V-TRACKS Vessel Tracking and Monitoring ASIA-PACIFIC
2nd - 3rd December 2014, Singapore

How we use fleet performance tools to increase our energy efficiency ?

3rd December 2014

Hideyuki Ando, MTI

Outline

1. Introduction
2. Operational measures and performance management
3. Implementation of PMS
4. Combination with weather routing
5. Further utilization of PMS
6. Summary

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NYK Corporate Profile

- **NYK LINE (Nippon Yusen Kaisha)**
  - **Head Office： Tokyo, Japan**
  - **Founded： September 29, 1885**
  - **Business Area**
    - **Liner (Container) Service**
    - **Tramp and Specialized Carrier Services**
    - **Tankers and Gas Carrier Services**
    - **Logistics Service**
    - **Terminal and Harbor Transport Services**
    - **Air Cargo Transport Service**
    - **Cruise Ship Service**
- **Employees : 32,342 (as of the end of March 2014)**
- **Revenues : $ 22 billion (Fiscal 2013)**

NYK Head office in Tokyo

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)

MTI Monohakobi Technology Institute

http://www.monohakobi.com/en/

- Established - April 1, 2004
- Locations
  - Head office – Yusen Bldg. 7F, Marunouchi 2-3-2, Chiyoda-ku, Tokyo, Japan
  - Branch office – MTI Singapore, Singapore
  - Laboratory – MTI Yokohama Laboratory, Yokohama, Japan
- Stockholder - NYK Line (100%)
- Number of employees – 60 (as of April 1, 2014)
- President – Mr. Makoto Igarashi

Monohakobi Technology Institute

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**

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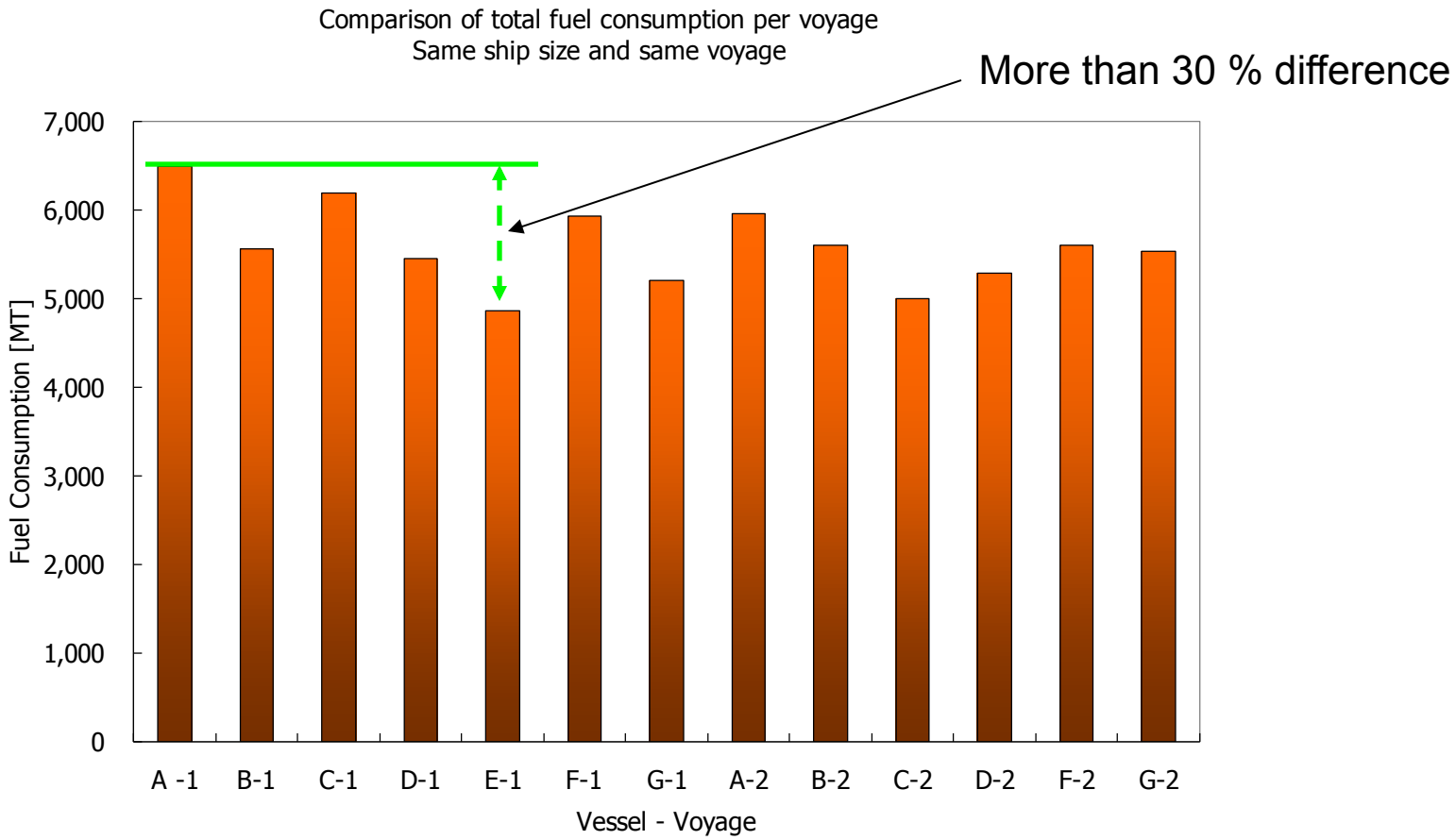
Diversity of actual fuel consumption



