Case Studies of Optimizing Operation for Increased Energy Efficiency
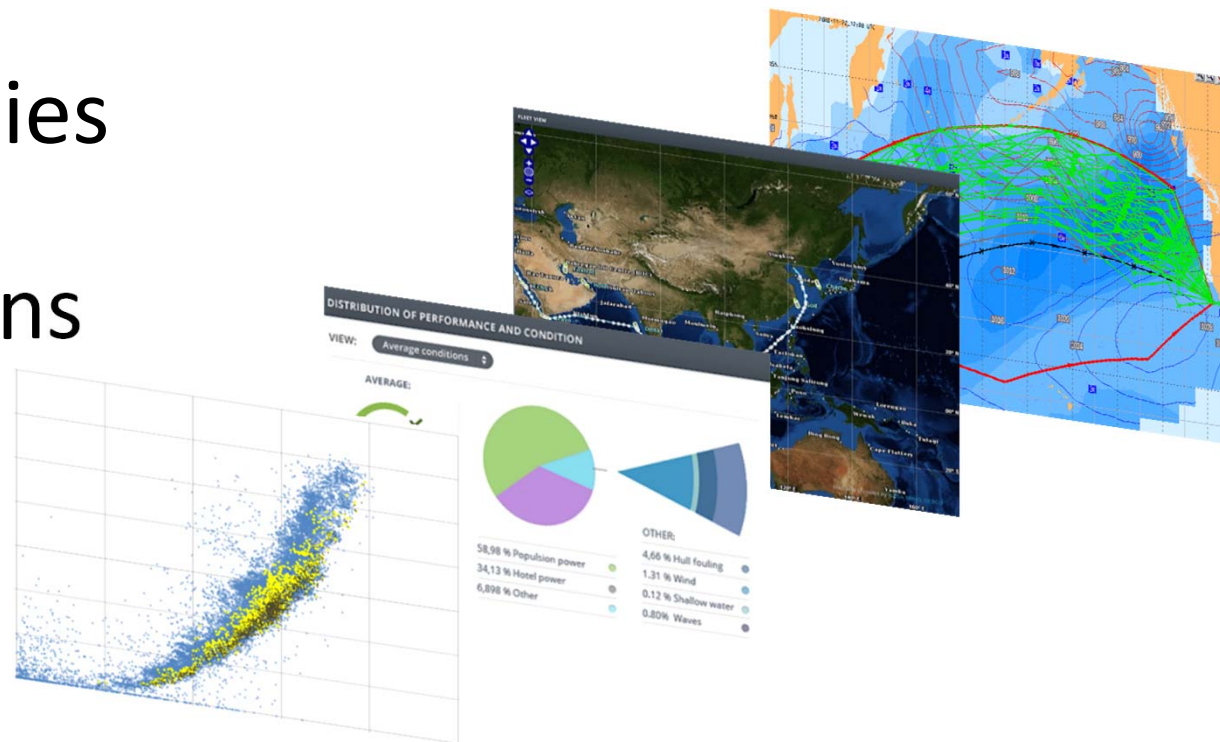
Green Technologies Seminars

16 November 2015

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- ClassNK NAPA GREEN Overview
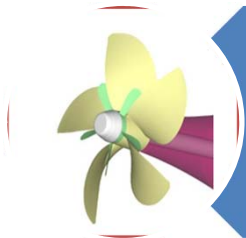
- Case Studies

- Conclusions

Introduction

ECO-Directions -Yes it is Ship Owners choice !

ECO Designs
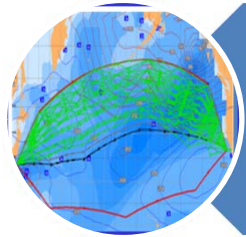
How much "ECO" is your ship?
You need a strong tool to validate

Retrofitting of Eco Devices

How you can achieve the optimum operation easily ?
A comprehensive tool for awareness and utilization of potential saving areas .

Optimum Operation

Introduction

Our Mission-For Owners and Operators :To reduce fuel costs and to make efficient operations.

- ClassNK and NAPA decided to develop new energy efficiency solutions "ClassNK-NAPA GREEN" in 2012.

- Later ClassNK acquired NAPA, which enhanced the collaboration deal and further development.

- Through developing **Dynamic Performance Model**, we launched the highest quality and real beneficial software solutions for energy savings.

Introduction

Adoption of ClassNK-NAPA GREEN

- ❏ Following shipping company decided to adopt
  - ➢ K Line
  - ➢ Evergreen
  - ➢ Wan Hai Lines
  - ➢ Stena Line
  - ➢ Bore Ltd

 Other companies in the world have adopted.

- ❏ Some shipyards have adopted for ;
  - ➢ Adding green value on their new building ships
 - ➢ Feedback to design by utilizing ship performance data in actual sea conditions

- ❏ R&D projects are undergoing total 6 ships with shipping companies and shipyards for proof of the solutions
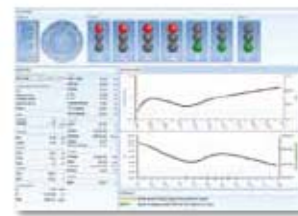
ClassNK NAPA GREEN Overview

