Smart Operations, Tokyo 2015

The Application of Big Data for Ship Operational Efficiency

11th June 2015

Hideyuki Ando, MTI (NYK group)

Outline

1. Introduction of MTI
2. Fleet operation and operational efficiency
3. Big data and ship performance model
4. Big data applications
5. Summary

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MTI (Monohakobi Technology Institute)

Company profile

Company name	Monohakobi Technology Institute
Established	April 1, 2004
Number of employees	63 (as of April 1, 2015)
Head office	7th floor, Yusen Building, Chiyoda-ku, Tokyo
Branch office	Singapore
Laboratory	Yokohama
Stockholder	NYK (100%)


Yusen Building, Chiyoda-ku, Tokyo

Please visit our new web site !
http://www.monohakobi.com/en/

R&D

Maritime Technology Division

- **Maritime Information Group**
- **Maritime Technology Group**
- **Singapore Branch**

Logistics Technology Group

- **Logistics Group**

Sales

Maritime technology | **Logistics technology**

- **Sales Group**
- **Yokohama Lab.**

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NYK fleet (as of the end of March 2014)

Containerships (including semi-containerships and others)

101vessels / 5,572,991 DWT

Bulk Carriers (Capesize)
129 vessels / 24,576,302 DWT

Bulk Carriers (Panamax & Handysize)

286vessels / 17,597,420 DWT

Wood-chip Carriers
49 vessels / 2,580,879 DWT

Cruise Ships
3 Vessels / 21,577 DWT

Car Carriers
125 vessels / 2,230,958 DWT

Tankers
77 vessels / 12,056,781DWT

LNG Carriers
29 vessels / 2,172,415 DWT

Others
26 vessels / 318,002 DWT

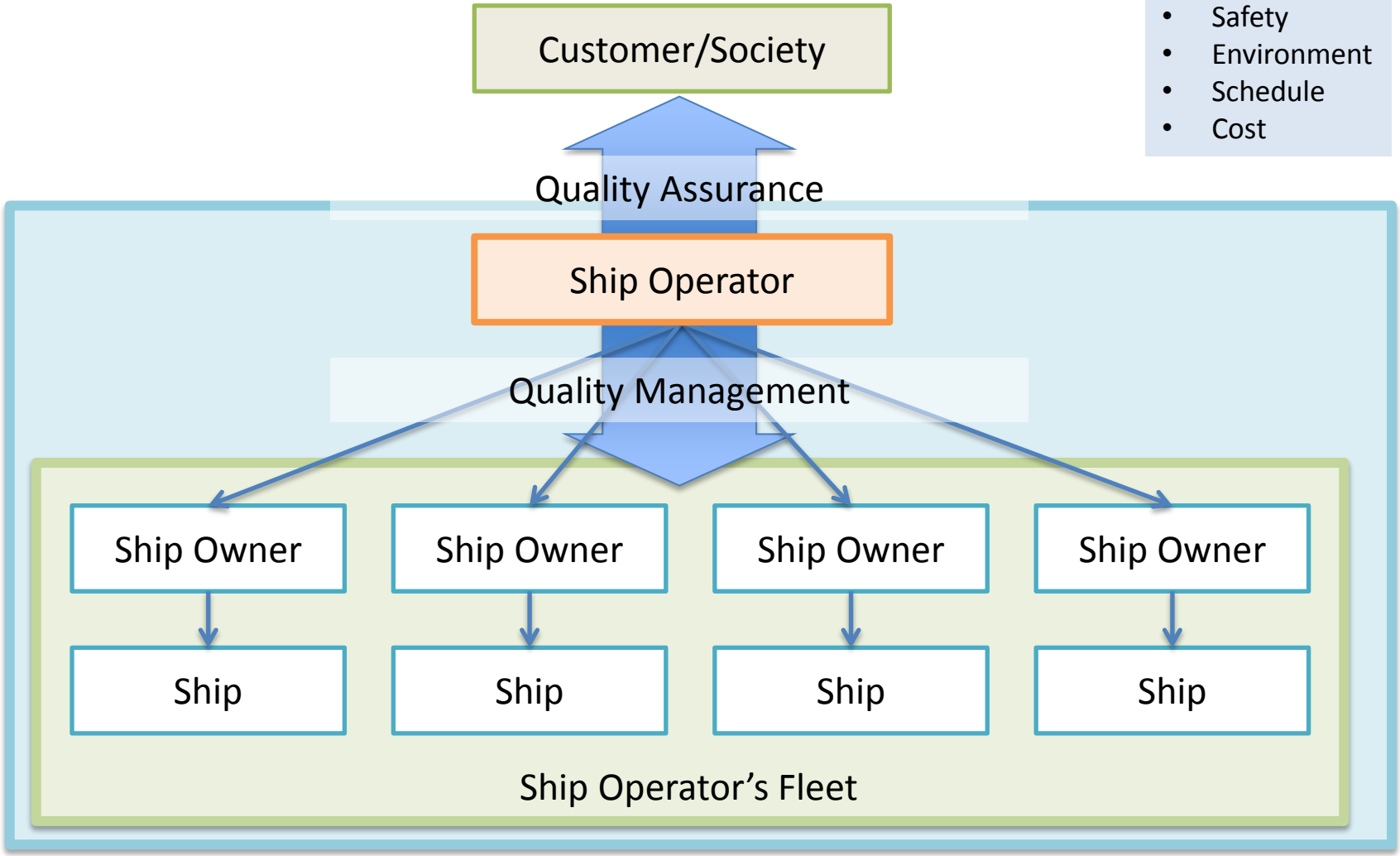
877 vessels
68,036,568Kt (DWT)