Same ship size and same voyage – but total amounts of fuel consumption largely differ

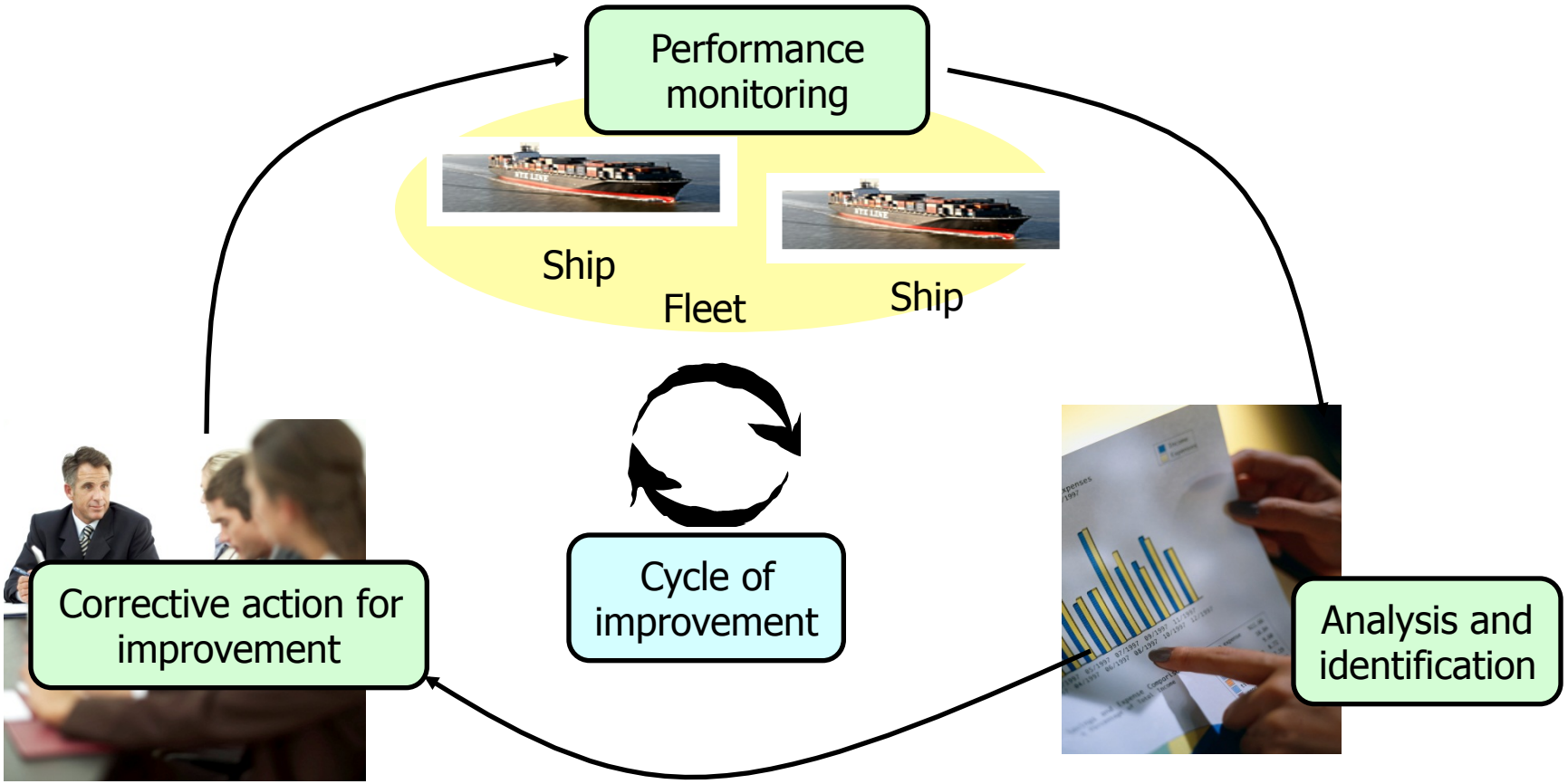
Operational measures for fuel saving

- Slow steaming
- Weather routing
- Optimum speed allocation
- Optimum fleet allocation
- Timely hull and propeller cleaning