Comprehensive solution using Dynamic Performance Model for supporting ship operations and decision-making
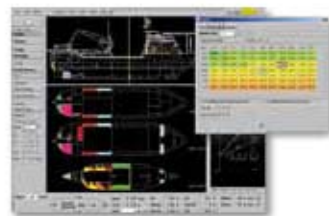
Planning of loading condition to optimum trim
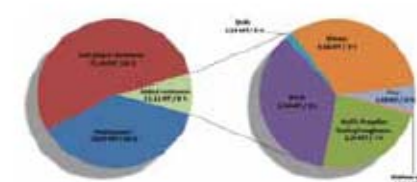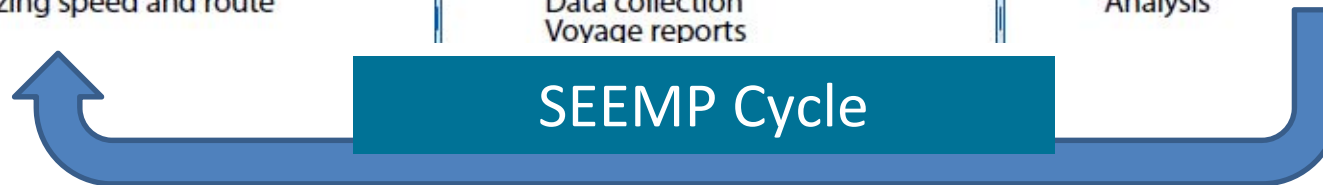
Plan
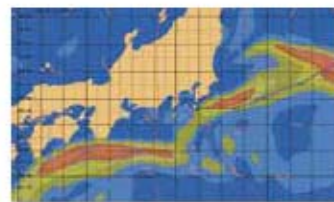
Optimizing speed and route

Real time monitoring

Monitor

Data collection
Voyage reports

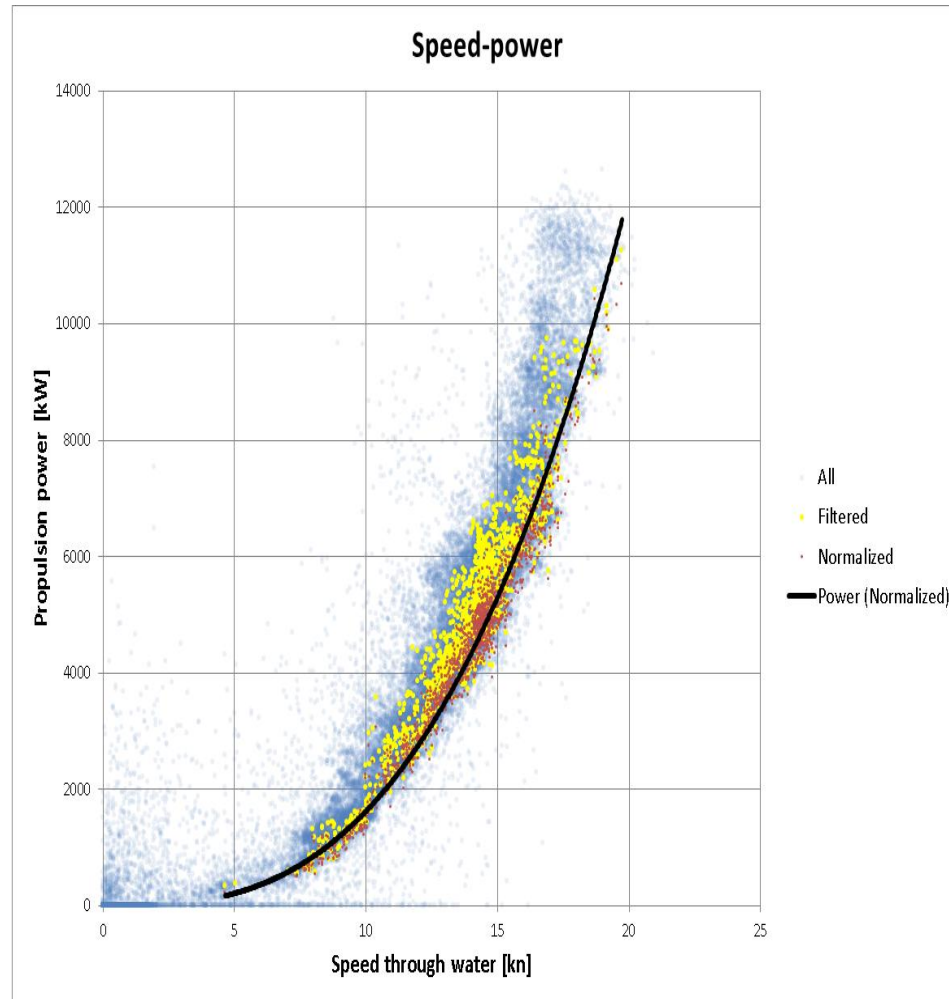Follow-up and monitoring of fleet

Follow-up

Analysis

SEEMP Cycle

ClassNK NAPA GREEN Overview

Dynamic Performance Model is the key for accuracy

Procedure
1. Data collected every 5 minutes
2. Filtering data for analyzing
3. Normalizing data by removing effects of environmental factors such as wind & waves and by adjusting displacement
4. Creating ship performance curves
Speed-Power-RPM-FOC
Response in wind and waves

Case studies

No	Case	Methodology
1	Trim optimization – two ships Savings potential 2.5 - 4 %	CFD, Full scale test, statistical analysis
2	Dynamic Performance Model Simulation accuracy 99.6%	Statistical analysis + Engineering model
3	Voyage Optimization Proven savings 3.8%	Trial + Simulation with Dynamic Performance Model
4	Bulbous bow work and DD Validated savings 25%	Filtering, normalization and statistical analysis
5	Speed optimization Proven savings 5.8%	Filtering and normalization

1. Trim optimization- 2.5 to 4%

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Methodology

- Make CFD analysis for initial trim curves
- Make full scale trim test
  – statistical analysis of full scale measurements
- Verify trim curves and tune as needed
- Do operational profile study and calculate savings potential
- **Results are accurate because trim curves are accurate.**

