurate comparisons of ship performance
- Through real-time, onboard analysis & display of service performance
- Stimulated by new IMO regulations (EEOI)

IMO

Service Performance Analysis JIP

– Objective: develop (on-board) analysis method for ship performance in service

– Focus points:

  – Increase accuracy & reliability of data

  – Transparent analysis model to deduce effect of environment & account for loading

– Follow-up from Sea Trial Analysis JIP

  – New standard practice for Trials

  – Standard tool for analysis

SPA-Participants (Sep 09)

1. NYK
2. UECC
3. Stolt
4. Maersk
5. HapagLloyd
6. Wagenborg
7. Stena
8. Wallenius
9. Danaos
10. MarineAtlan
11. Seatrade
12. Vroon

1. L-3 Sam
2. Marorka
3. Maris
4. Netwave
5. MeteoConsult
6. SeaWare
7. Napa
8. Kongsberg
9. Imtech
10. Aquametro
11. Amarcon

1. DSME
2. GL
3. DNV
4. LR
5. BV
6. Min.Transport
7. SMI
8. Marin

Improve performance data from ships

Data collection

– Issues in Noon reports:

– Manual input :o(

– Combining average with snapshot data:

– Changing weather conditions & Transient conditions

– Snapshot meaning

– Continuous measuring:

– Reliability of signal

– More data in different conditions

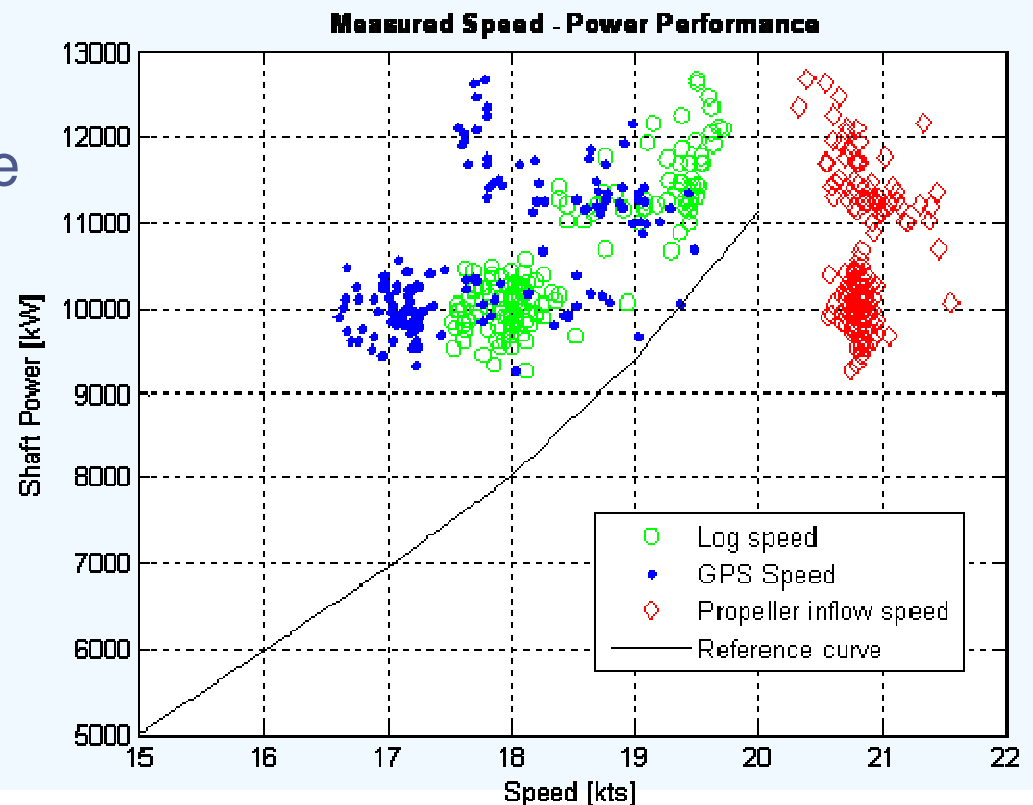– Allows smart filtering & data conditioning