Example of slow steaming e.g. 8,000 TEU container

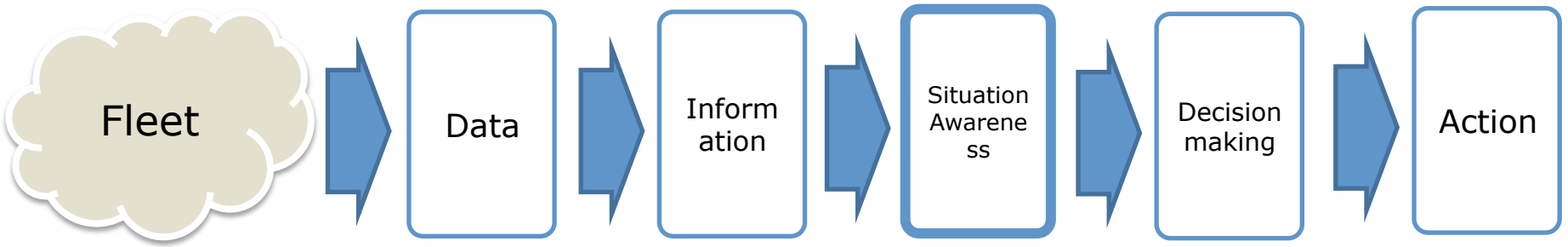
	Design speed	Slow steaming	Difference
Ship speed	24 knot	20 knot	- 16 %
M/E fuel consumption	225 ton/day	130 ton/day	- 42 %
M/E fuel cost (@ 600 USD/MT)	134,800 USD/day	78,000 USD/day	
CO2 emission	696 ton/day	403 ton/day	

Performance management for fuel saving



To encourage all participants efforts for energy efficient operation by sharing correct information and good communication with right scheme for good

The role of data in performance management



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

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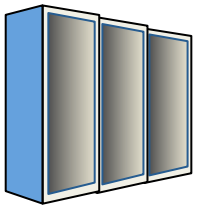
Example of ship data collection
SIMS (Ship Information Management System)

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



Data Center

SIMS Data Collection System Onboard

VSAT/Inmarsat-F/FB

SIMS Monitoring & Analysis System at Shore

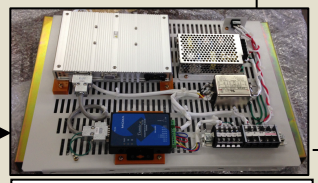
Communications via Technical Management

Feedback to captains

Operation Center
Singapore, ...

- GPS
- Doppler log
- Anemometer
- Gyro Compass

SIMS unit



Viewer

VDR / ECDIS

Data Acquisition and Processing

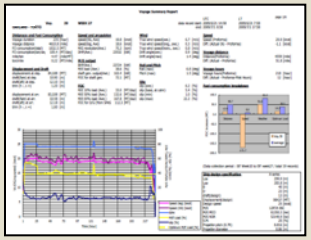
Motion sensor

<Navigation Bridge>

<Engine Room>

- Main Engine
- FO flow meter
- Torque meter

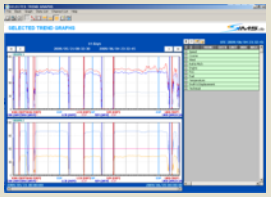
Engine Data Logger



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

Report

Technical Analysis (MTI)



SIMS Viewer

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

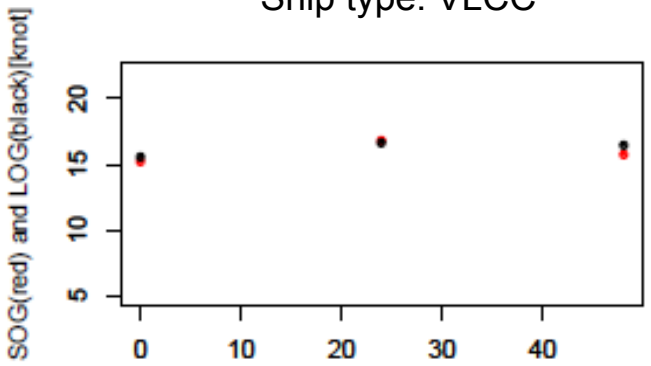
- Engine monitoring

Data sampling interval

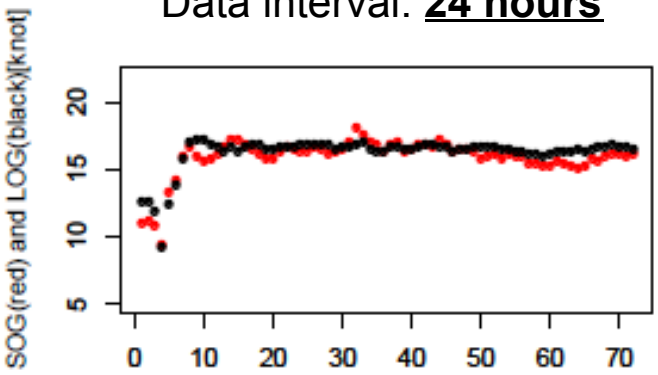
- Existing data collection approaches
  - Manual reporting (every 24 hrs)
  - Automatic data collection (sampling can be every 1 sec)

- Every 1 hour data give detail information about performance
  - Speed increasing profile and effect of current can be seen in the 1 hour interval graph.