1. Trim optimization
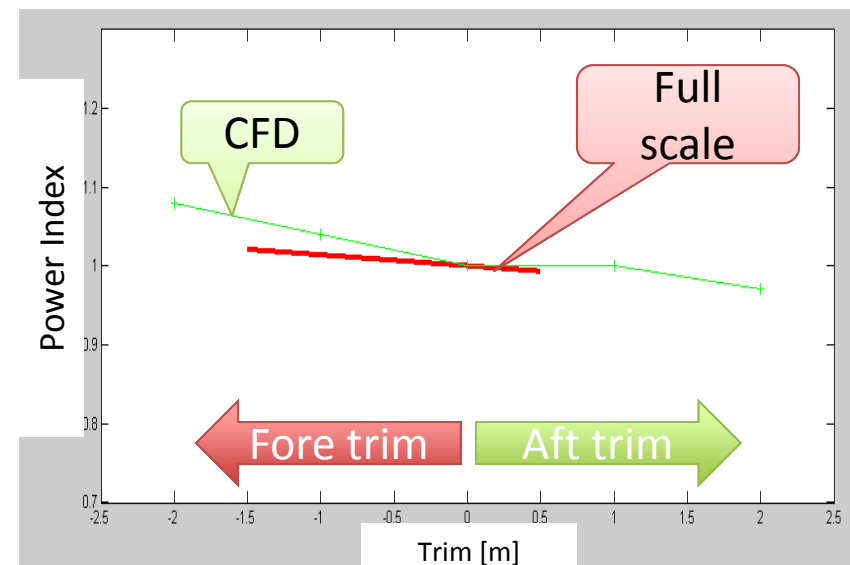## Full scale verification

8000+ TEU #1

- CFD done on generic hullform

- 2 x full scale tests done

- At 20kn speed, only full scale show that aft trim is also optimal
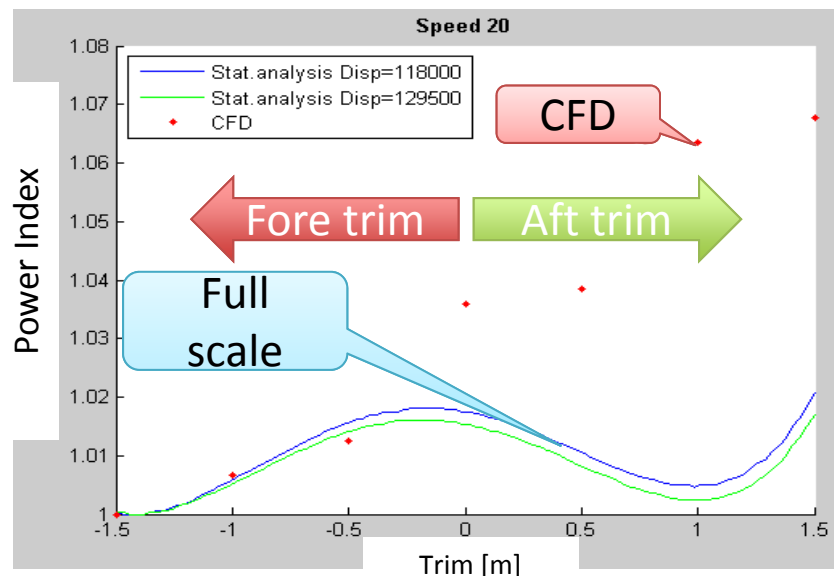
8000+ TEU #2

- CFD done on actual hullform

- 1 x Full scale verification done

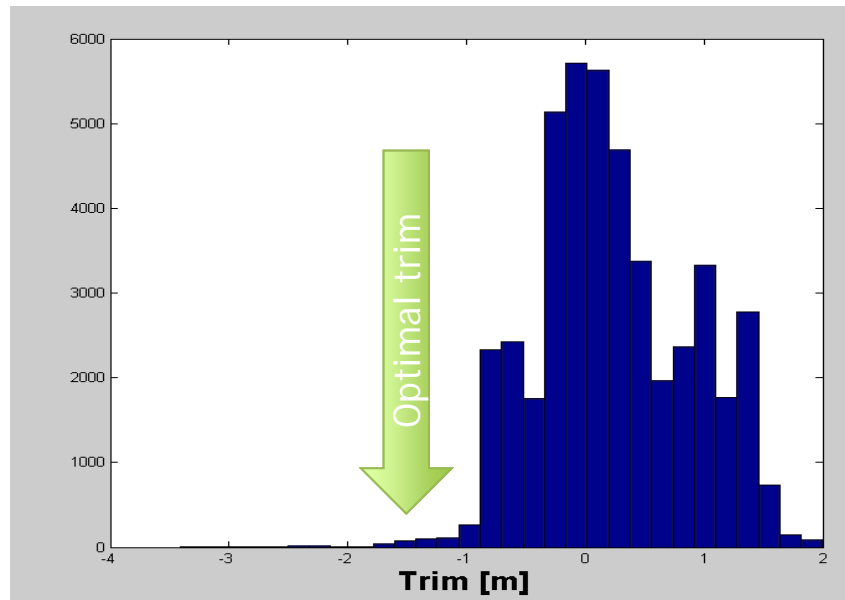- CFD matches full scale quite well → Aft trim is optimal

