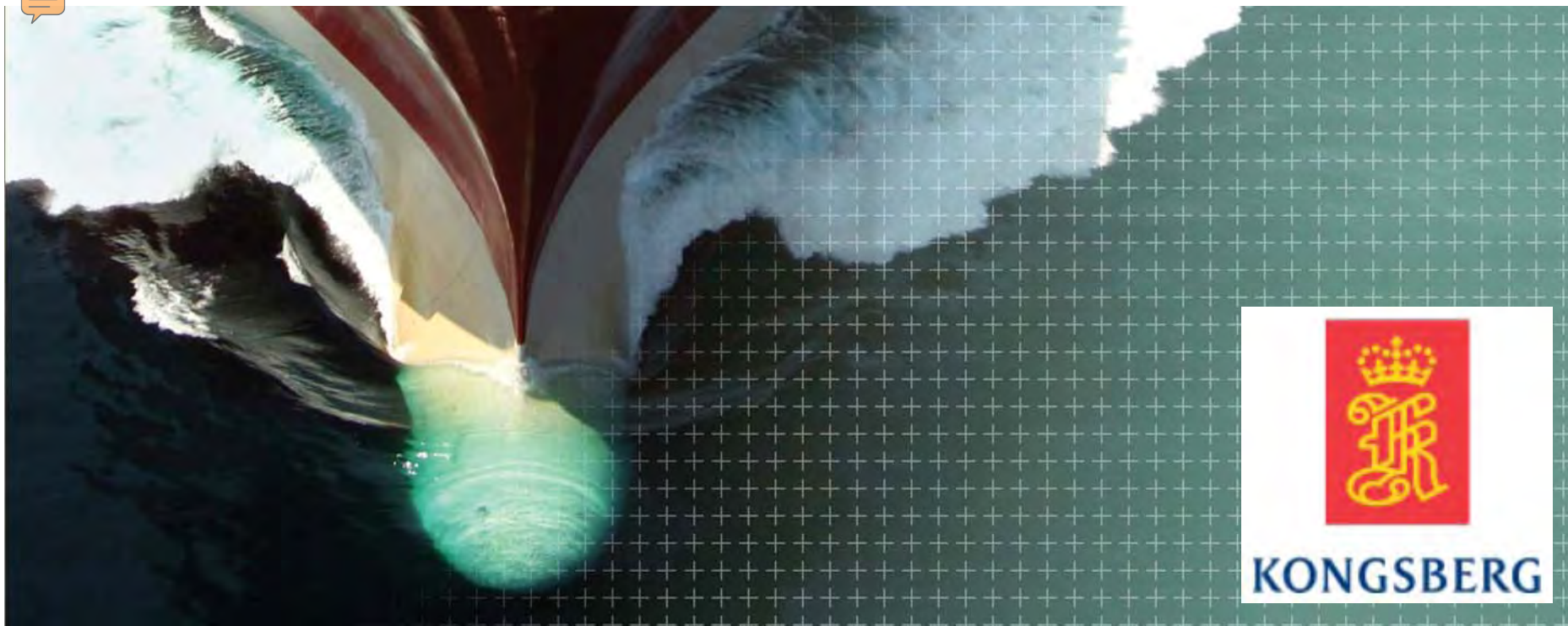




Kongsberg Maritime

“Green Ship” paper at Mari-Tech 2010

Montreal 11 June 2010

Kongsberg Gruppen



Kongsberg Gruppen (KONGSBERG) is an international, knowledge-based group that supplies high-technology systems and solutions to customers engaged in the oil and gas industry, the merchant marine, and the defence and aerospace industries.



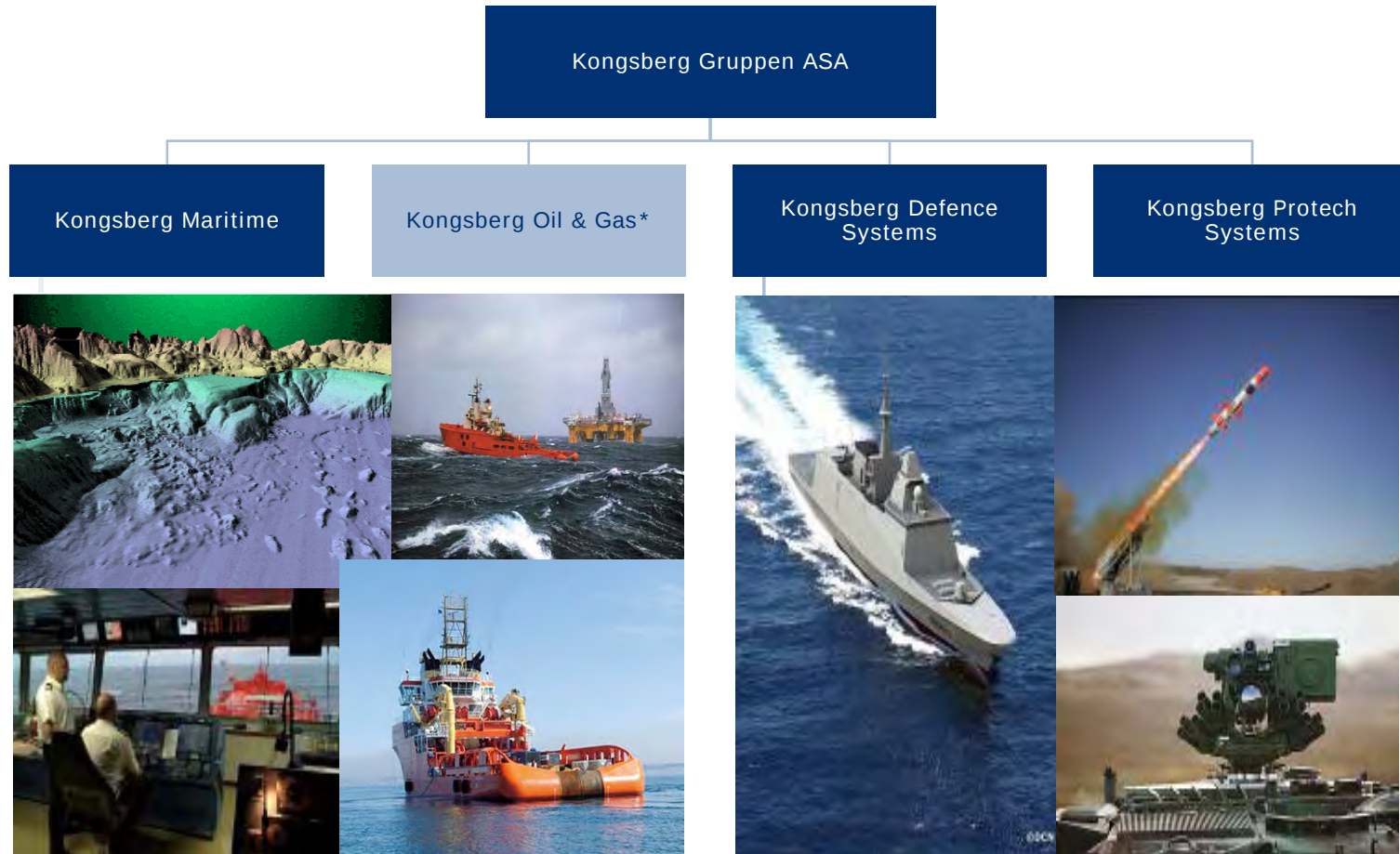
Year 2009

Revenue us\$2,300,000,000

Backlog us\$3,300,000,000

Employees ~ 5,400

Kongsberg Gruppen



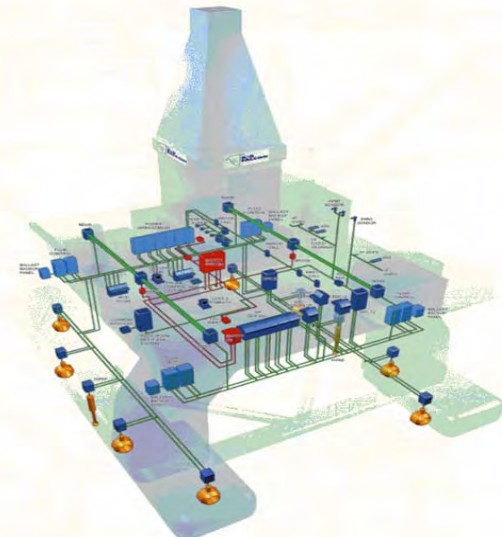
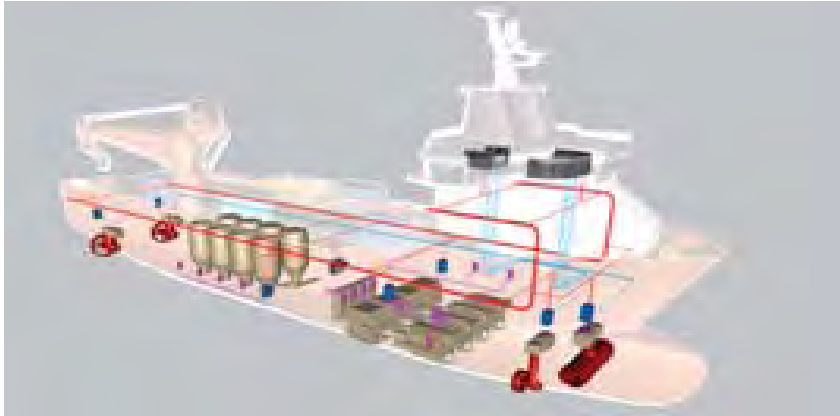
Briefly about **Kongsberg Maritime**