Data interval comparison
red: OG speed, **black**: log speed
Ship type: VLCC



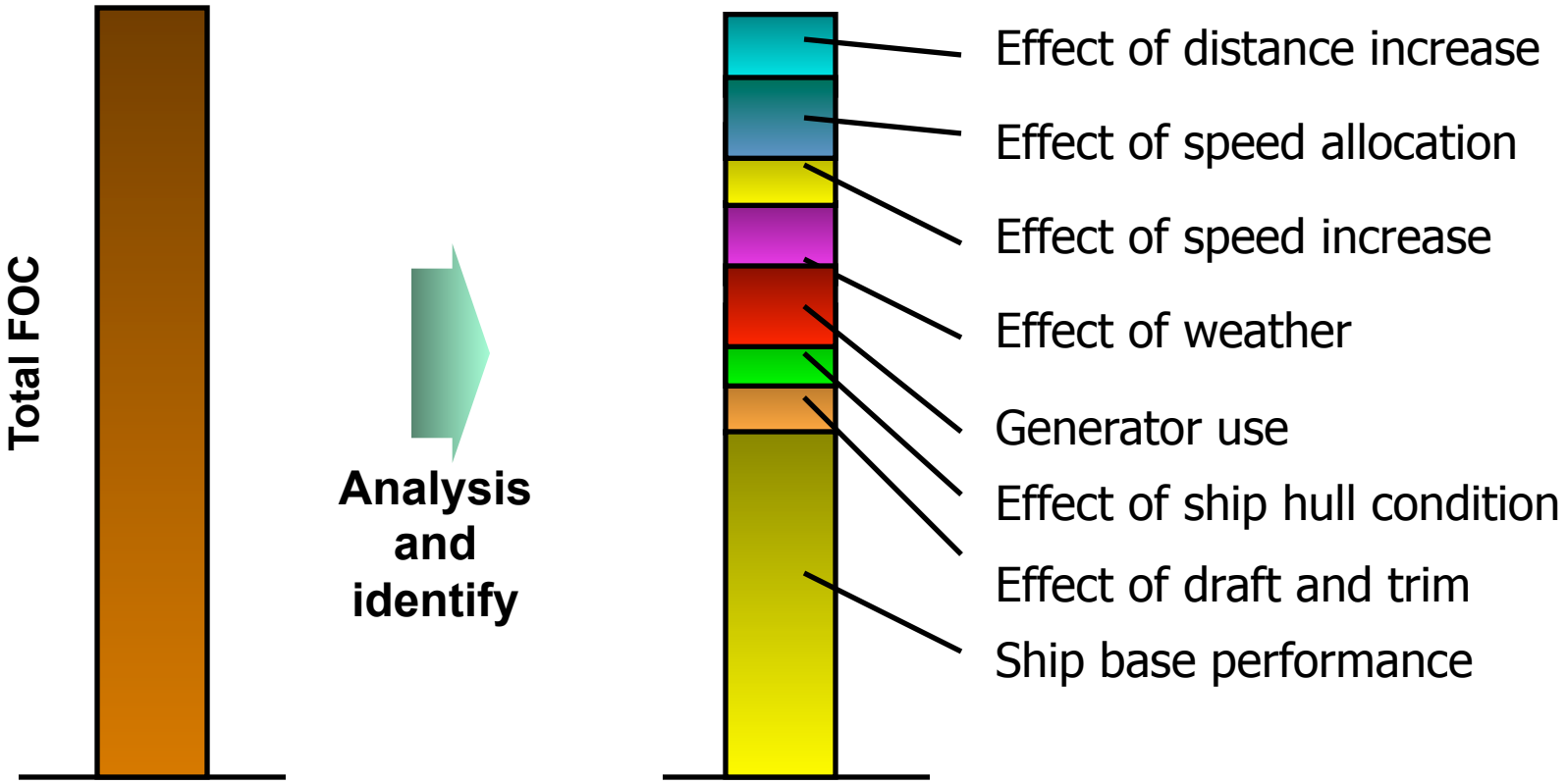
Data interval: **24 hours**



Data interval: **1 hour**

Identify each cause of fuel consumption

- By using detail monitoring data and appropriate analysis methods, total FOC can be breakdown into each cause.
- It will be the key concept for SEEMP management too.