1. Trim optimization
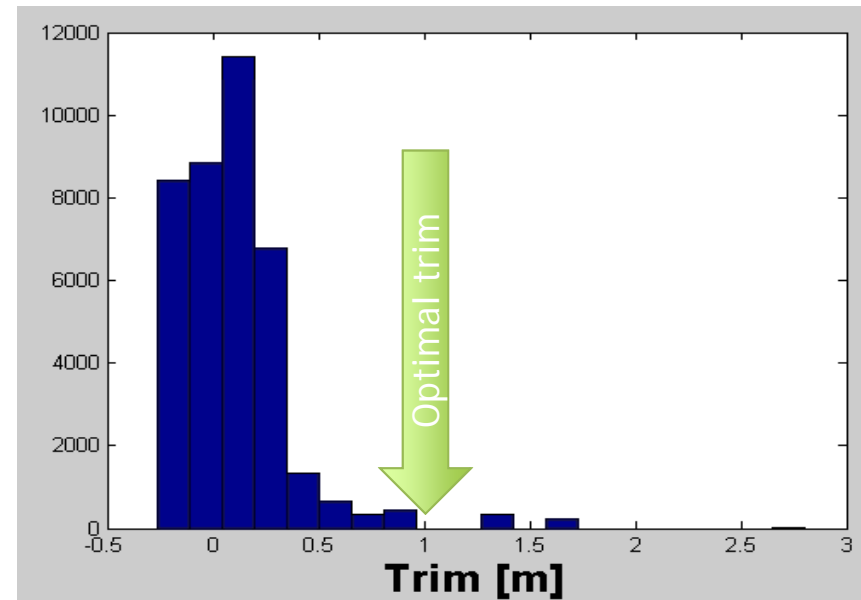## Trim optimization potential

8000+ TEU #1

- Trim optimization potential is ~4%.
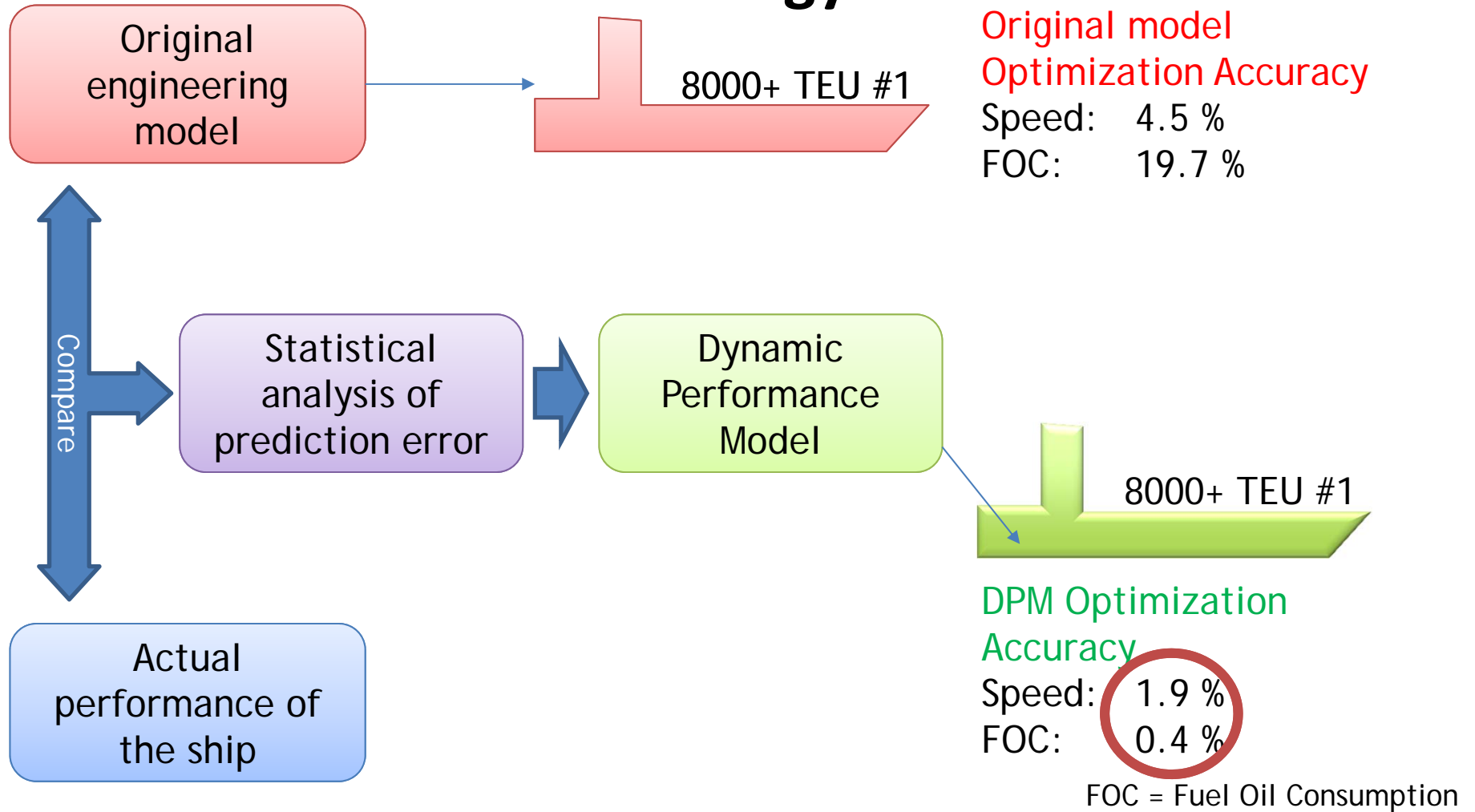
8000+ TEU #2

- Trim optimization potential is ~2.5%.

Trim distribution last 6 months

Trim distribution last 8 months

2. Dynamic Performance Model
Simulation Accuracy is 99.6%

Methodology

Original engineering model

8000+ TEU #1

Original model Optimization Accuracy
Speed: 4.5 %
FOC: 19.7 %

Compare

Statistical analysis of prediction error

Dynamic Performance Model

8000+ TEU #1

DPM Optimization Accuracy
Speed: 1.9 %
FOC: 0.4 %

FOC = Fuel Oil Consumption

Actual performance of the ship

3. Voyage Optimization

8000+ TEU full scale results for ~4% proven savings in one voyage

3. Voyage Optimization

Methodology

- Make accurate Dynamic Performance Model
  - Fuel consumption accuracy 99.6%

- Define reference voyage (Captain's plan)