Fleet operation

- Fleet operation pursue best performance in terms of safety, economy and environment
  - Minimize cargo damage and downtime
  - Schedule integrity
  - Cost saving
  - Environment conservation

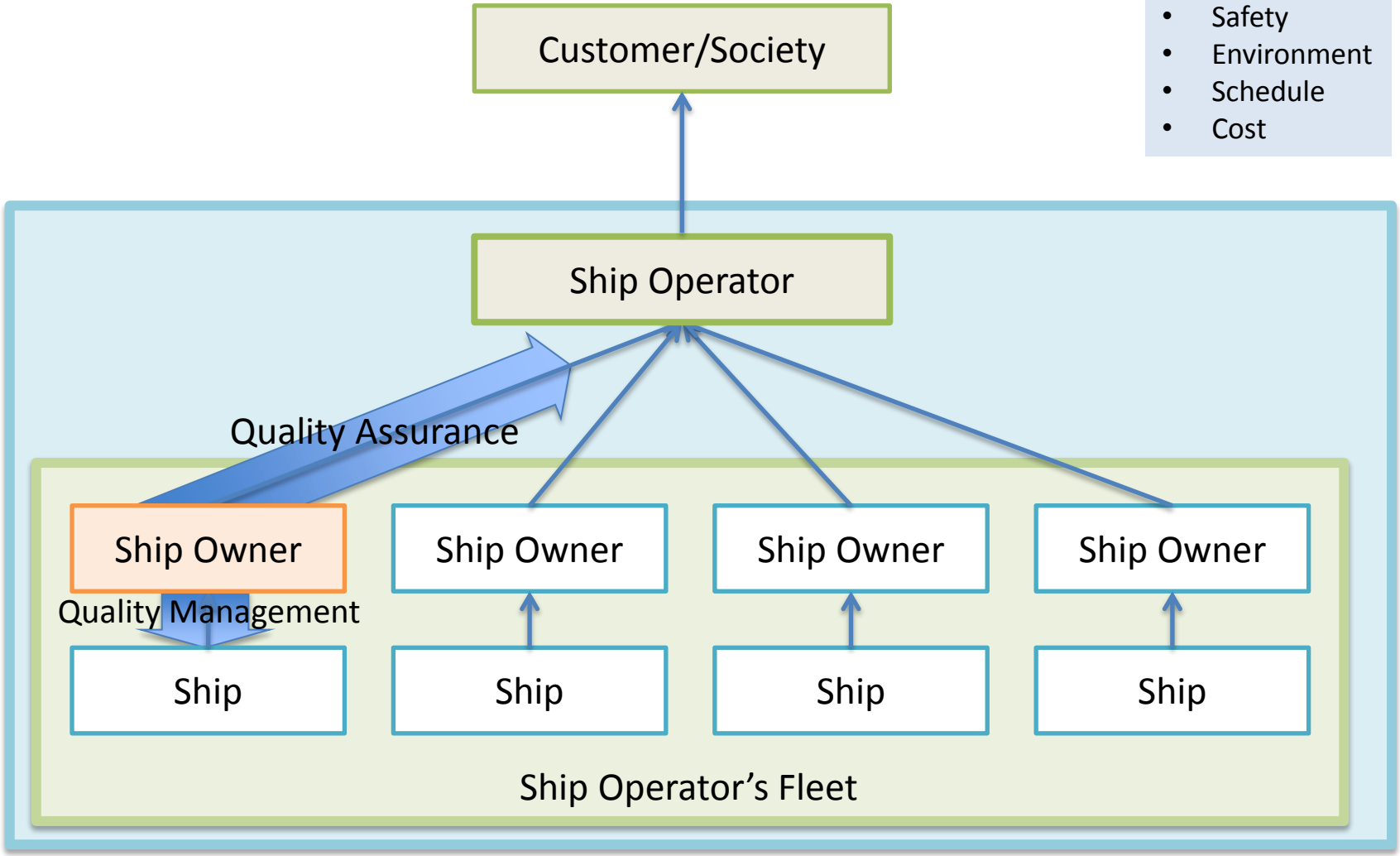
Operational efficiency – ship operator's view

Quality Shipping
- Safety
- Environment
- Schedule
- Cost



Operational efficiency – ship owner's view

Quality Shipping
- Safety
- Environment
- Schedule
- Cost



Performance management

Performance management is organizational improvement process by using performance monitoring

- Share objective among related parties
- Continuous improvement and learning cycle with performance monitoring
- Pursue target by Information sharing and collaboration

Operational efficiency project with NYK

NYK IBIS Project
(2012-)

IBIS – Innovative Bunker and Idle time Saving

Fuel Efficiency Helped NYK Line Succeed in 2013

Tuesday January 7, 2014

Efficiency improvements, particularly reductions in fuel consumption, helped **Japan**'s **Nippon Yusen Kaisha Line** (NYK Line) succeed in 2013, despite a difficult market and high bunker prices, President **Yasumi Kudo** said in his New Year statement.