- ~ 3500 employees in 25 countries
- 60 years marine experience (Norcontrol, Autronica, Simrad & Albatross)
- Marine Automation
- Dynamic Positioning
- Navigation
- Cargo Monitoring & Control
- Maritime Training Simulators
- Position Reference Systems
- Hydroacoustics & Sub Sea systems



Dynamic Positioning



Monitoring & Control

Machinery & Propulsion



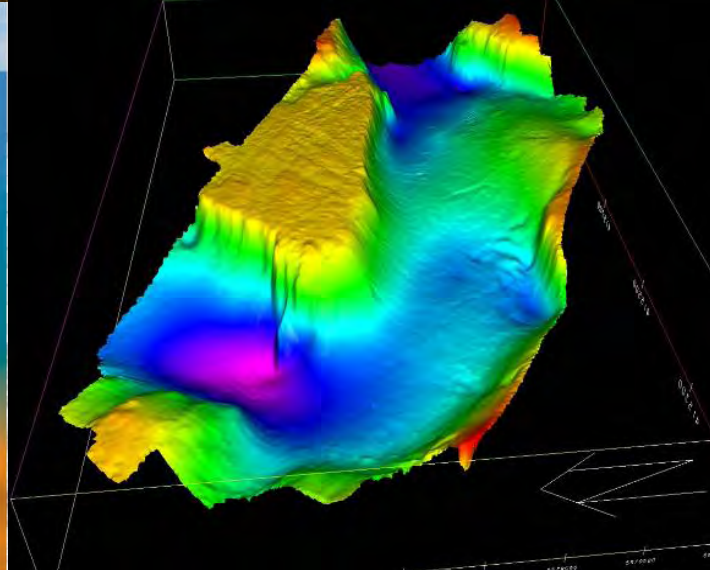
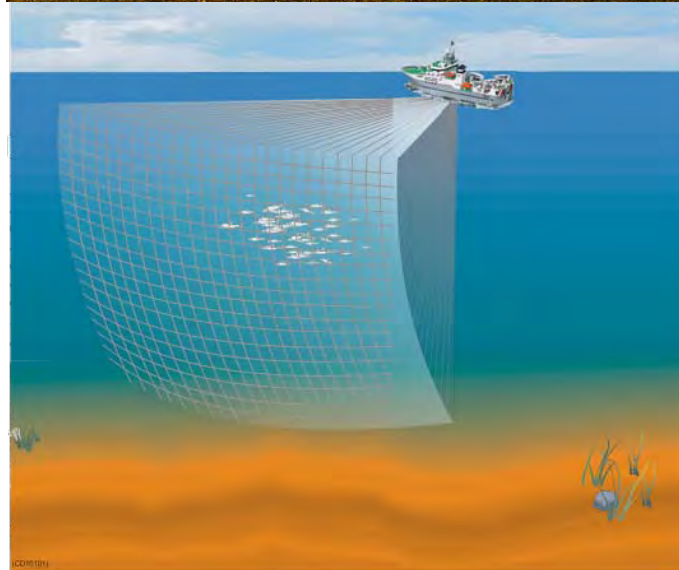
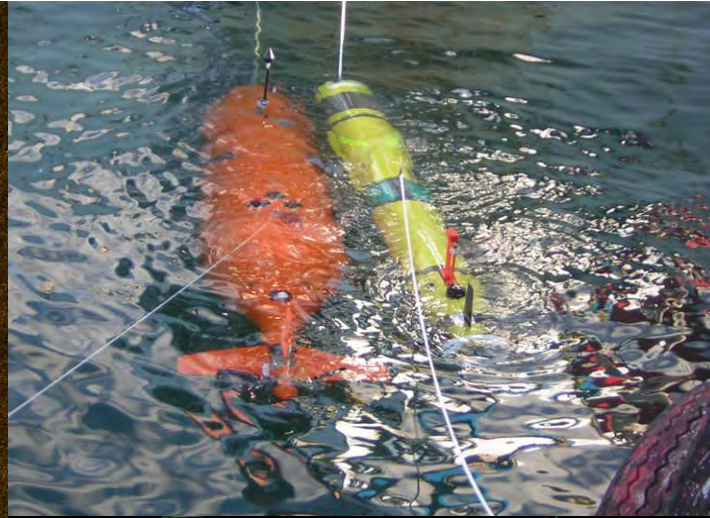
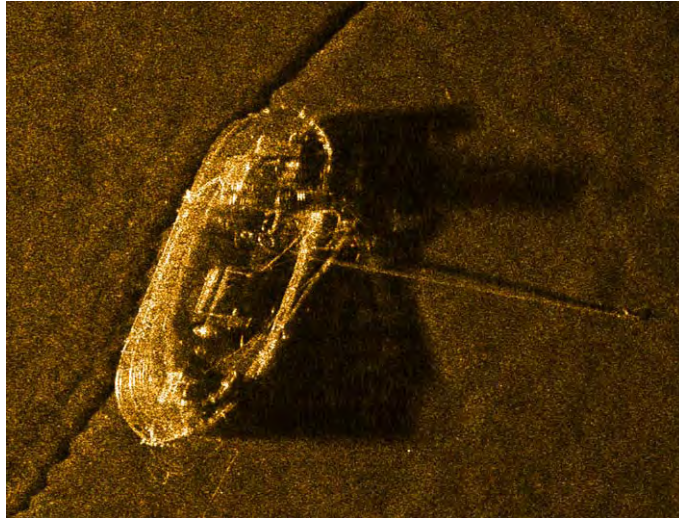
Process automation



Ship Simulation



Hydroacoustics



Kongsberg Maritime

- World Wide Customer Support



More than 15 000 Ships



THE FULL PICTURE

Maximizing marine
performance by providing

the Full Picture



REMOTE
DIAGNOSTICS



LOGGING &
REPORTING

NAVIGATION

CARGO
MONITORING
& CONTROL

PROCESS
CONTROL

THRUSTER
CONTROL

ALARM &
MONITORING
(UMS/E0)