- Sail trial voyage with system

- Simulate reference and trial voyage fuel consumption

- **Compare results → 3.8% reduction in fuel cons**
  Results are comparable because Dynamic Performance Model is accurate
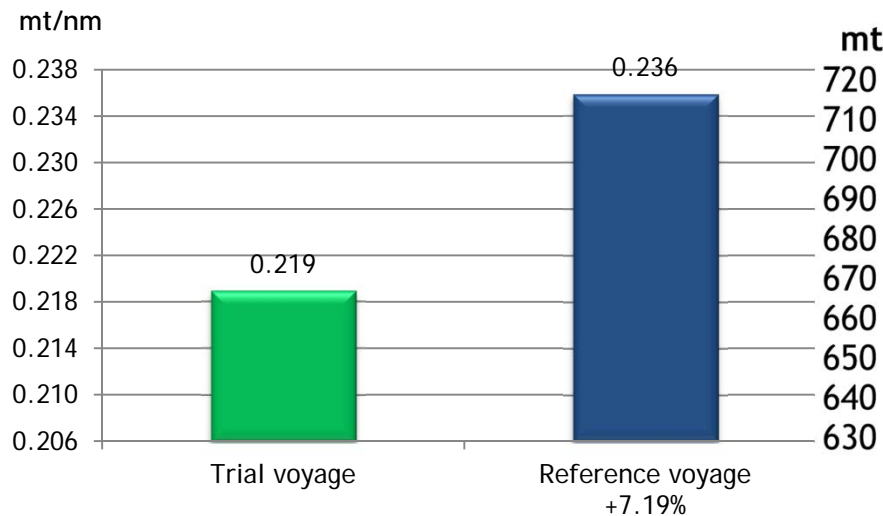
3. Voyage Optimization

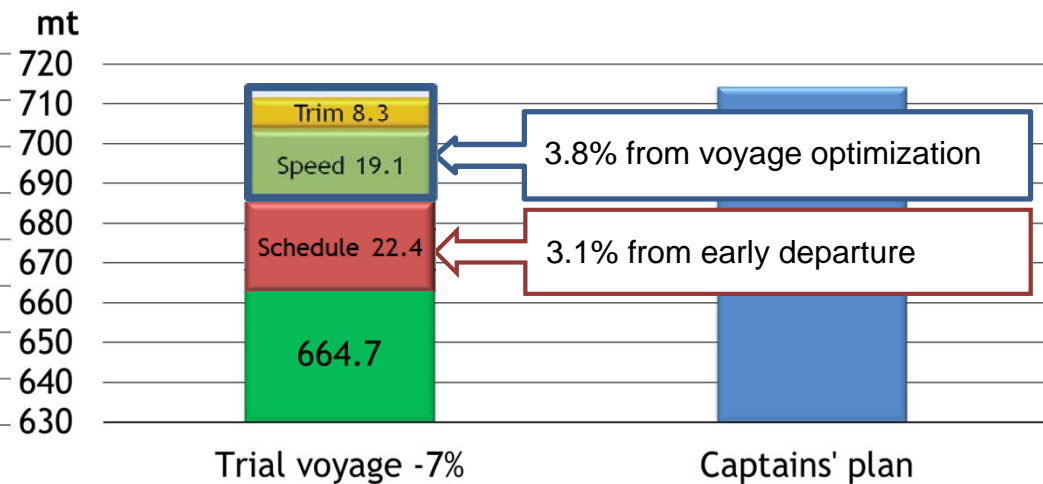Full scale VO trial 8000+ TEU Results

- Mediterranean/Europe route
  - **Speed optimization** 2.67% ⎤
  - **Trim optimization** 1.16% ⎦ 3.8%

Simulated FOC/nm

Savings break down

3.8% from voyage optimization
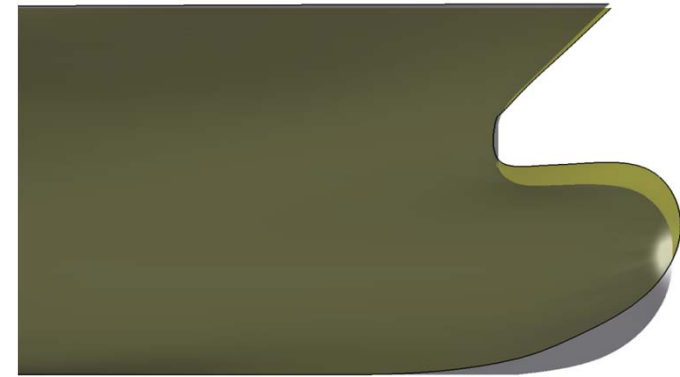
3.1% from early departure

3. Voyage Optimization

Full scale VO trial 8000+ TEU Results

- Speed optimization means optimal ConstantRPM speed profile and minimum pocket time (proven savings)

- Trim optimization means sailing on more optimum trim (proven savings).