ready logged terface

Scatter more than 60% higher from noon reports than from continuous measurements

Speed through water measurements…
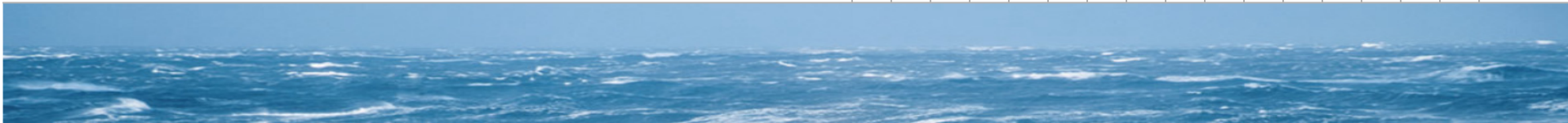
Difficult to measure:

– Effect of currents

– Salinity & temperature changes

– Calibration errors

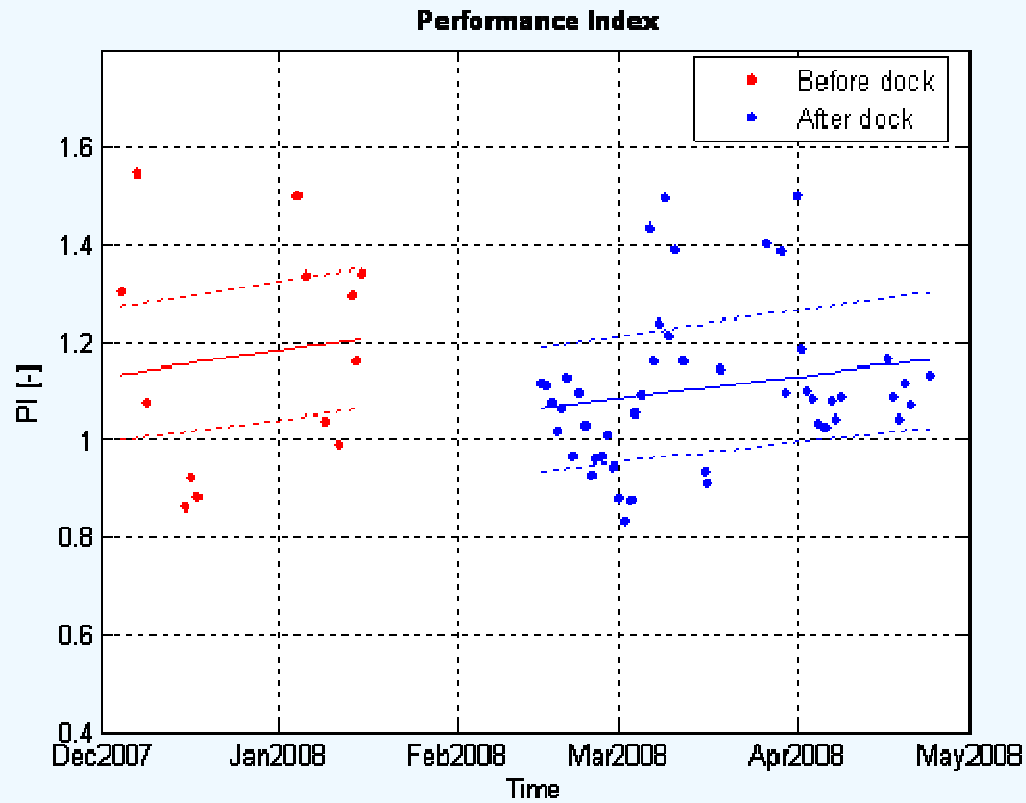– Fouling effect on boundary layer?