POWER
MANAGEMENT

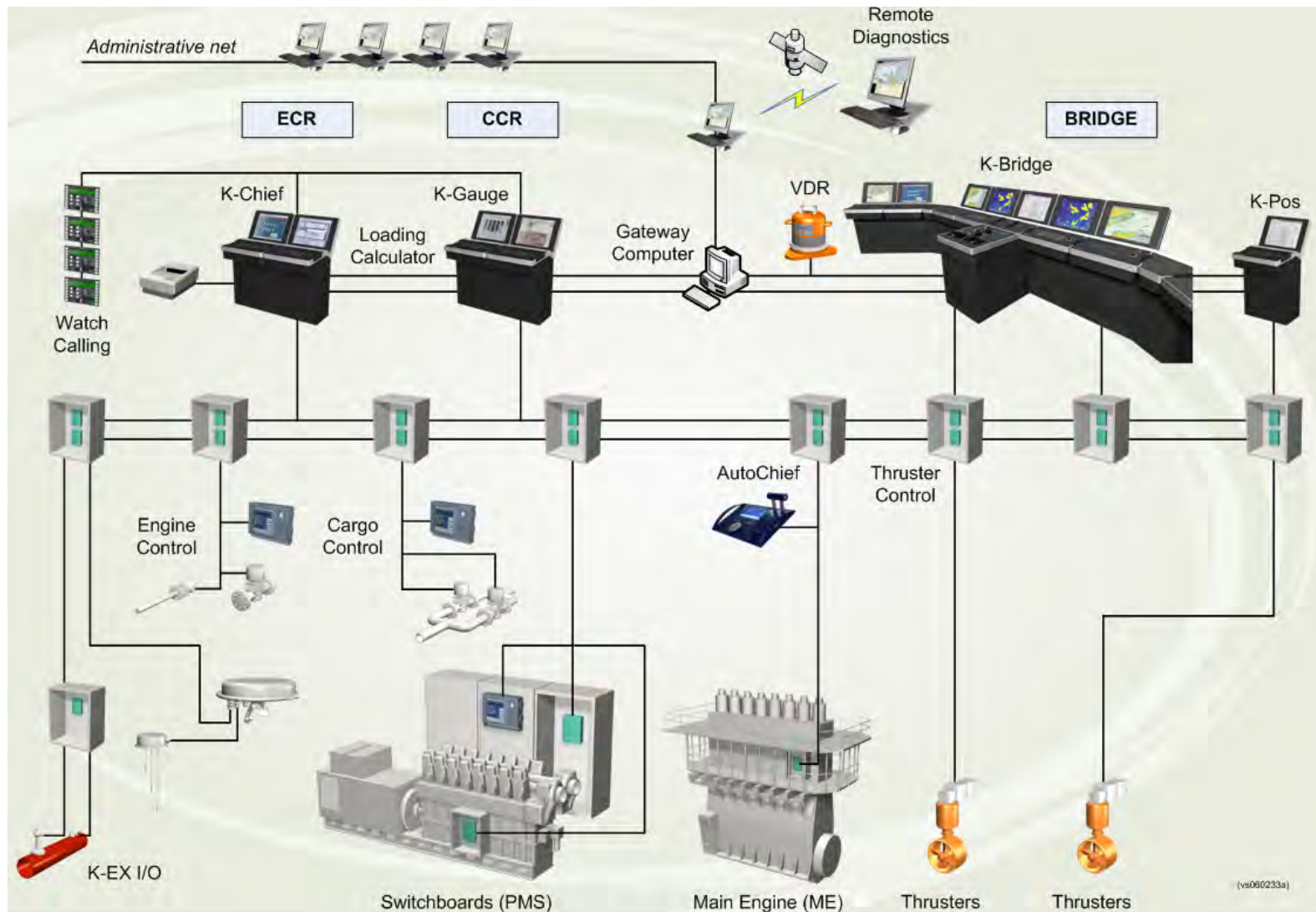
PROPULSION
CONTROL



KONGSBERG

THE FULL PICTURE

Maximizing performance by providing the Full Picture





*How can **Kongsberg** contribute
to a **greener** shipping
environment?*



KONGSBERG

the Full Picture

in a Green perspective



- Organizing Control/Monitoring > integrated system
- Operator has **full picture** of onboard machinery condition.
- We cannot revolutionize ship/engine. We can ensure **optimal performance** so vessel is operated in most environmentally friendly way.
- **Optimize** directly through automation & indirectly by giving crew tools to control.
- We develop/deliver sensors and systems to give operator in-depth knowledge of machinery condition
- Achieve **optimization** with minimal maintenance cost.

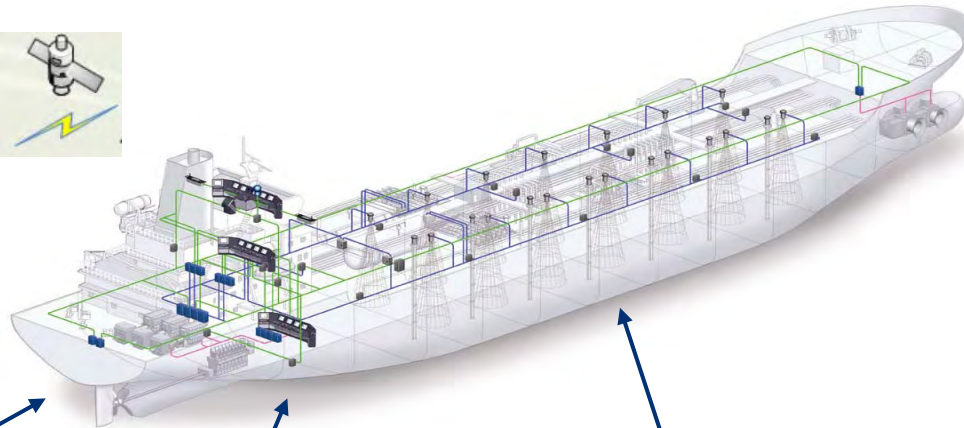
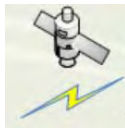
the Full Picture

in a Green perspective



KONGSBERG

**FLEET
MANAGEMENT**



**ENGINE
PERFORMANCE**

**ENERGY
PERFORMANCE**

**HULL
PERFORMANCE**

**NAUTICAL
PERFORMANCE**

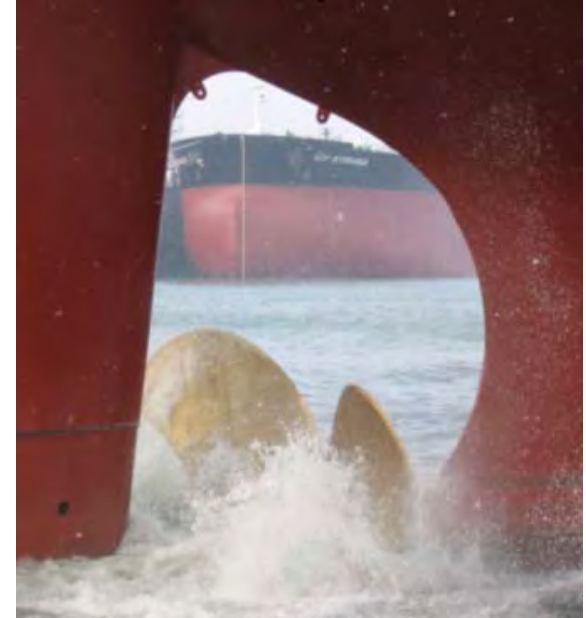
THE FULL PICTURE

Kongsberg Maritime

Vessel Performance System



- Integrates Kongsberg Maritime products + selected 3rd party applications
- Gives crew & owner “the full green picture” of vessel & onboard machinery
- Modern, future-oriented 3rd party integration = flexible system, adapts to each vessel
- Key elements:
 - ✓ Engine optimization
 - ✓ Fuel oil monitoring
 - ✓ Efficiency monitoring
 - ✓ Power monitoring
 - ✓ Draft monitoring
 - ✓ Trim monitoring
 - ✓ Voyage planning
 - ✓ Reporting