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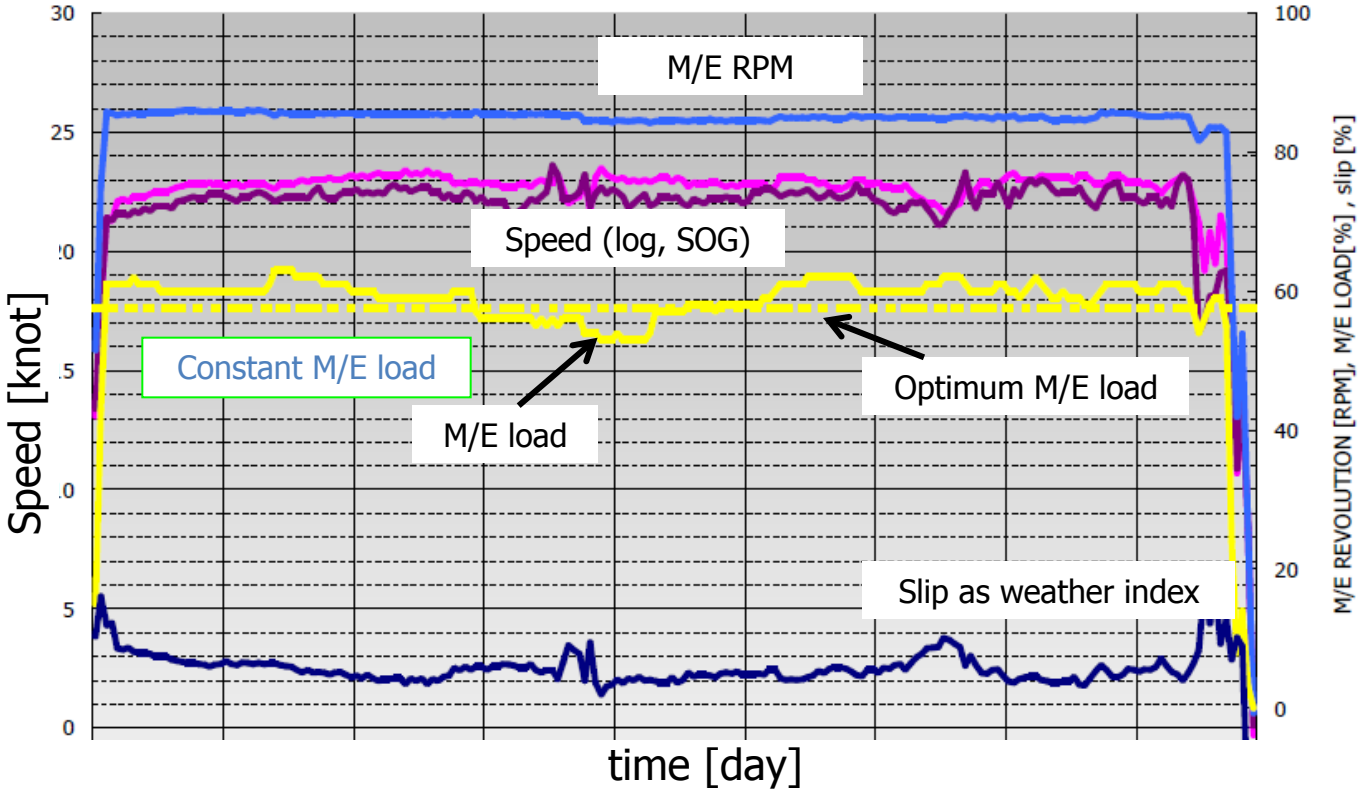
Good practice

Check point of eco voyage
- ✓ No drifting, No early arrival
- ✓ Reduce speed in rough weather
- ✓ Constant M/E load