- Weather routing is not included in this specific case

Voyage optimization proved effective even when this ship was slow streaming at 16Knots
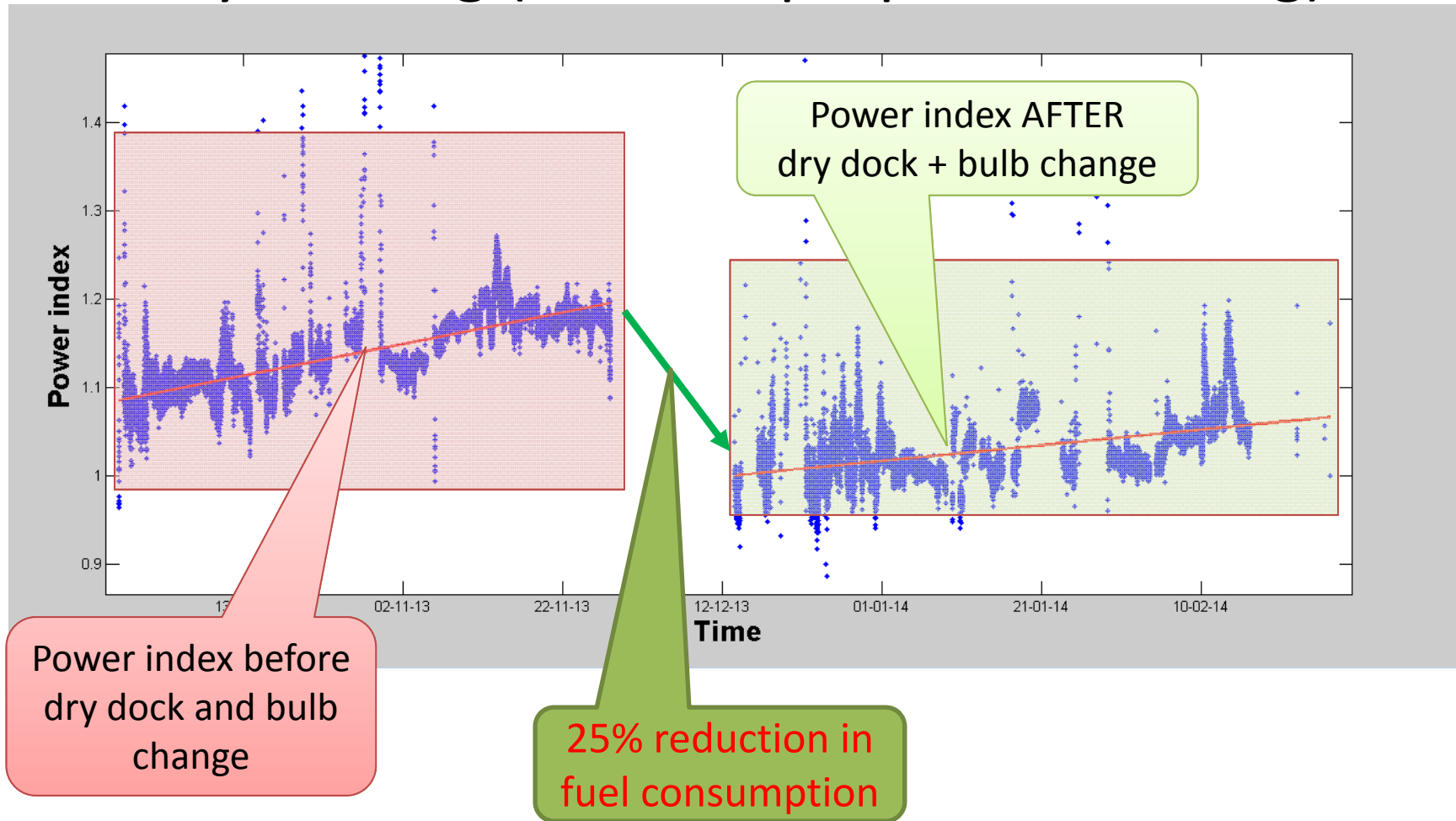
4. Bow Modification and Drydock

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- Collect data from ship
  - Before drydock
  - After drydock

- Filter, normalize, statistical analysis

- Observe effect on power index

- Calculated fuel savings → 25%

4. Bow Modification and Drydock

ClassNK

Effect of bulb change
and dry docking (hull and propeller cleaning)

Power index AFTER
dry dock + bulb change

Power index before
dry dock and bulb
change

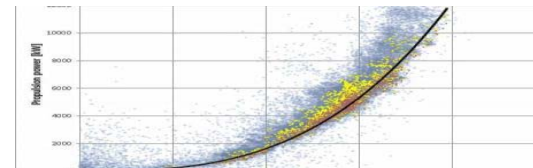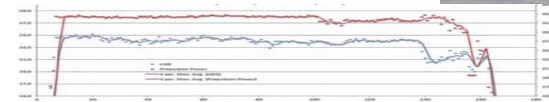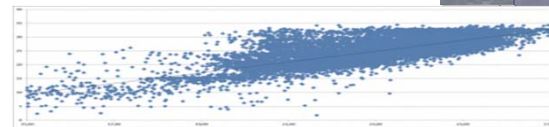25% reduction in
fuel consumption

5. Speed Optimization

ClassNK

Fuel Savings
5.8%

- Install systems
  - Trim and Displ. Optimization
  - Voyage Optimization
  - Voyage Reporting
  - Real Time Monitoring
  - Office web portal
  - Analysis service

- Did reference period 2 months

- Did trial period 3 months
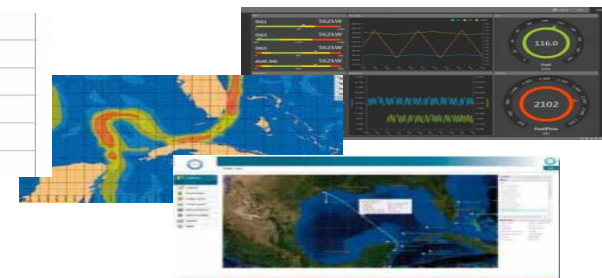
0.068 t/nm ➡ 0.065 t/nm

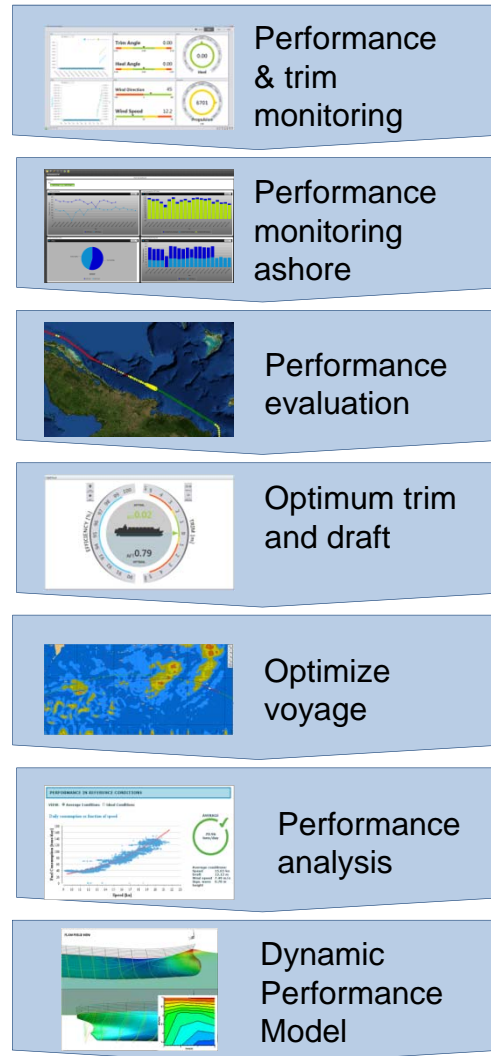**Source: RoRo Shipping Conference 2013, Copenhagen, Denmark**