KONGSBERG

Engine Performance and Optimisation

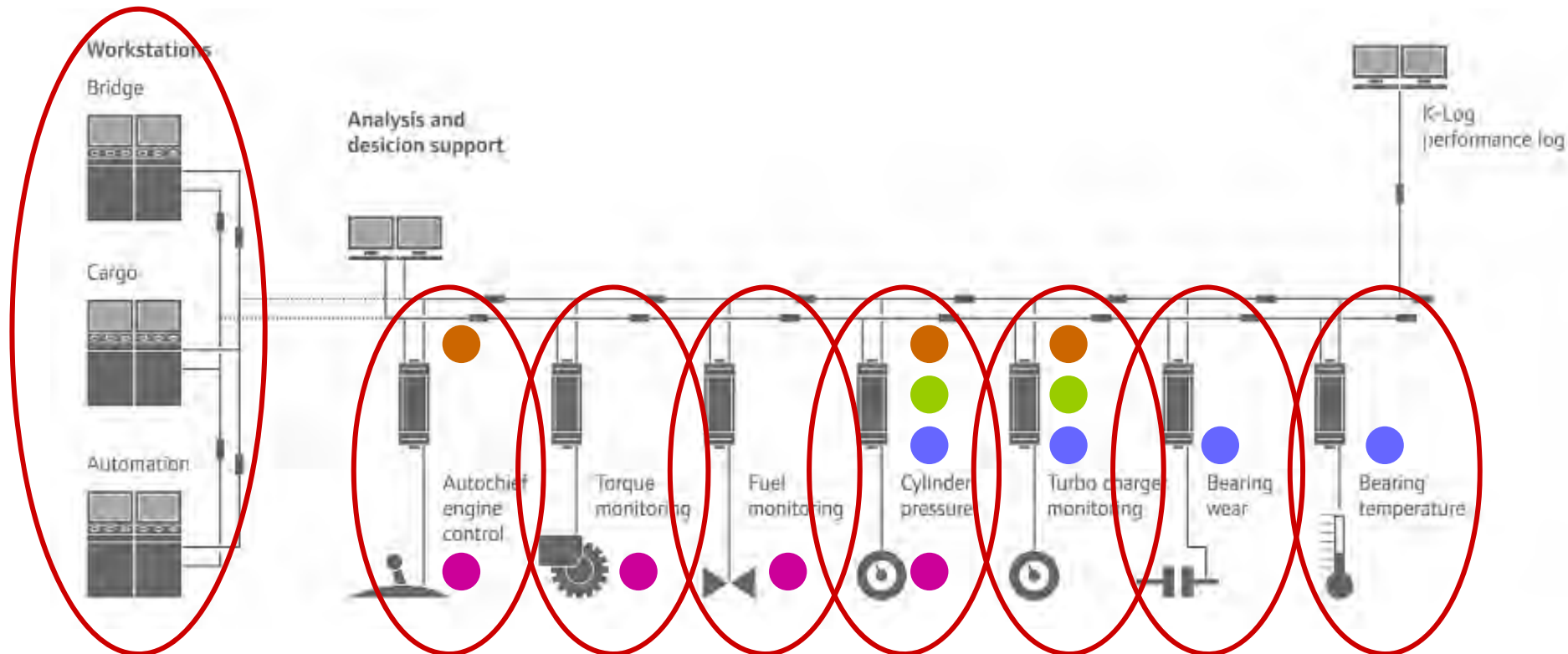


Engine Performance and Optimization

- Measuring points

- Fuel efficiency
- Reduced emission
- Condition monitoring for predictive maintenance
- Data for performance calculation

Optimization guidance



Engine Performance and Optimization

- Performance Monitoring Display (K-Chief 600)

- ✓ Power Performance (kW/rpm)
- ✓ Fuel Performance (kg/nm)
- ✓ Fuel Consumption (g/kWh)
- ✓ Power Consumption (kNm)
- ✓ Fuel Oil Flow (kg/h)
- ✓ Shaft Power (kW)
- ✓ Power curve (kW/knots)
- ✓ Aux engine Fuel Oil Flow(kg/h)
- ✓ Cylinder Lub oil Flow (kg/h)
- ✓ Propeller slip (%)
- ✓ Other information (on request)



Engine Performance and Optimization

- Flexible and informative user views (K-Chief 600)

Night view



Day view



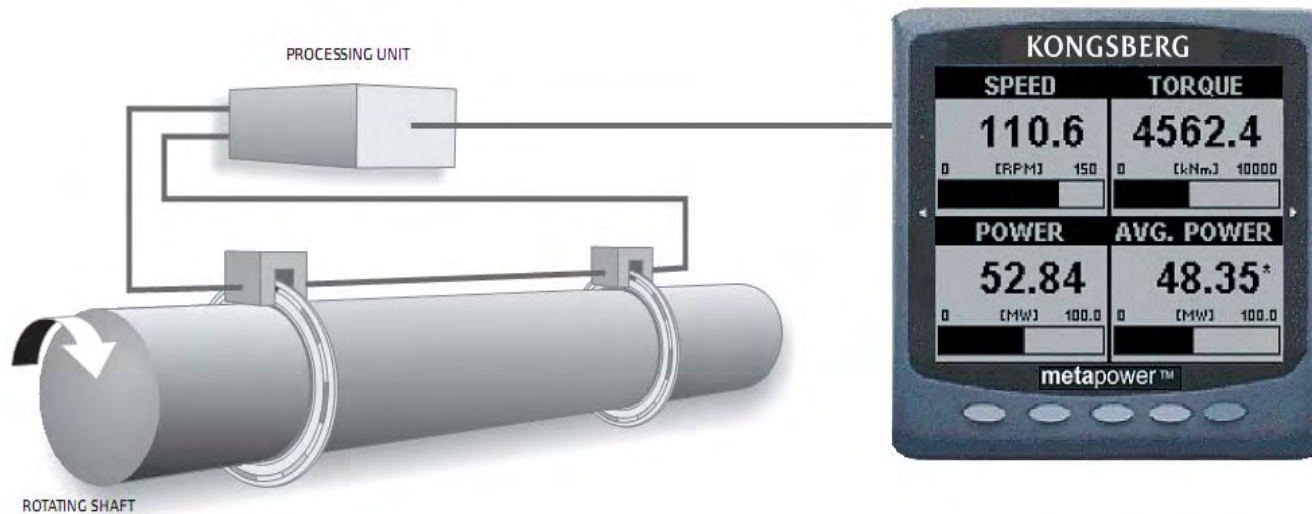
Engine Performance and Optimization

- Propulsion Control System (AutoChief C20)



Engine Performance and Optimization

- Shaft Torque Measurement (MetaPower)



Advantages compared to conventional methods

- No sensitive electronics glued to shaft
- No mechanical wear
- No zero point drift over time
- Not affected by ambient temperature variations
- Easy to re-install

Service free operation





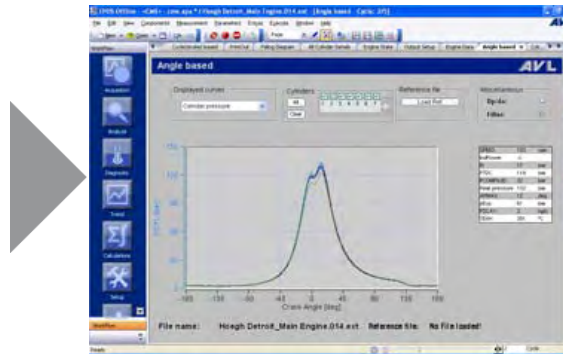
Engine Performance and Optimization

- Cylinder Pressure Measurement

- Continuous monitoring of cylinder pressures
- Diagnostic algorithms based on engine know-how & validated empirical results
- Provides the tool and guidance for engine tuning and optimization
- Sensor and diagnostic algorithms developed by AVL software integrated in K-Chief 600 and operated from the Remote Operation Stations