OAKLAND - TOKYO

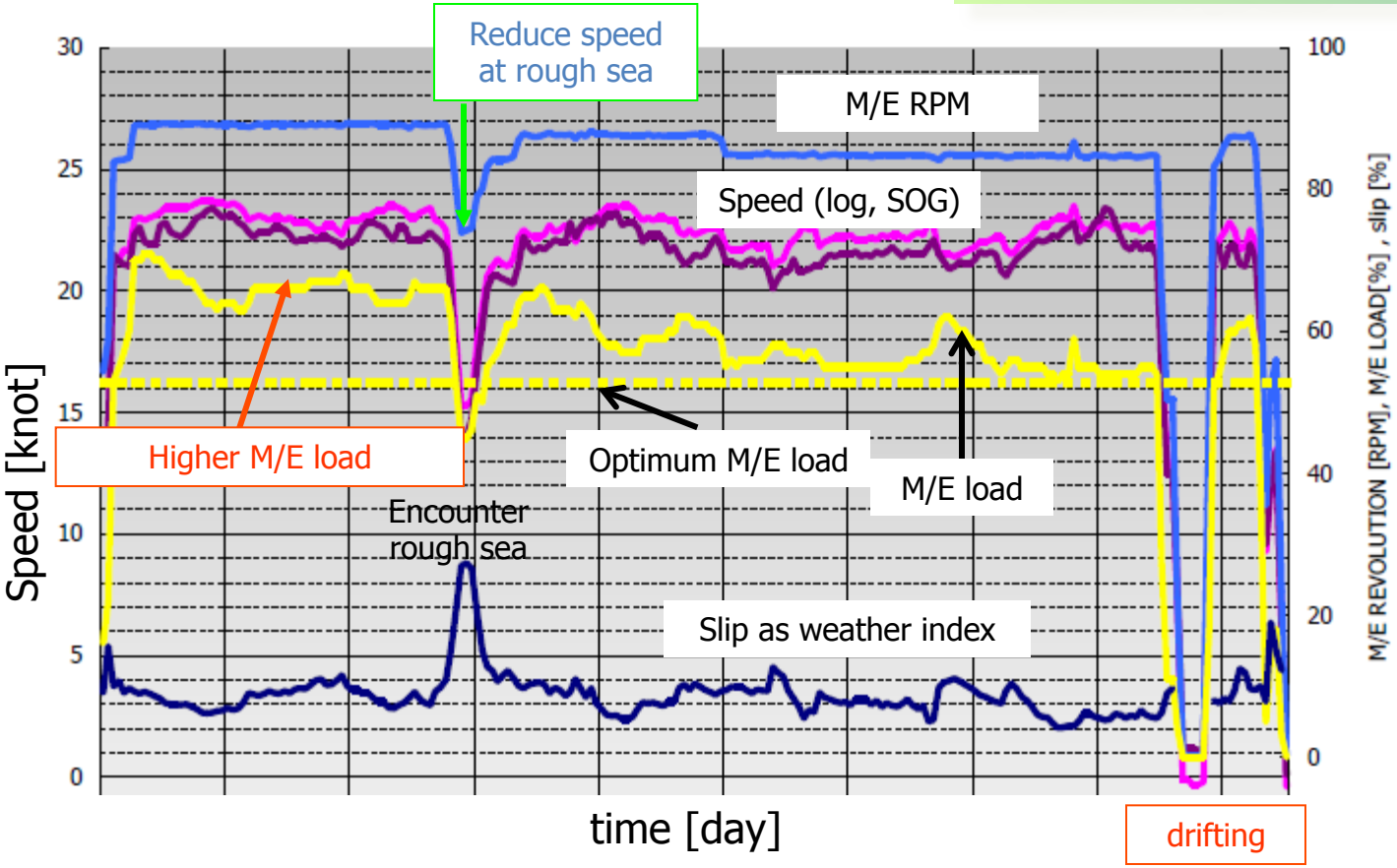


Additional FOC: comparison to optimum M/E load = 0.5 %

Practice can be improved

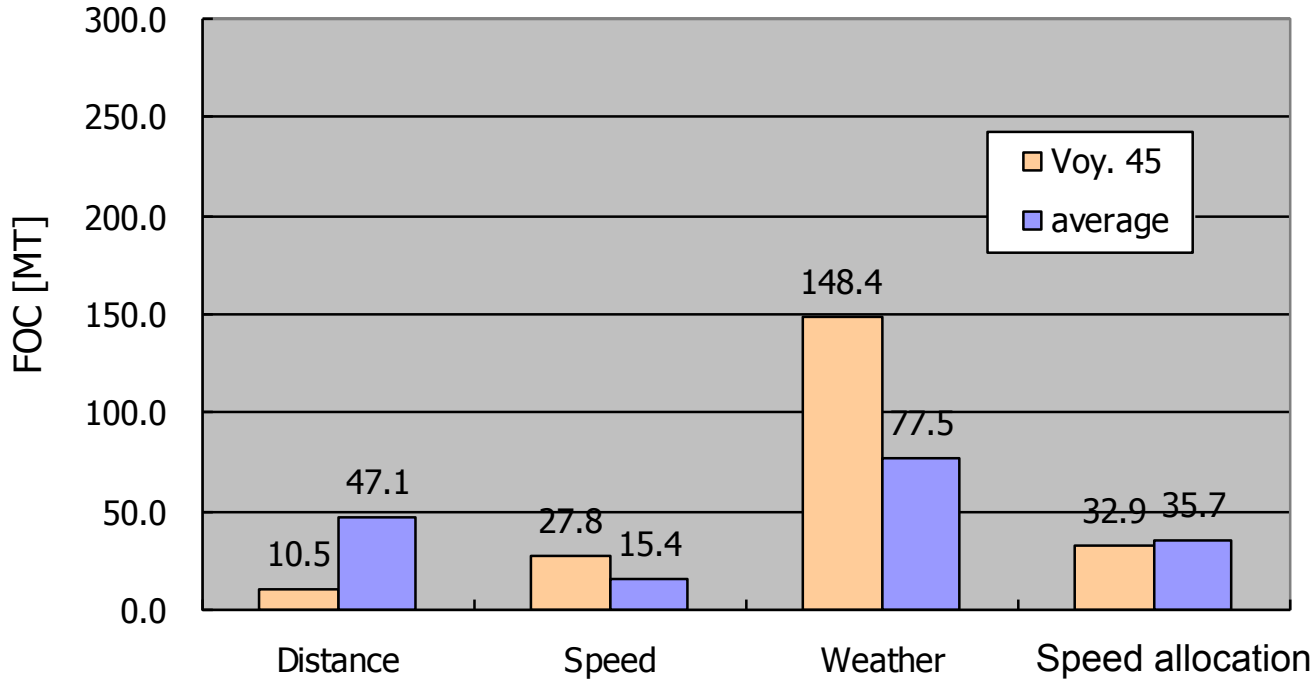
Check point of eco voyage
- ✓ No drifting, No early arrival
- ✓ Reduce speed in rough weather
- ✓ Constant M/E load