Kudo said the shipping company reduced "muda," or wasted activity, through initiatives including its "**Innovative Bunker and Idle-time Saving**" (IBIS) project, which shares real-time information between land and ships to economise ship movements, and an air-lubrication system adopted on the vessel *Soyo* to increase fuel efficiency.

NYK Line President Yasumi Kudo said the company faced difficult conditions in 2013

Article from Ship and Bunker

Fuel cost saving by IBIS $40 million in 2013

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Big data in shipping

The followings are examples of Big data, by which MTI try to create values

Voyage data

- Automatically collected data
- Noon report

AIS data

- Satellite AIS / shore AIS

Weather data

- Forecast / past statistics

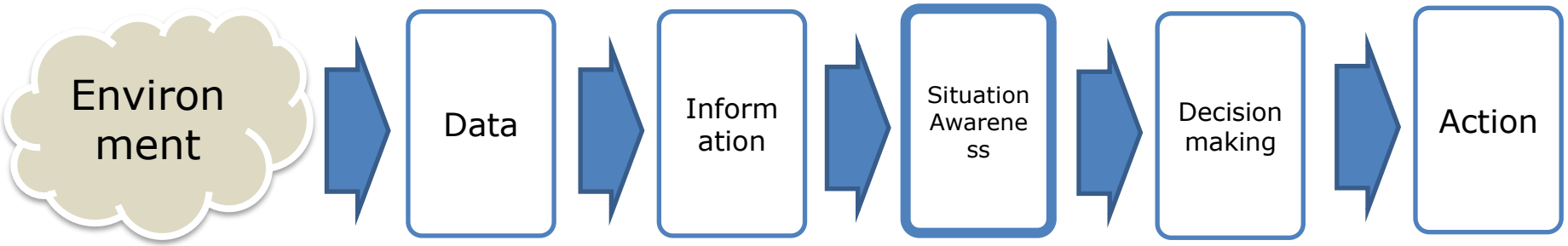
Business data

- Container transport data

Trouble data

- Engine trouble data

Big data processing flow



Necessary Technology

- Sensor
- Measurement
- Network
- Communication
- IT

- Data analysis
- Statistics
- Engineering
- Visualization
- Web

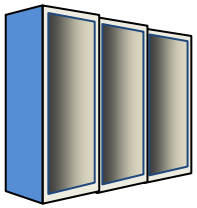
- Business knowledge
- Workflow
- Collaboration
- Organization

- Management
- Business

- Command
- Assistance
- Training
- Incentive
- PR
- Change Business

Provide information to right people at right time for assisting their situation awareness for right decision and action

Our data collection platform
SIMS(Ship Information Management System)



Data Center

SIMS auto logging data (per hour)
& SPAS electronic abstract
logbook data (per day)

Weather routing service provider

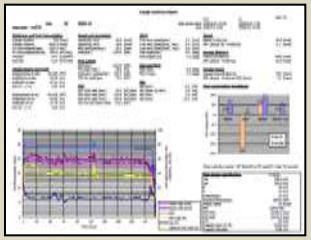
SIMS Data Collection System Onboard

Inmarsat-FBB / VSAT

SIMS Monitoring & Analysis System at Shore

Communications via Technical Management

Feedback to captains



Voyage Analysis Report
Break down analysis of fuel consumption for each voyage

Operation Center
Singapore, ...

Report

SIMS Viewer

-Trend monitoring of speed, M/E RPM, fuel consumption and other conditions per hour