Monitoring



Analyses & diagnosis

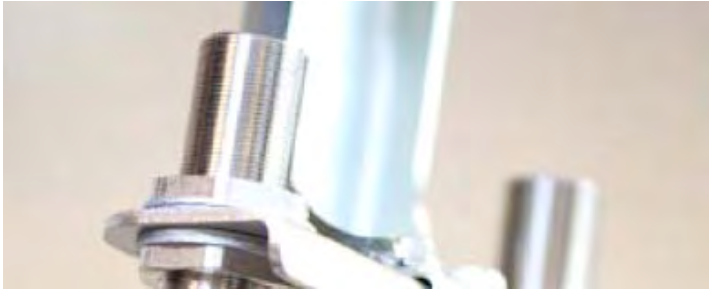


Decision support

Engine Performance and Optimization

- Condition Monitoring Sensors

Bearing Wear Monitoring



MetaPower - Shaft Torque Monitoring



Bearing Temperature Monitoring



SENTRY – Wireless Temperature Monitoring



Water in Oil Monitoring



Liner Scuffing Control



Engine Performance and Optimization

- Summary



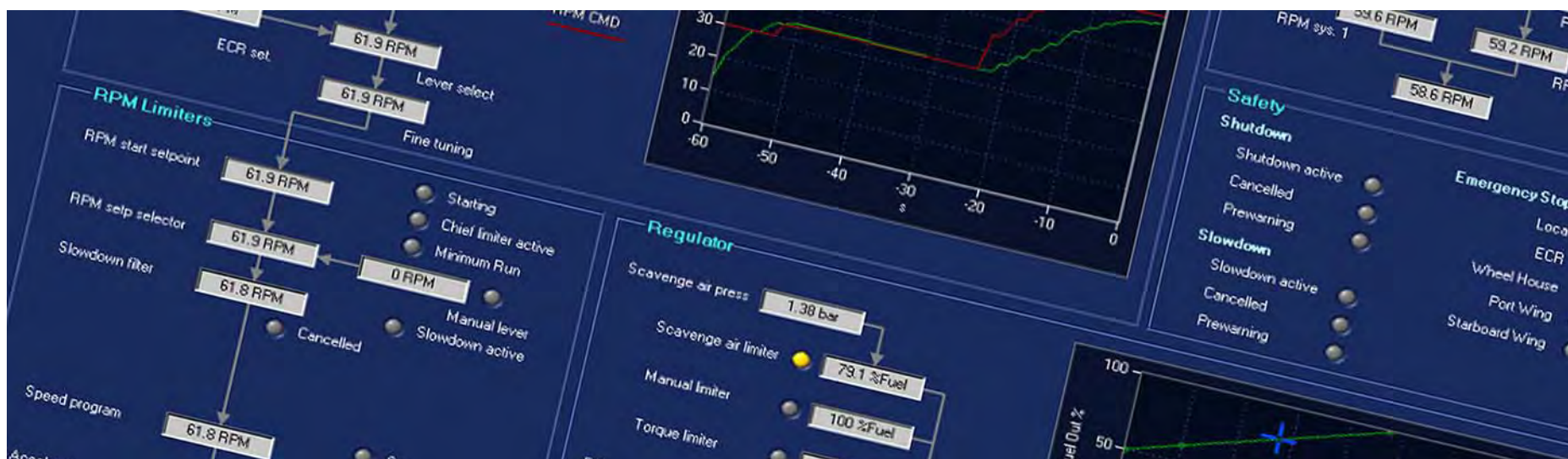
KONGSBERG

- Continuous observation of engine performance
- Early detection of potential wear, failures or damages
- Decision support - assist crew in optimal engine adjustment
- Reduced fuel consumption – less emission
- K-Log is prepared for emissions report (e.g. Sox, Nox).
- Fleet-wide data base enables fleet bench-marking



KONGSBERG

Energy Performance & Management



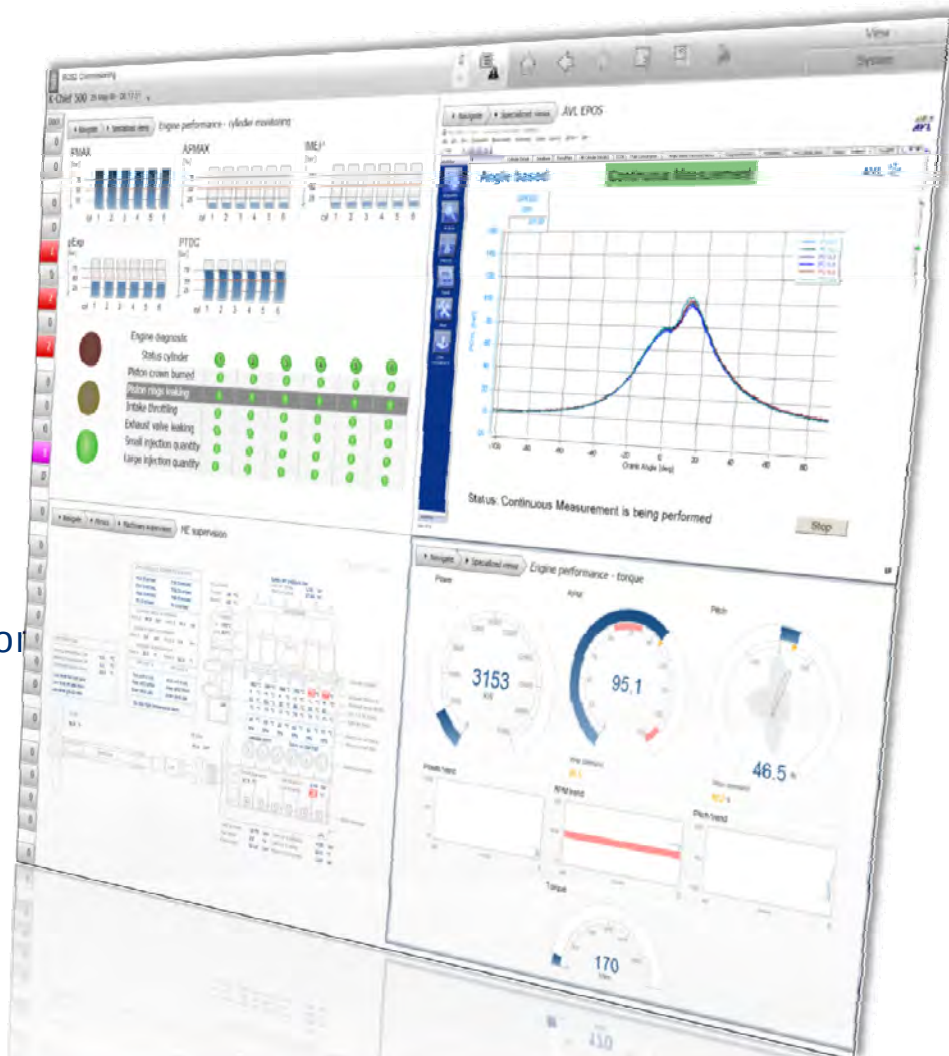
Energy Performance & Management

- Fully integrated in K-Chief 600



KONGSBERG

- ✓ Advisory Functionality
- ✓ Emission Supervision
- ✓ Decision Support
- ✓ Server for 3rd Party Applications
- ✓ Fuel Manager
- ✓ Trim/List
- ✓ Propulsion
- ✓ Engine Performance & Optimization
- ✓ Turbo Charger Monitoring



THE FULL PICTURE

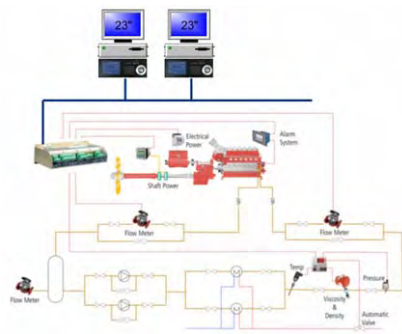


Engine Performance and Optimization

- Fuel Oil Efficiency

Calculation for Main engines, Auxiliary engines, Boilers, etc.

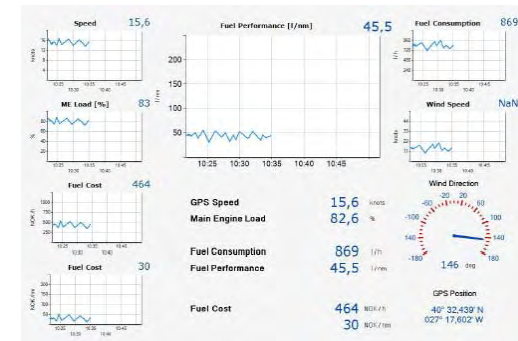
- Fuel consumption, cost, efficiency
- NO_x, SO_x, CO₂
- Decision support
- Reports



Monitoring



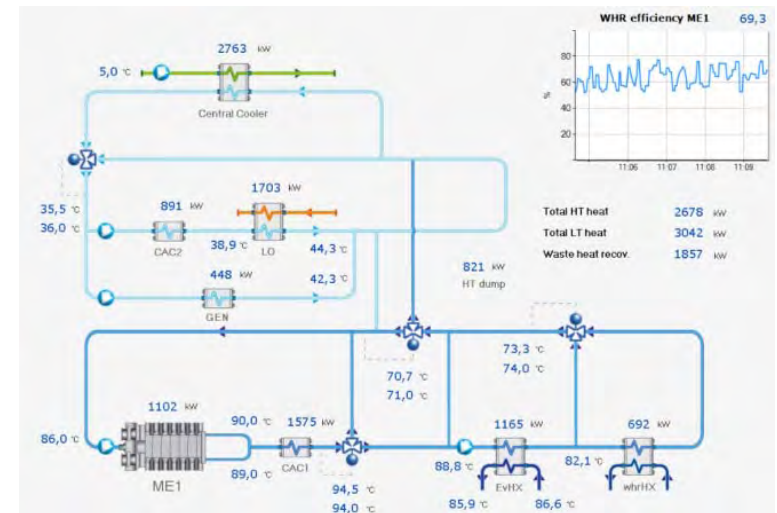
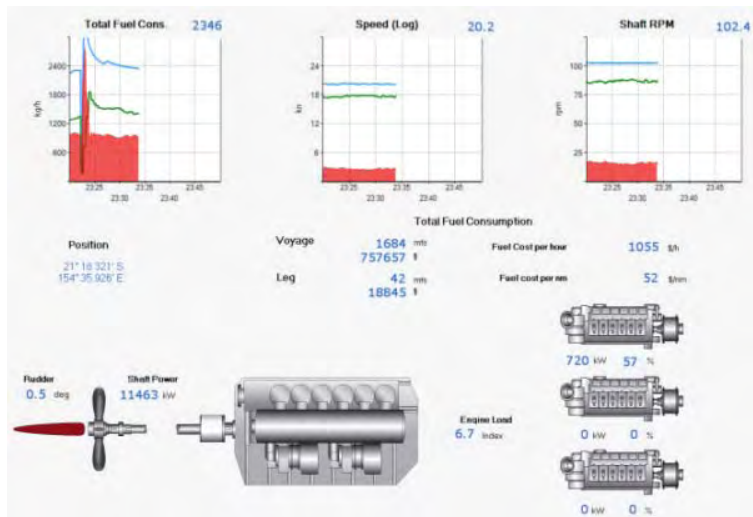
Analyses