Conclusion – Solution Outline

Monitoring

Ship performance monitoring and data analysis

Comprehensive tools for
- evaluating and reacting to ship performance
- learning of ship characteristics
- creating savings through increased awareness

Performance & trim monitoring

Performance monitoring ashore

Performance evaluation

Optimum trim and draft

Optimize voyage

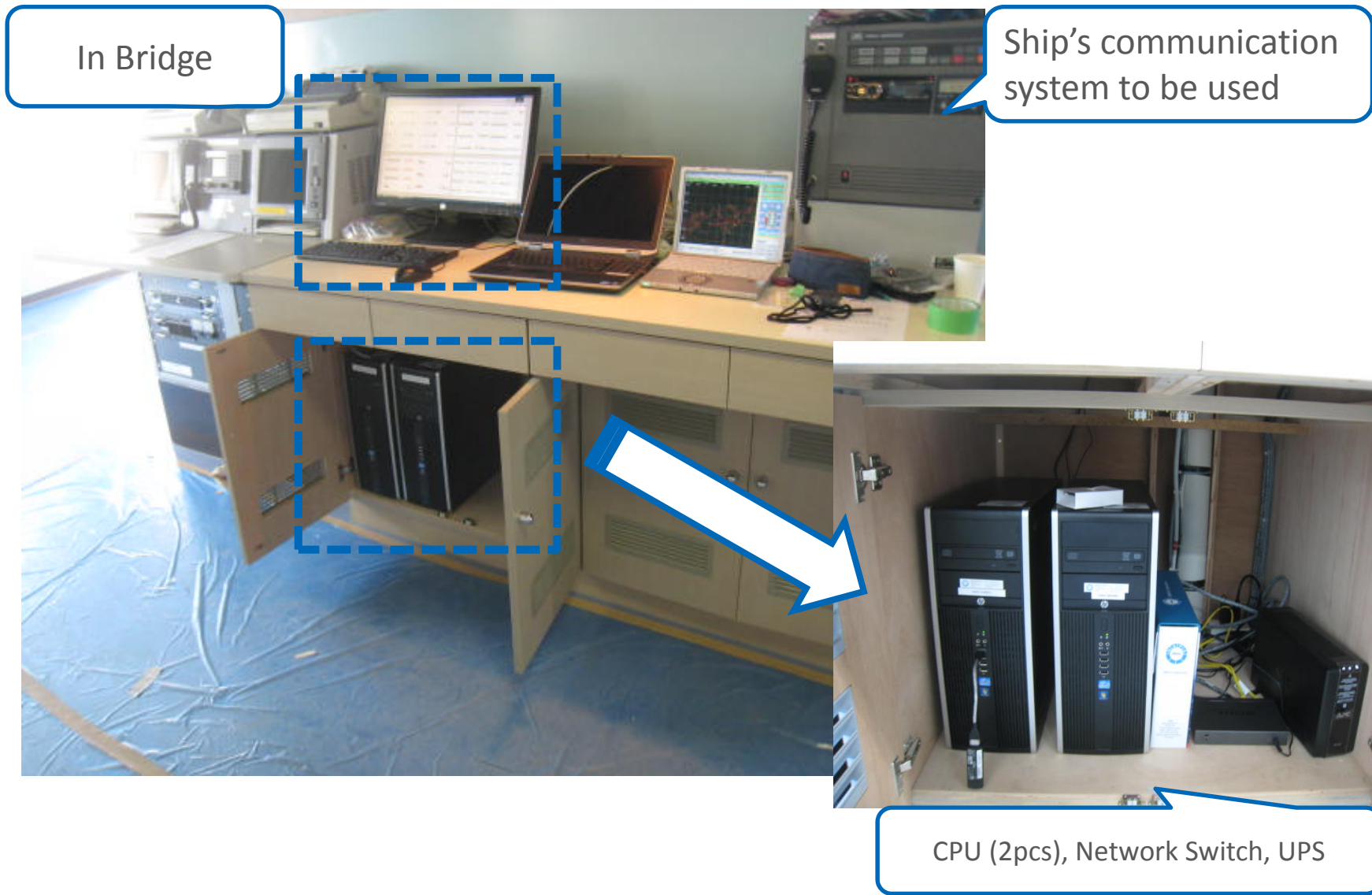Performance analysis

Dynamic Performance Model

Optimization
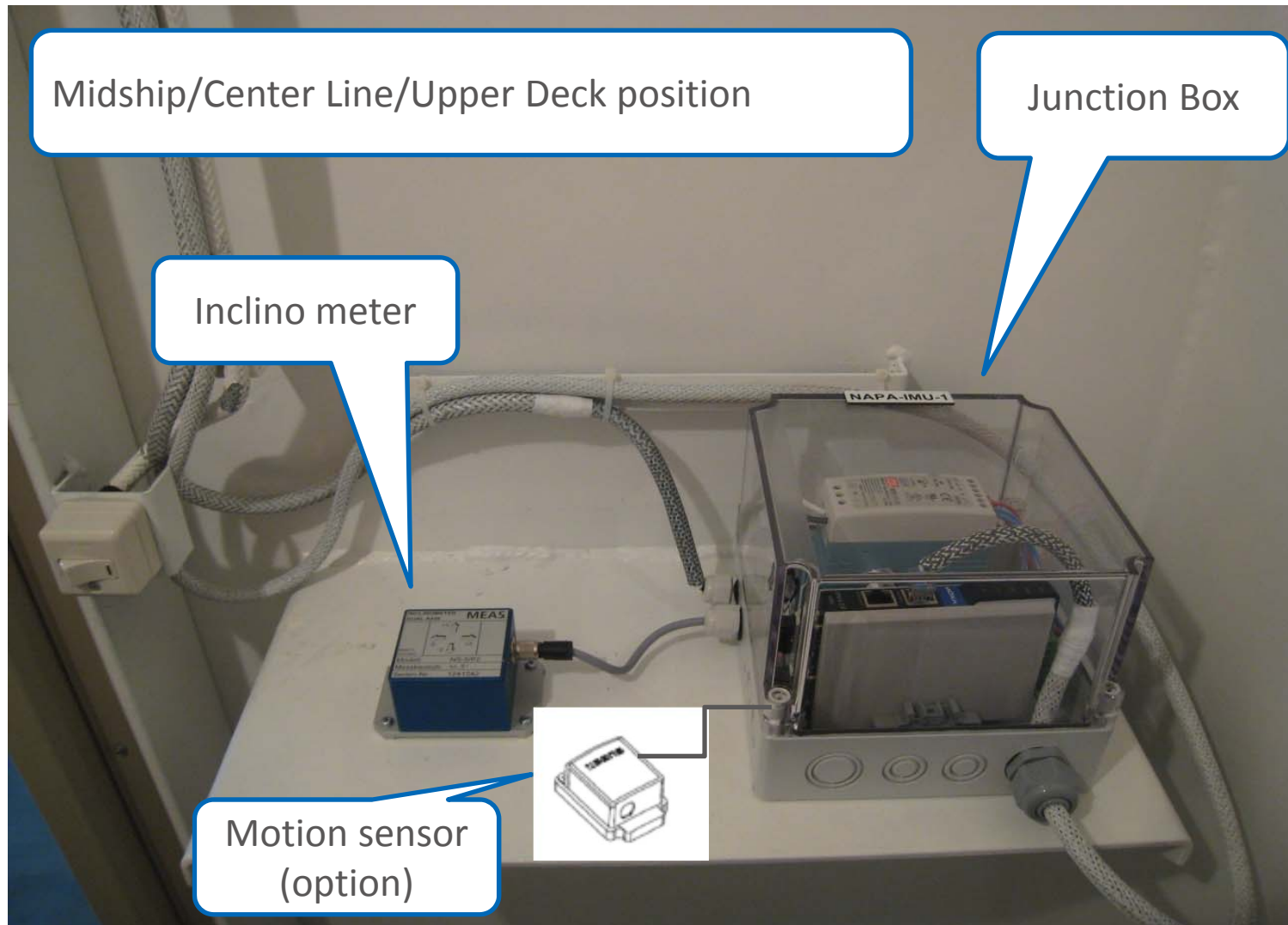
Fleet performance management and optimization

Excellent voyage execution through
- accurate voyage planning and optimization
- route, speed and trim recommendations
- flexible fleet performance management tools
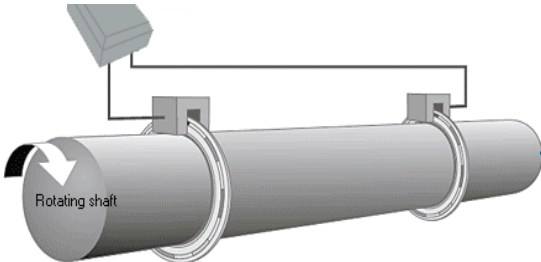
Conclusion – Image View

In Bridge

Ship's communication system to be used

CPU (2pcs), Network Switch, UPS

Conclusion – Image View

Midship/Center Line/Upper Deck position

Junction Box
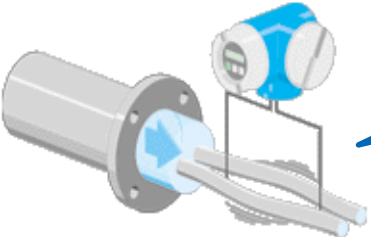