- Engine monitoring

- GPS
- Doppler log
- Anemometer
- Gyro Compass

SIMS unit

Viewer

VDR / ECDIS

Data Acquisition and Processing

Motion sensor

<Navigation Bridge>

<Engine Room>

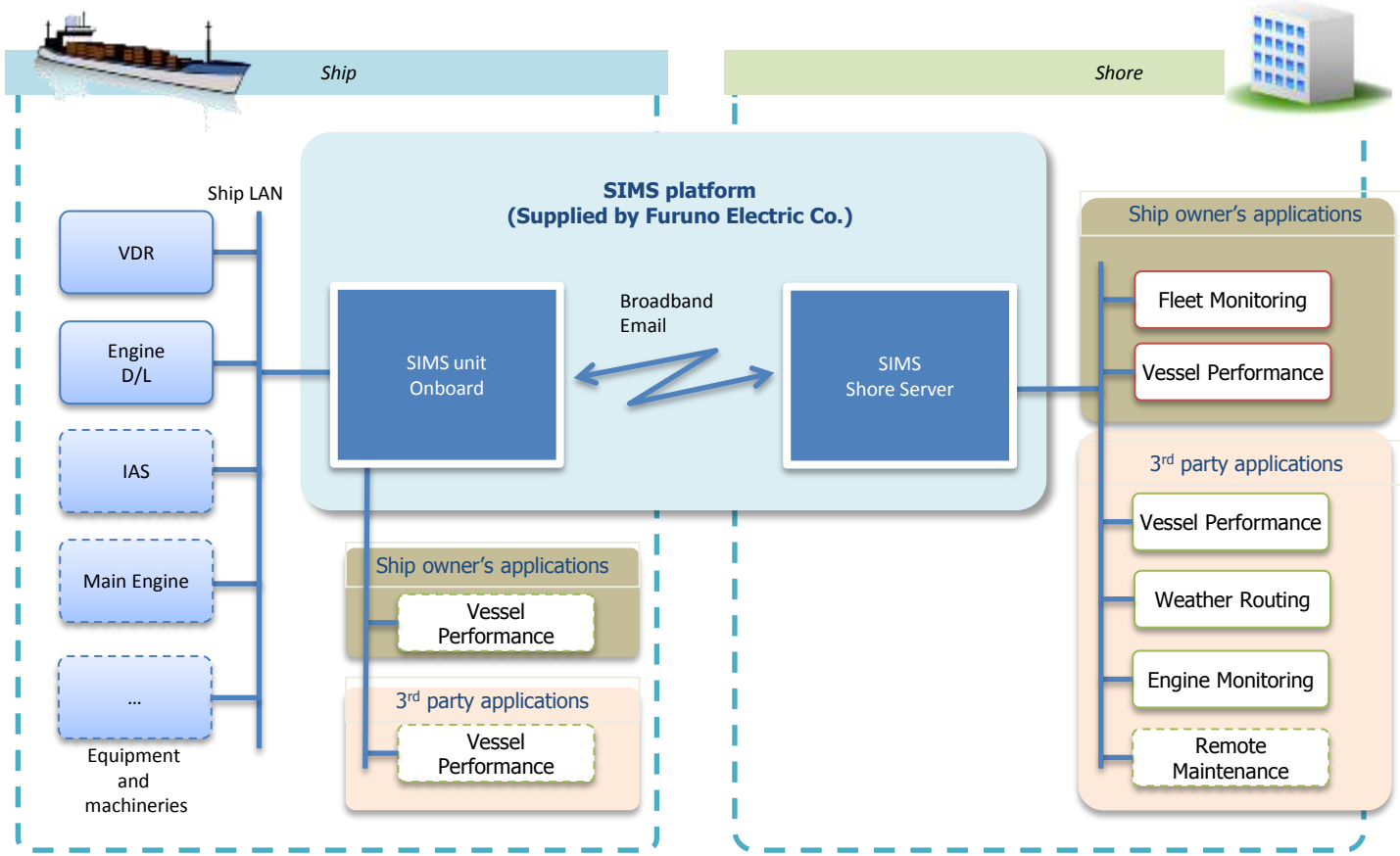
- Main Engine
- FO flow meter
- Torque meter

Engine Data Logger

Technical Analysis (MTI)