Decision support

Energy Performance

- Compares fuel consumption with energy output
- Energy benchmarking (Boilers, Auxiliary Engines, Main Engine, Electricity consumption, etc.)
- Momentary and accumulated values for fuel consumption and propeller shaft power during a round-trip or sea voyage
- Decision support to reach optimum values based on mathematical models and trial data



Energy Performance

MARORKA



KONGSBERG



Interface,
Data Storage
& History

Parameter Optimization,
Simulation
& Decision Support

Data
Sensors

Mathematical
Model



THE FULL PICTURE



KONGSBERG

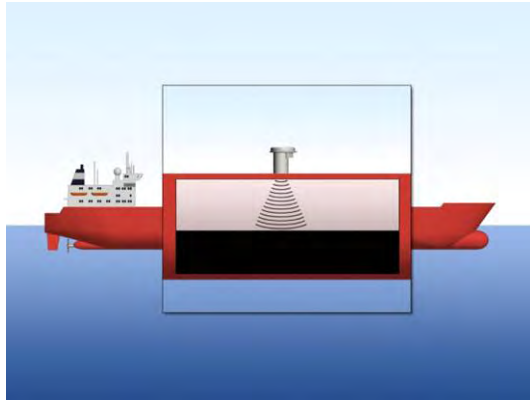
Hull performance



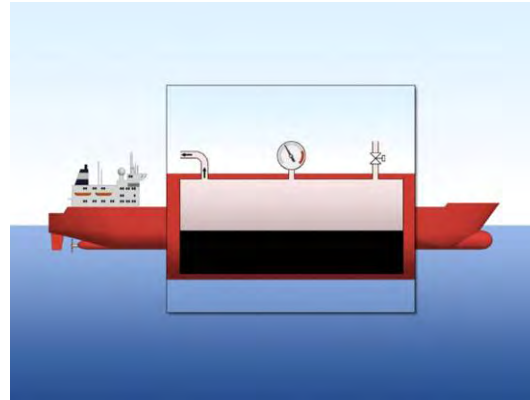
Hull Performance

- Ballast & Cargo tank monitoring, control & management

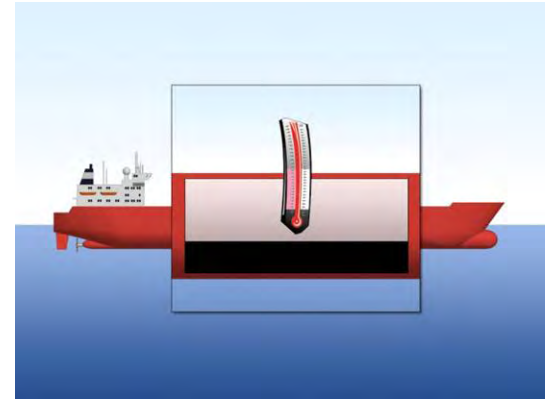
- K-Gauge main applications



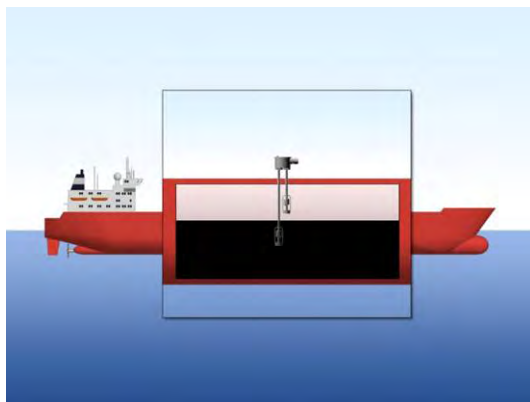
- Tank Level



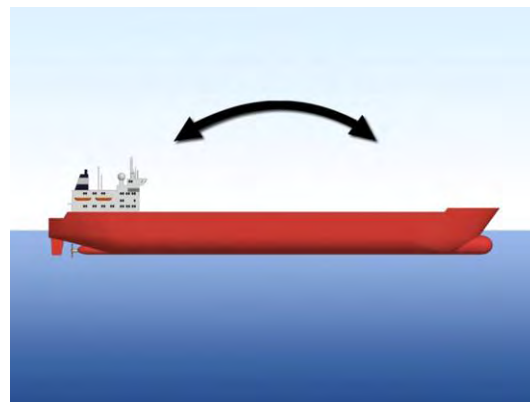
- Vapour Pressure



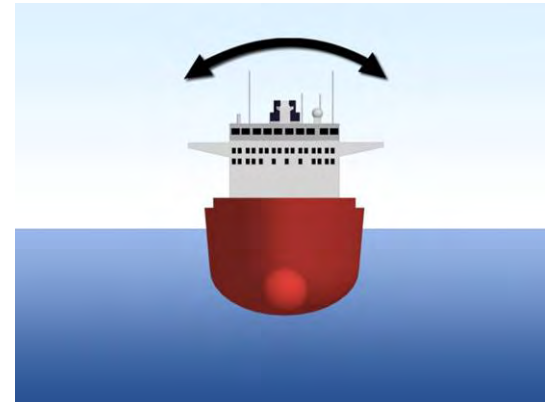
- Tank Temperature



- Overflow



- Trim



- List

Hull Performance Optimizer



- Advanced loading computer built up by a 3-D vessel model for loading and stability solution
- Trim/draft optimisation to minimize fuel consumption
- Resistance calculations - Monitoring of hull/propeller fouling

Loading Condition B: Stability

Loading Plan Input

Main Plan Data
 Voyage no:
 Plan Identification:
 Operator Name:
 Comments:

Read Plan... Save Plan... Print Plan...

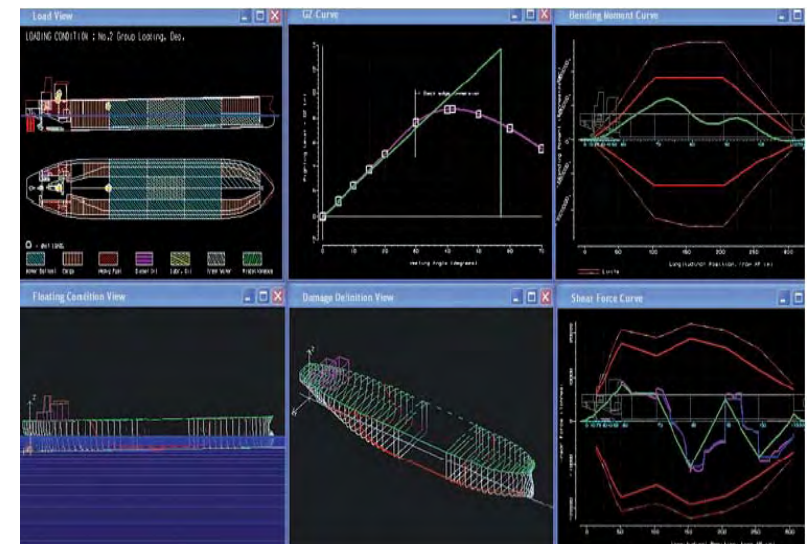
Planning Functions (Cargo & Ballast)
☐ Optimize Trim for Minimum Fuel Oil Consumption
 Cargo Type:
 No. of Segregations:
 Temperature Unit: ☐ °C ☐ °F
 Volume Unit: ☐ m³ ☐ US bbl

Seq. 1 - Abadan Seq. 2 - Kharg
 Port:
 Scheduled:
 Plot Date:

Plotting Position Limits
 Max. Extreme Draught:
 Min. Trim (+ = aft):
 Max. Trim (+ = aft):
 Min. List (+ = starb):
 Max. List (+ = starb):
 Min. Height from Sea Bottom to Maindeck:
 Max. Height from Sea Bottom to Maindeck:
 Total Data