Inclino meter

Motion sensor (option)

Conclusion – Necessary Equipment

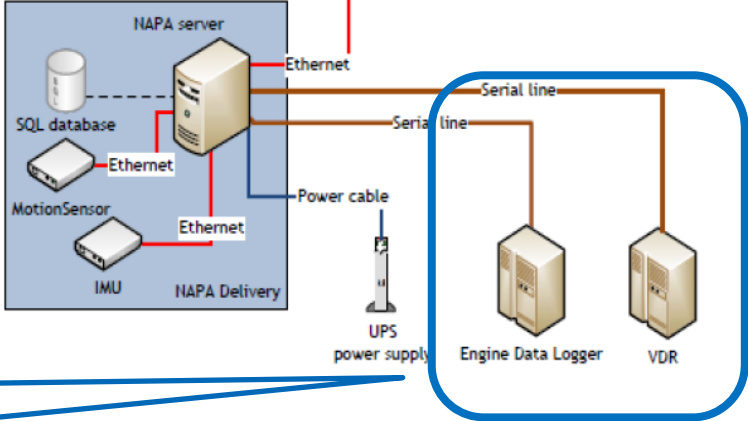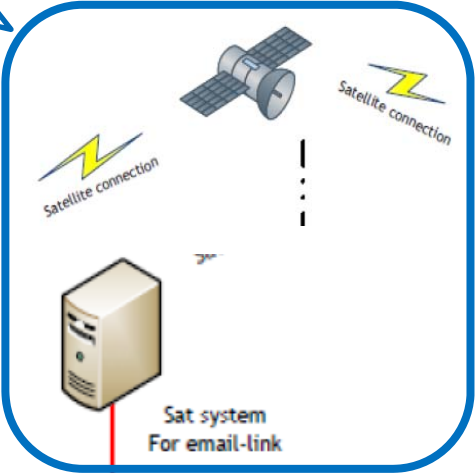
E-mail communication & ship's LAN

Torque Meter

FO Flow Meter

Interface with VDR & Data Logger

Conclusion

➢ **Effective analysis of data is one of the key for energy efficiency in operation and further decision making.**

➢ **Technology has grown to hold hands with Captain for finding the optimum speed and route with just in time arrival.**

➢ **Energy Management Awareness for both crew and shore personnel is facilitated by using effective tools.**

➢ **Still much of the trim saving potential is unutilized by ships which has to be reaped for efficient operations.**

➢ **Fuel saving software ClassNK NAPA Green case studies showed very good results.**

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THANK YOU

For Your Kind Attention

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