SIMS as open platform

Open platform = interface to 3rd party applications

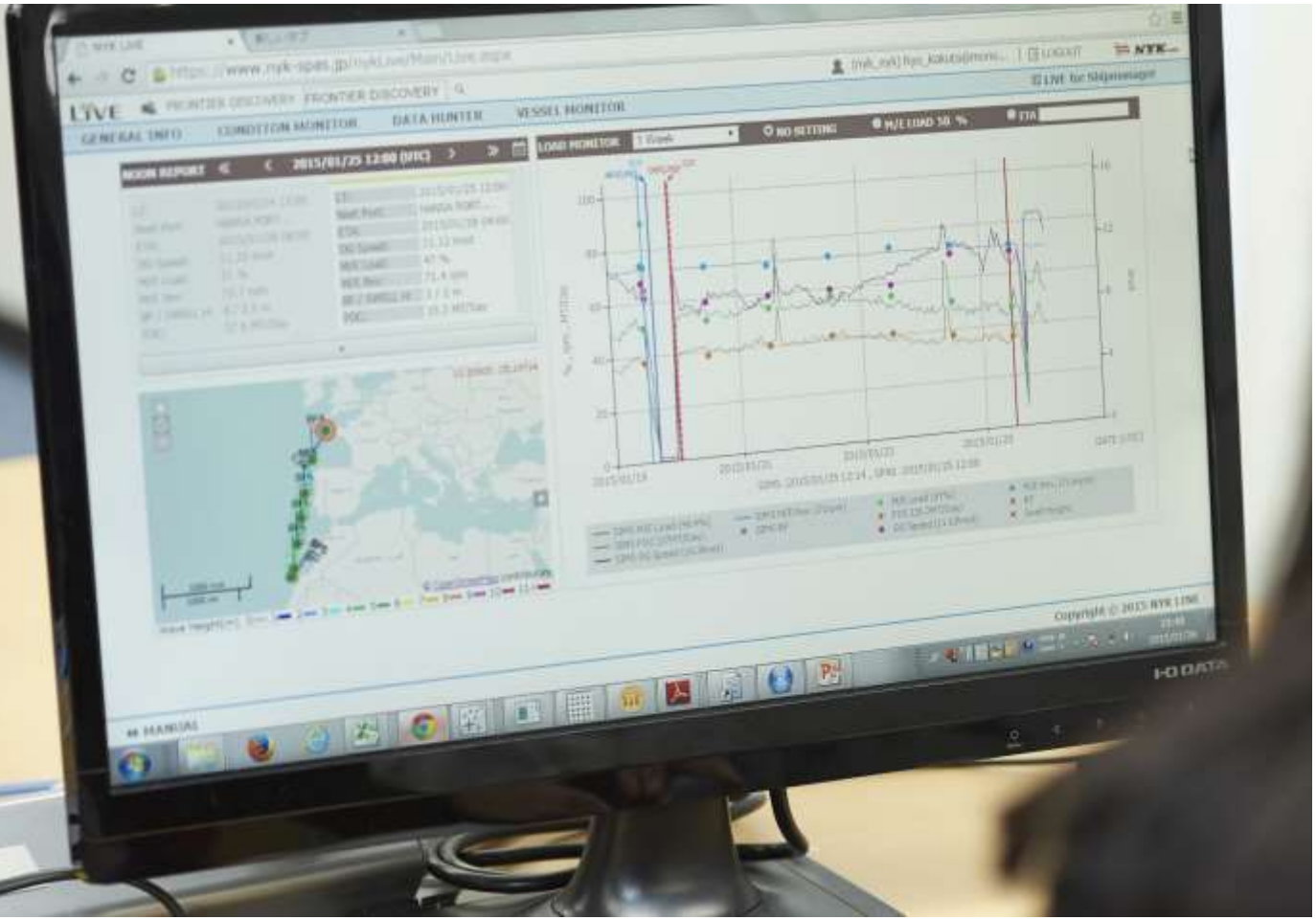


SIMS is a computer system to collect onboard equipment data and share it with 3rd parties' onboard and shore applications

Candidate 3rd party applications include

- **Weather routing**
- **Vessel performance analysis**
- **Engine condition monitoring**
- **Remote maintenance**

Shore dashboard for ship operator



Ship operator can easily check current situation of the vessel and voyage records.

Map:
- **ship position**
- **ship speed**
- **Beaufort scale**
- **wind direction**

Trend graph:
- **departure time**
- **arrival time**
- **ship speed**
- **RPM**
- **fuel consumption**

Shore dashboard for ship technical manager

Ship technical manager can check engine plant condition of each vessel

Trend graph group: (diesel engine ship)

- **M/E Exh. Gas & Scav. Air & JCFW**
- **M/E T/C & A/C**
- **M/E FO & LO**
- **M/E Torque Rich**
- **M/E Exh. Gas x M/E Load**
- **M/E SFOC**
- **M/E Cylinder Oil Consumption**
- **D/G & S/G & T/G**
- **Boiler & EGE**
- **M/E Performance**

Steam turbine vessel version will be released in July 2015

Ship performance – key technology for analysis

6500TEU Container Ship

Wave height 5.5m, Wind speed 20m/s

BF scale 8, Head sea

@ engine rev. 55rpm

<Calm sea performance>

speed: 14 knot

FOC: 45 ton/day

<Performance in the rough sea(BF8)>

speed: **8 knot**

FOC: **60 ton/day**

Effecting factors

1. Weather (wind, wave and current), 2. Ship design (hull, propeller, engine), 3. Ship condition (draft, trim, cleanness of hull and propeller, aging effect)