Cargo to be Loaded and Tanks that may be used

Cargo Id.	Cargo Type 1	Cargo Type 2	Cargo Type 3	Cargo Type 4												
Temperature [°C]	29.0	29.1														
Min. Amount [m³]	19000	24000														
Target Amount [m³]	20000	25000														
Max. Amount [m³]	21000	26000														
Load Rate [m³/h]	10000	10000														
CT	Max. %	Use	Utlage	%	Use	Utlage	%	Use	Utlage	%	Use	Utlage	%	Use	Utlage	%
CT 1 p	100	✓	17.000	100	4500	4410	41.0									
CT 1 s	100	✓														
CT 2 p	100	✓														
CT 2 s	100	✓														
CT 3 p	100	✓														
CT 3 s	100															
CT 4 p	100															
CT 4 s	100															
CT 5 p	100															
CT 5 s	100															
CT 6 p	100															
CT 6 s	100															
CT 7 p	100															
CT 7 s	100															
CT 8 p	100															
CT 8 s	100	✓														



Hull Performance Optimizer



- Decision support for optimal Trim and Draft
- Decision support for optimal speed in relation with engine performance module
- Indicating speed loss or additional fuel consumption for hull and propeller fouling compared to clean hull

Ship Performance Monitoring

Description: Comments:

Date/Time:

Duration: Elapsed:

Conditions:

Monitoring Data

	Current	Mean	Max. Dev.	Meas. Status
Water Speed [knots]:	10.14	10.15	-0.08	OK
Ground Speed	10.16	10.13	-0.11	OK
Engine Power [kW]:	4365	4369	-12.2	OK
RPM:	72.4	72.7	-0.5	OK
Pitch:	1.316	1.319	-0.004	OK
Shaft Power [kW]:	4068	4071	-10.9	
Propulsive Efficiency:	0.6313	0.6314	-0.0002	

Potential Speed Gain

Potential optimization of water speed with current shaft power. New RPM: New Pitch:

Water Speed Gain [knots]:

Potential Power Savings

Potential optimization of shaft power with current water speed. New RPM: New Pitch:

Shaft Power Savings [kW]:

Fuel Consumption Optimization

Destination Details

Distance to Destination [n.m]:

ETA (UTC): ☐ Fixed ☐ January

ETD (UTC): ☐ Current ☐ January

Time to Destination [hours]:

Floating Position Limits

Max. Draught: [m] ☒ Max. Airdraught: [m]

Max. Aft Trim: [m] [°] Max. Port List: [°]

Max. Fore Trim: [m] [°] Max. Stb. List: [°]

Consider Floating Position Changes: ☐

Ship Data Status - Current and Recommended

	Current	Recomd.
Mean Draught [m]:	8.365	8.024
Trim (aft - °) [m]:	0.536	1.031
List (stb - °) [°]:	0.303	0.000
Strength Exploitat. Ratio	39.0 %	41.3 %
GM [m]:	12.011	11.978
Stability Margin [m]:	4.567	3.955
Req. Speed [knots]:	☐ Fixed 9.40 9.40	9.40
RPM:	☐ Fixed 69.2 67.1	67.1
Pitch:	0.967 0.970	0.970
Req. Shaft Power [kW]:	2305 2155	2155
Engine Output [kW]:	☐ Fixed 3612 3501	3501
Est. Shaft Gen. Output [kW]:	350 350	350
Potential Savings [USD]:	Settings... 2161	2161

Ballasting Plan From Current Condition to Achieve Recommended Floating Position

Seq. No.	BW Tank Id.	Current Weight [tonnes]	Current Filling [%]	Recomd. Weight [tonnes]	Recomd. Filling [%]	Weight Change [tonnes]
1	BW AFT PORT 1	1000.000	50.000	2000.000	100.000	1000.000
2	BW AFT STB. 1	1000.000	50.000	500.000	25.000	-500.000
3	BW FORE PORT	1000.000	50.000	500.000	25.000	-500.000
4	BW FORE STB. 1	1000.000	50.000	0.000	0.000	-1000.000
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						



KONGSBERG

Nautical operations performance



Nautical Operation Performance

- Integrated Bridge System, K-Bridge



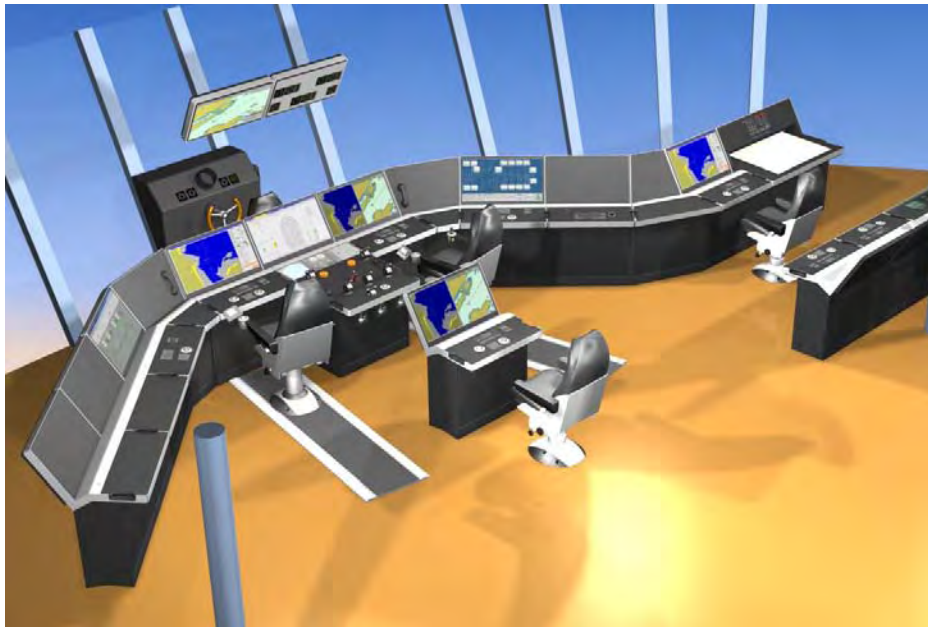


Nautical Operation Performance

- Integrated Bridge System, K-Bridge



- Multifunctional operator stations
 - ARPA
 - ECDIS
 - Conning
- Integrated Steering Control
- Integrated Autopilot and Track Pilot
- Integrated Central Bridge Alarm System
- Integrated control of Bridge Auxiliaries
- Route Planning
- Weather Routing



THE FULL PICTURE

Nautical Operation Performance

- Route Planning & Weather Routing



KONGSBERG

1. Route planning on ECDIS

- ETA
- Weather forecast via satellite communication
- Tide
- Sea current
- Shallow water
- Vessel response boundaries



2. Data to Vessel performance module

- Waypoints
- Weather forecast
- Actual Weather data
- Sensor input for actual fuel consumption, torque, speed, RPM, Engine performance etc.