– Aeration of water

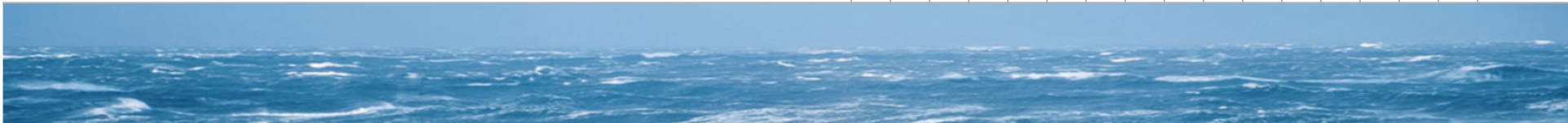**Measured Speed - Power Performance**

Legend:
- ○ Log speed
- • GPS Speed
- ◇ Propeller inflow speed
- — Reference curve

X-axis: Speed [kts] (15 to 22)
Y-axis: Shaft Power [kW] (5000 to 13000)

SPA Prototype tested on 6 ships

Effect of docking

10% power reduction by 1 m trim
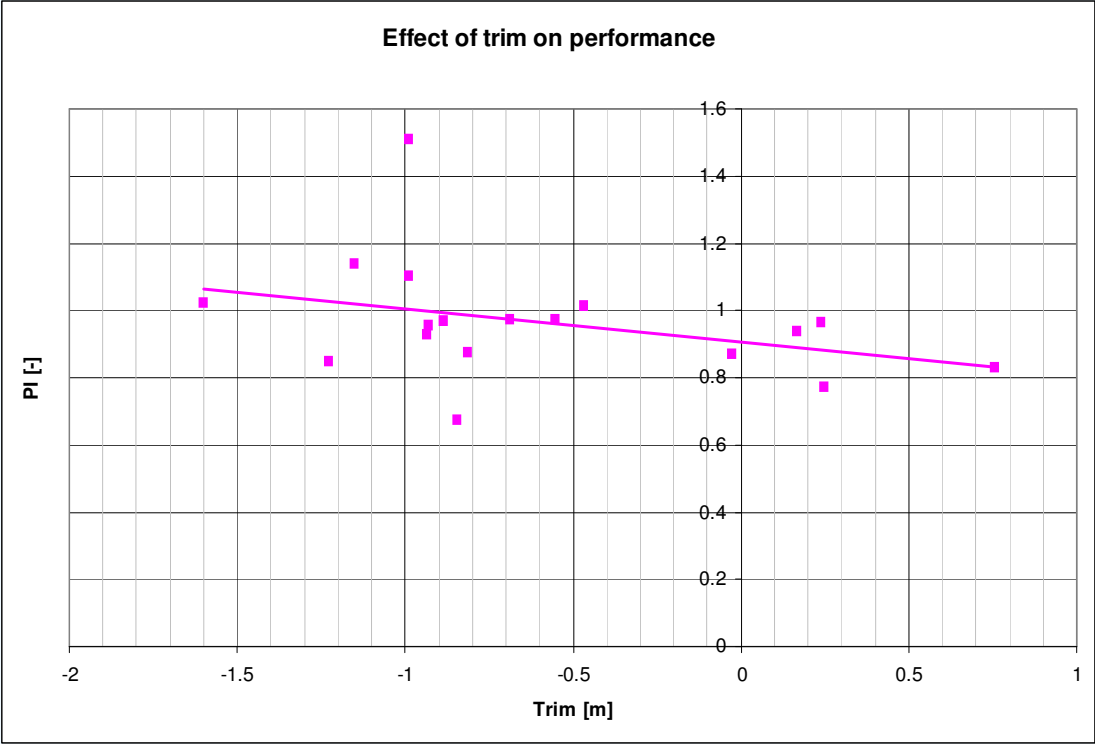
Effect of trim on performance

Ship Performance Analysis

– Scatter in KPIs almost uniquely caused by STW measurement errors

– More research underway to improve STW & data conditioning

– If service performance results are used in KPIs to assess effect of Energy Saving actions:

Accuracy & Transparency of data & analysis is a MUST!

Conclusions

1. Ships are designed for Speed Trial, not for operation → Design for Service!

2. Reliable Speed trials → STA

3. ESD may improve performance, but requires validation

4. Operational performance can be often improved by 10-15%

5. In-service performance monitoring is underway, and stimulated by new IMO regulations

For further information please contact

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