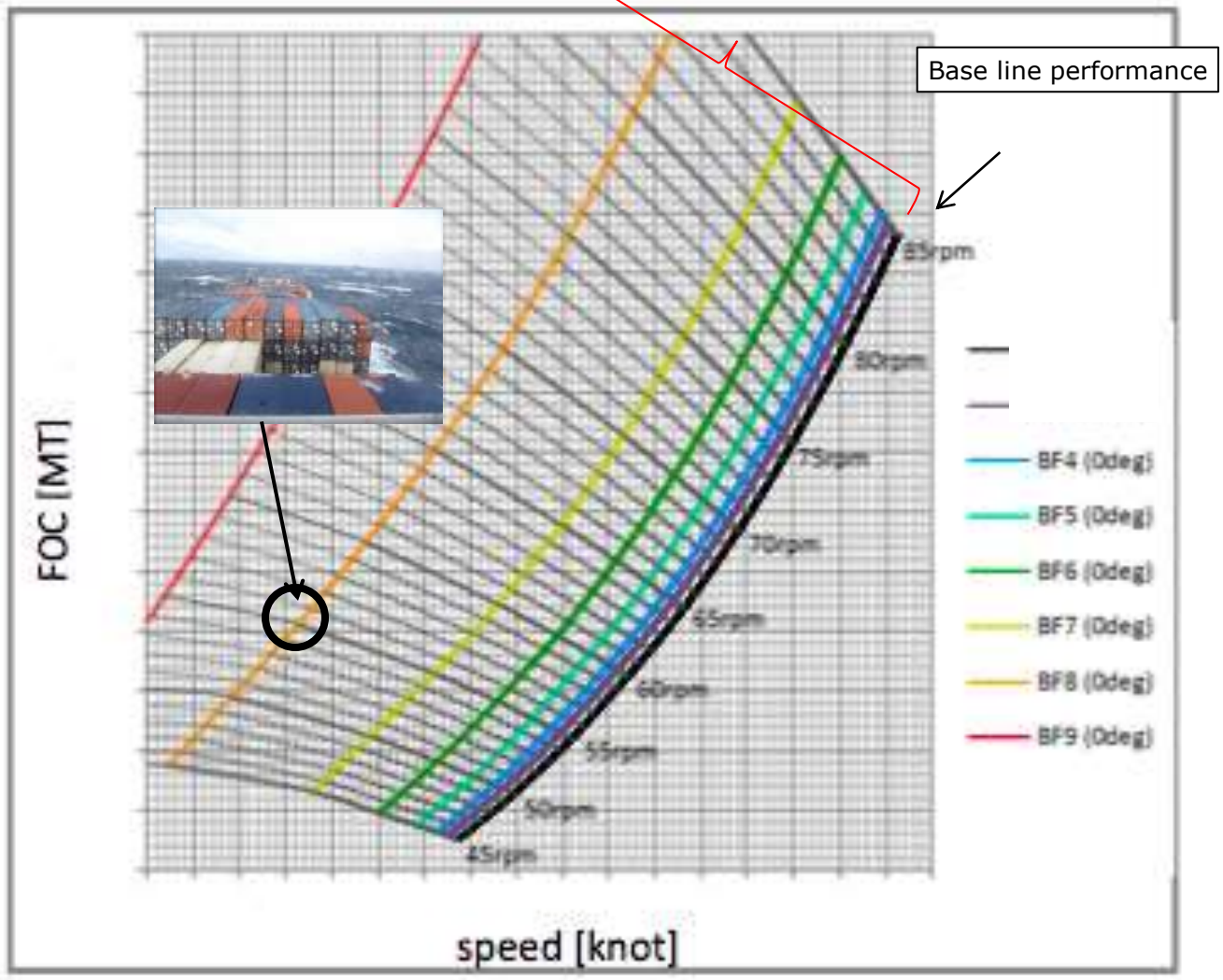
Ship performance in all weather

<Target vessel>
6500TEU Container
Draft 12m even

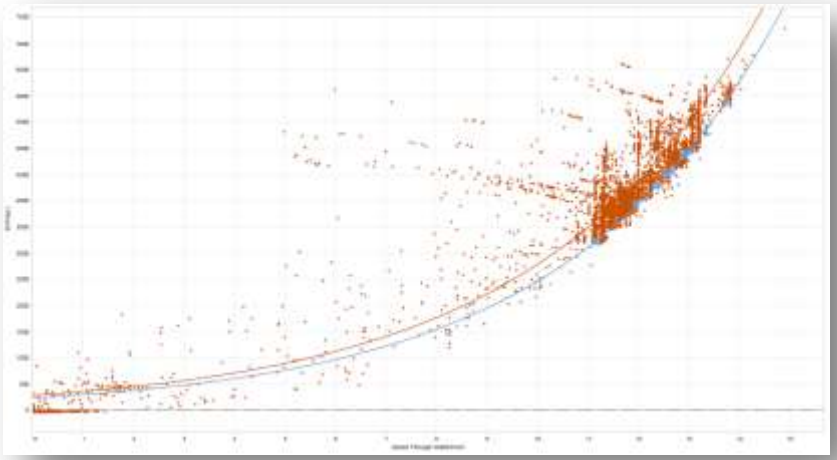
Sea condition
Beaufort scale

	wind speed (m/s)	wave height (m)	wave period (sec)
BF0	0.0	0.0	0.0
BF3	4.5	0.6	3.0
BF4	6.8	1.0	3.9
BF5	9.4	2.0	5.5
BF6	12.4	3.0	6.7
BF7	15.6	4.0	7.7
BF8	19.0	5.5	9.1
BF9	22.7	7.0	10.2