3. Advice in optimal sailing

- Speed profile on the leg
- Trim and draft optimization

4. Reports

- Cost calculation of the selected route
- Route comparing tables



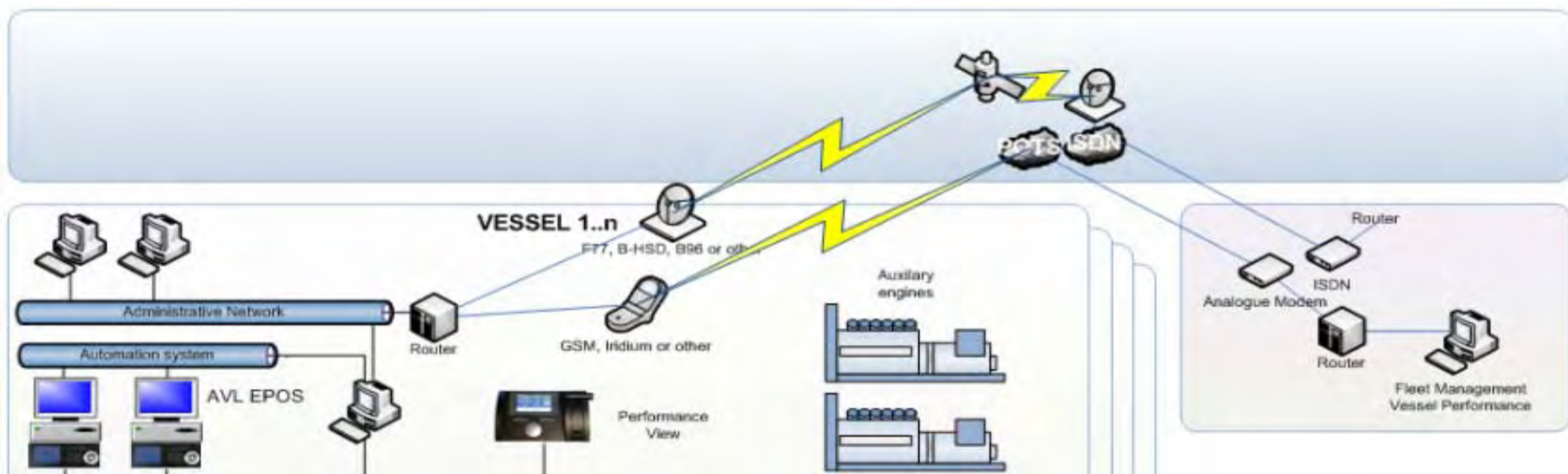
Nautical Operation Performance

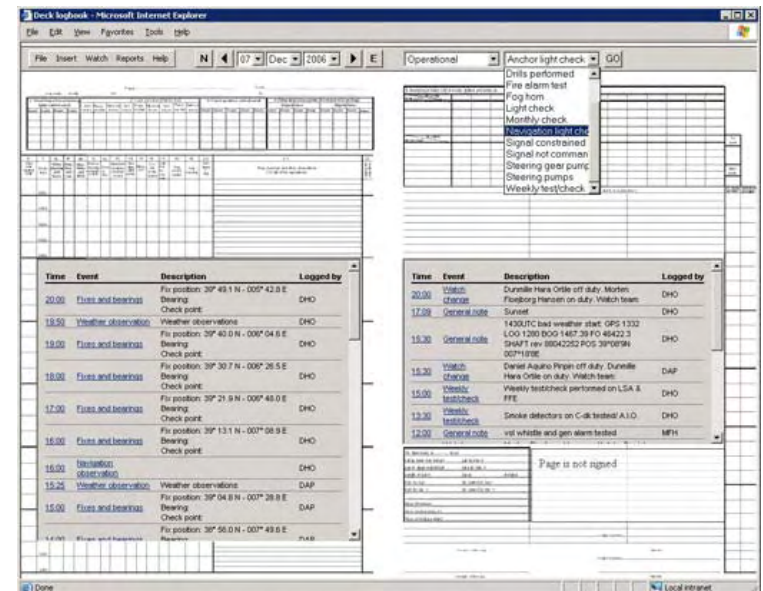
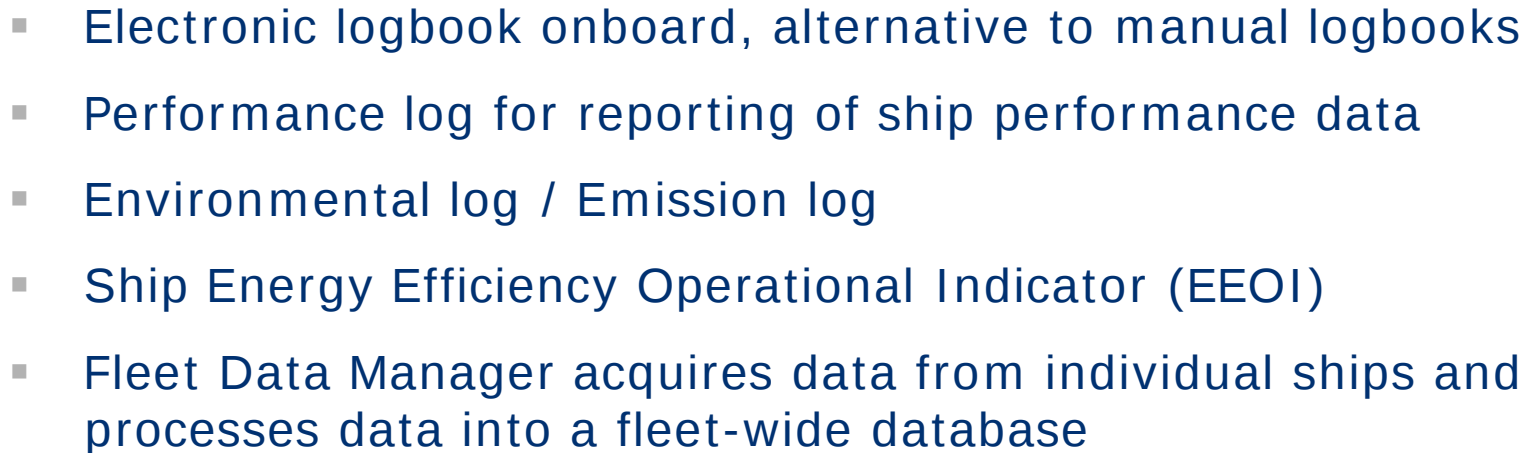
- Benefits

- Optimize ship speed & speed profile for a voyage dependant on ETA, sailing route, weather data and tidal current
- Load planning functions to optimize applied draught and trim, including reduction of water ballast
- Speed loss and additional fuel consumption compared to clean hull



Shore Management for vessel performance



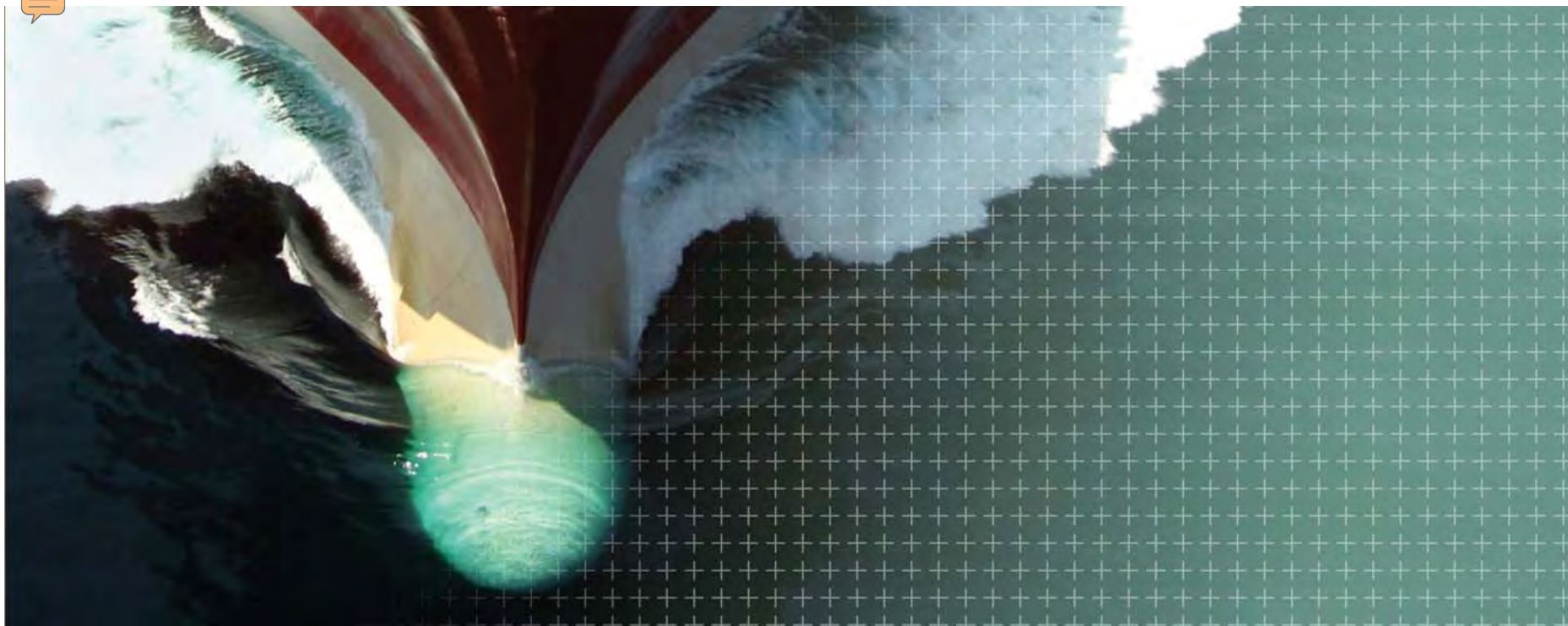


Shore Management

- Owner portal for vessel performance of complete fleet 'traffic light'
- Advanced diagnostics from remote
- Reports and comparing functionality



Shore Management



Green Ship: Less fuel – Less emissions

- Optimum engine performance
- Optimized routing
- Enhanced safety and reliability

Environmentally friendly voyage



KONGSBERG

Vision

WORLD CLASS

through people,
technology and
dedication