OAKLAND - TOKYO



Additional FOC: comparison to optimum M/E load = 8 %

Breakdown analysis of additional FOC



- As the result of break down analysis, factors for additional FOC in the voyage are shown quantitatively
- Compare each FOC factor with past average provides qualitative information

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Optimum weather routing

- Role of weather routing
  - (past) Avoiding severe weather
  - (now) Optimum weather routing

    Best balance of
    - Safety
    - Schedule keep
    - Economy
    - Environment

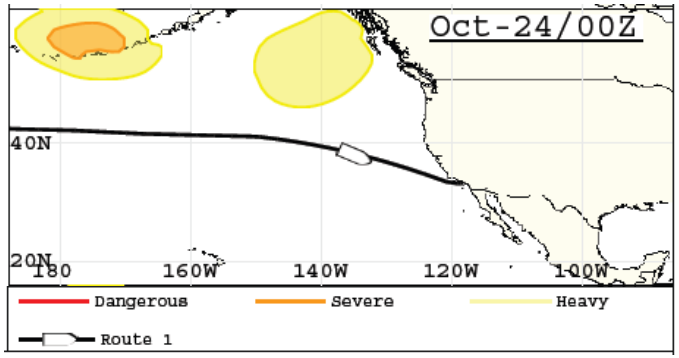
- Necessary technology for optimum weather routing
  - Ship performance model
    - RPM – speed – fuel consumption
  - Ship motion and performance in severe weather

[Major Waypoints of Route 1]

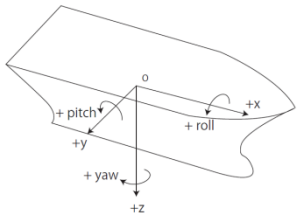
Major waypoint	DateTime	Nav.	Dist	OG SPD	RPM	Remarks
				(OG SPD:Over Ground Speed)		
Latest Reported Position		RL	780	20.7	77	nil
41N/150W	Oct-22nd 1345Z	GC	1445	20.6	77	nil
SW of San Miguel Is.	Oct-25th 1200Z	RL	133	17.0	77	nil
LOS ANGELES	-					

Req.Ave.OG SPD:20.2 kts for RTA/remaining distance.

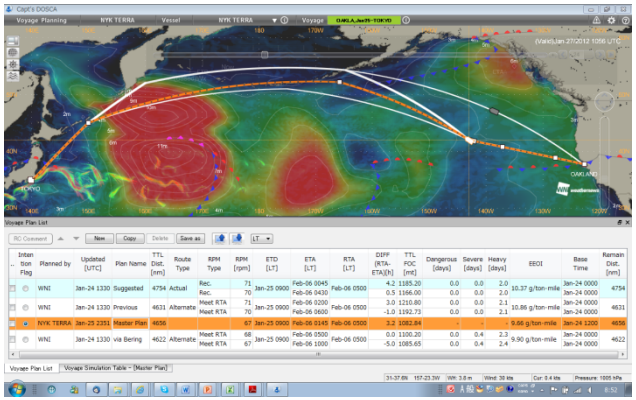
Way points

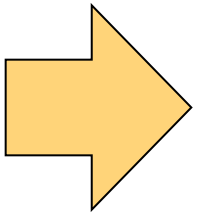


Routes and weather



Integration of weather routing and monitoring

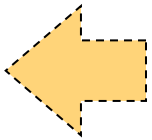




Weather Routing（PLAN）

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.