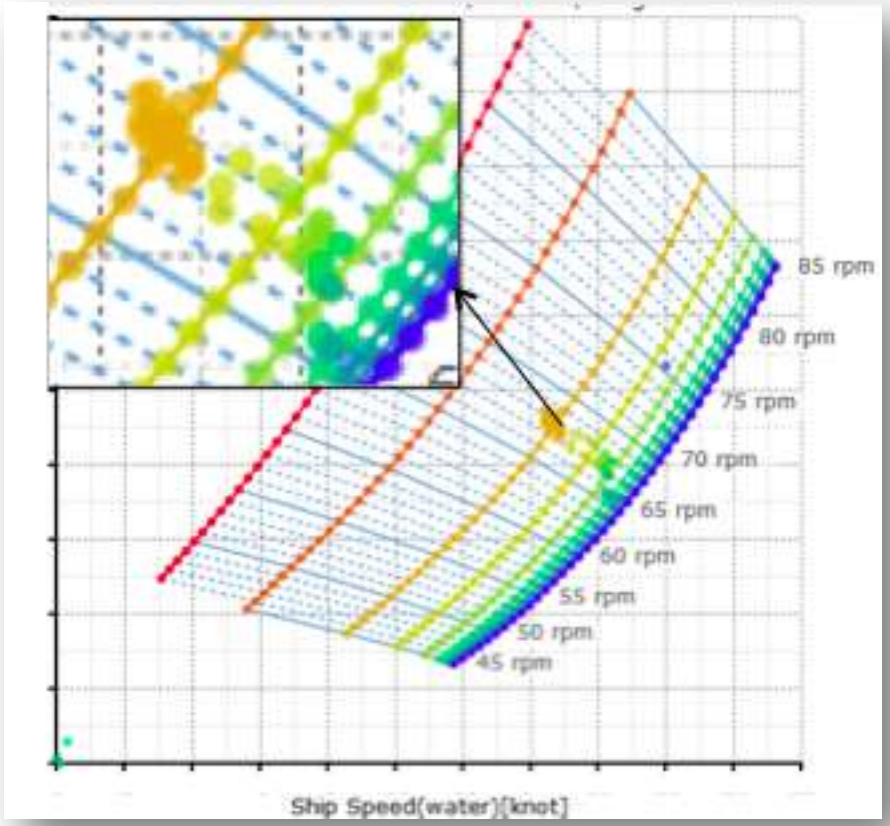
0deg (wind, wave) – head sea



Performance model correction by measurement data



Measurement data



Performance model correction

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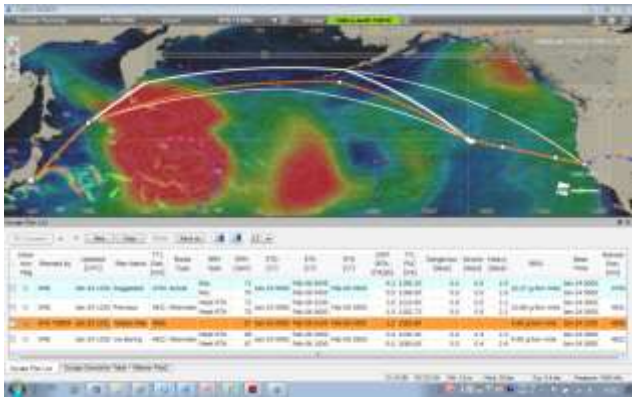
Big data application areas

Role	Function	Example of Big data application
Ship operator	Operation	• Energy saving operation • Safe operation • Schedule management
	Fleet planning	• Fleet allocation • Service planning • Chartering
Ship owner	Technical management	• Safe operation • Hull & propeller cleaning • Condition monitoring and maintenance • Environmental regulation compliance • Energy saving retrofit
	New building	• Design optimization

Optimum weather routing with performance monitoring



Weather Routing（PLAN）

Monitoring（CHECK）

- Voyage plan
  + course, speed, RPM, FOC, weather
  + ship performance model

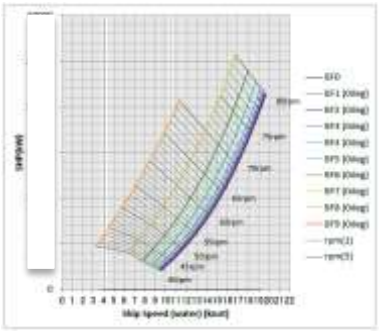
Feedback

- Voyage actual
  + actual speed – RPM, RPM - FOC
  + actual weather

Ship model and weather forecast are inherently include errors.

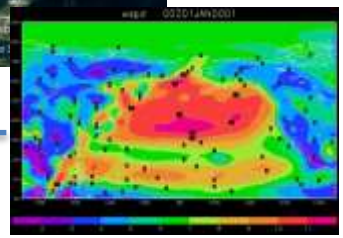
But feedback loop by monitoring can make this system work better.