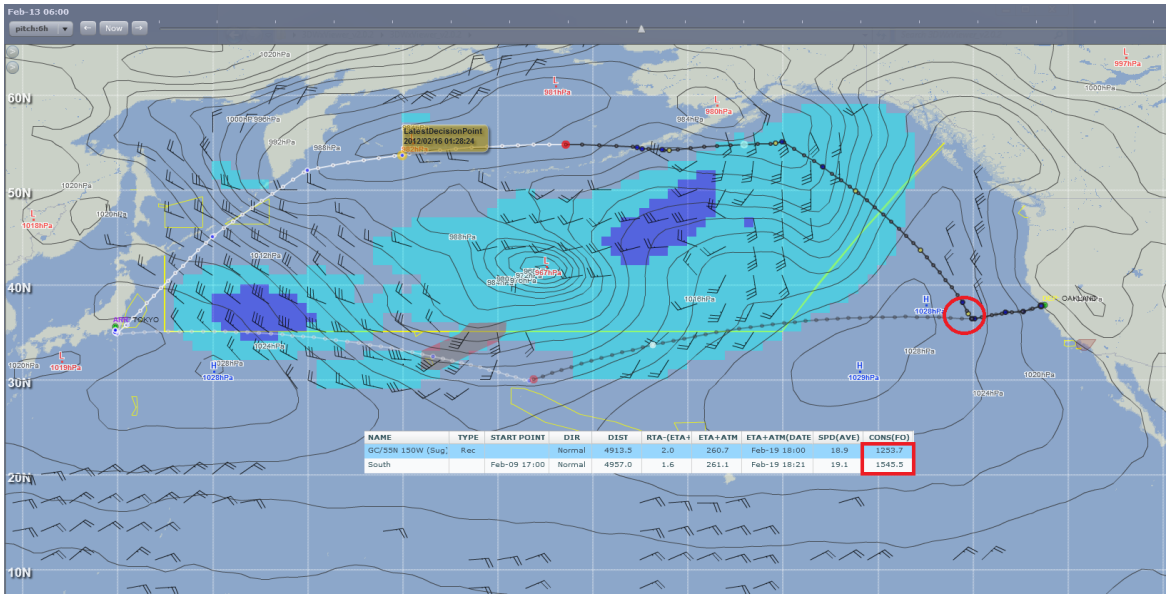
Optimum Route Selection

Situations, such as weather forecast and port availability, are changing every moment. Share situation awareness and select optimum route.

(Voice from captain onboard)
"Weather forecast changed, can we keep the schedule ?"
"Give us advice estimate fuel consumption for both routes"

What is optimum weather routing ?

⇒ Not only to avoid severe weather, but also to keep schedule and cost target



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Ship performance in bad weather

6500TEU Container Ship

Wave height 5.5m, Wind speed 20m/s,
Head sea

Propeller rev. 55rpm

<Calm sea performance>

speed: 14 knot

FOC: 45 ton/day

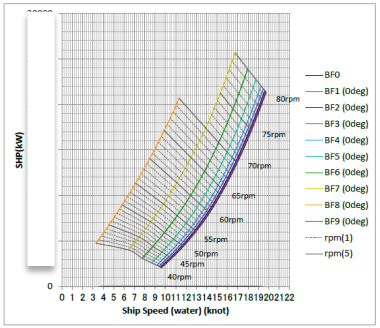
<Performance in the rough sea>

speed: 8 knot

FOC: 60 ton/day

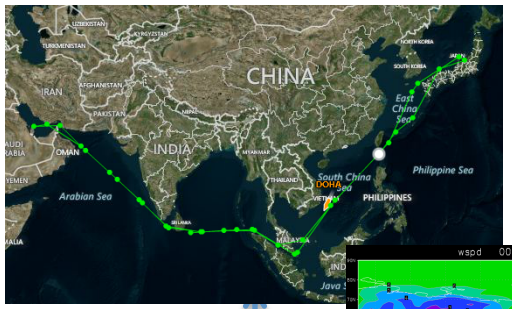
<Factors of performance change>
1. Wind and wave, 2. Ship design (hull, propeller, engine), 3. Ship condition (draft, trim, cleanness of hull and propeller, aging effect)

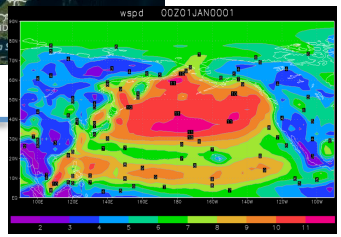
Business optimization with performance model



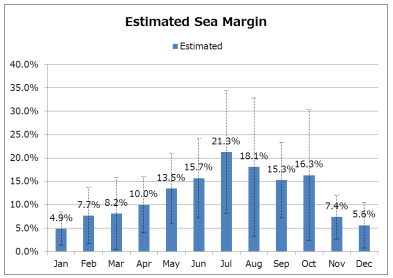
Ship performance model

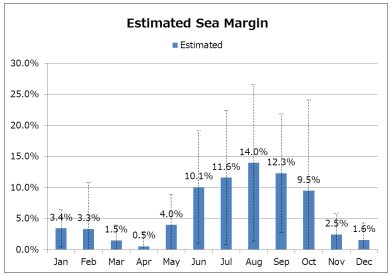
Service route





Hindcast weather data





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

Accurate vessel performance model contributes to optimization of vessel deployment.

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Summary

- Performance management system (PMS) plays key role in implementing operational measures for fuel saving
- Our implementation of PMS and data analytics examples are shown. Quantitative fuel consumption analysis provides information for fuel saving.
- Feedback from PMS to weather routing makes the system more reliable
- Vessel performance model in all weather is one of the key technology to optimize ship operation.

Thank you very much for your attention