Service optimization

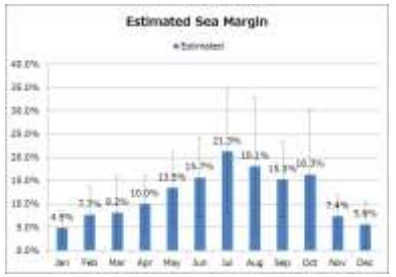


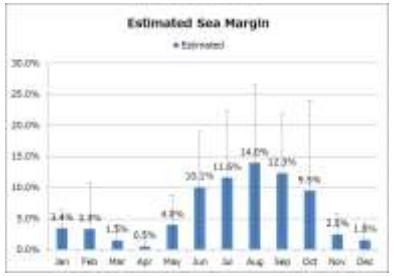
Ship performance model

Service route



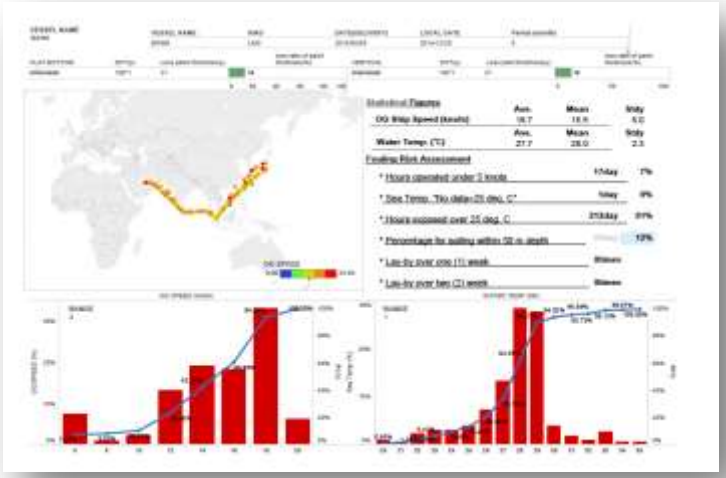
Hindcast weather data





Estimation of
- Sea Margin
- Sailing time
- Average Speed
- Total FOC

Fouling risk assessment

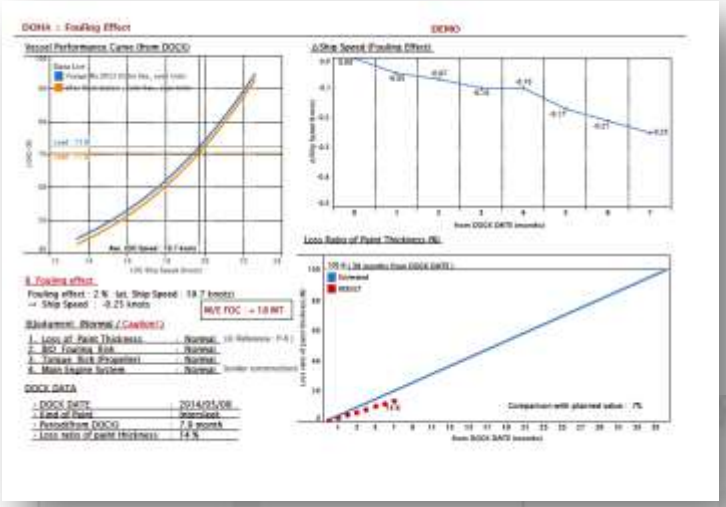


Operation profile

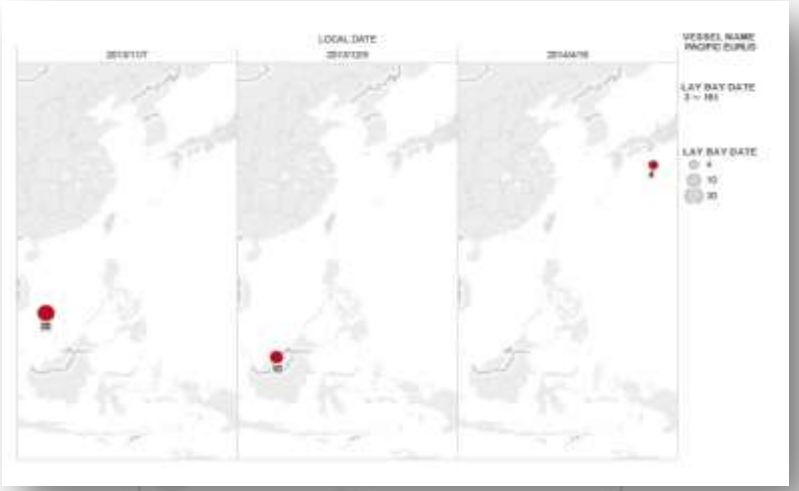
Fouling risk assessment will be conducted by using the following information

- **Operation profile**
- **Long term performance analysis**
- **Lay-by days/area/season**

To recommend under water inspection and hull / propeller cleaning

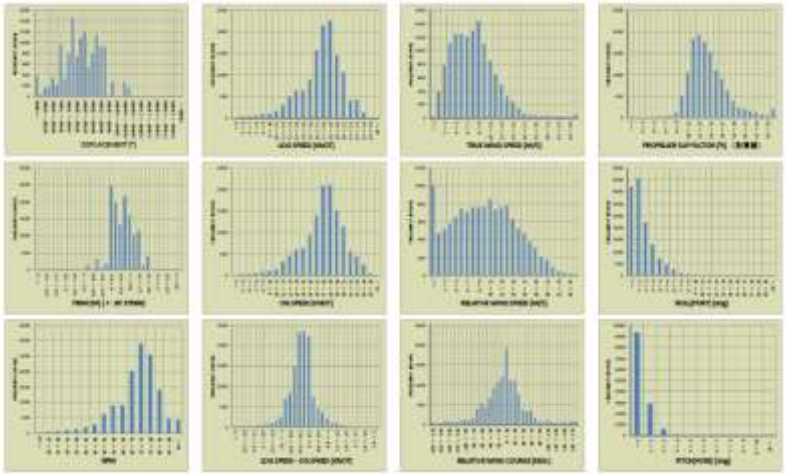


Long-term performance analysis



Lay-by days/area/season

Energy saving hull modification



Operation profile

- Speed, RPM, Power
- Draft, trim, displacement
- Weather
- Sea margin
- etc

23 % CO2 reduction was confirmed

Energy saving modification

- Bulbous bow modification
- Install energy saving device (MT-FAST)
- etc

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Summary

- Big data has a big potential to improve operational efficiency in shipping. Reliable ship – shore network and data collection platform is necessary.
- One of the key technology to utilize big data is accurate ship performance model
- We need to understand two different perspectives of ship owner and ship operator for making Big data applications
- Several Big data applications are introduced

Thank you for your attention