Norway – Japan Maritime Seminar
New Technologies in Shipping and Ship building

Connected Ships – a Future Reality

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The era of connected ships

- Use assets more efficiently -

- Automate ship oper
- Manage ship/shore productive team
- Integrate fleet syste
- Use big data to find reduce accidents
- Inform managemen

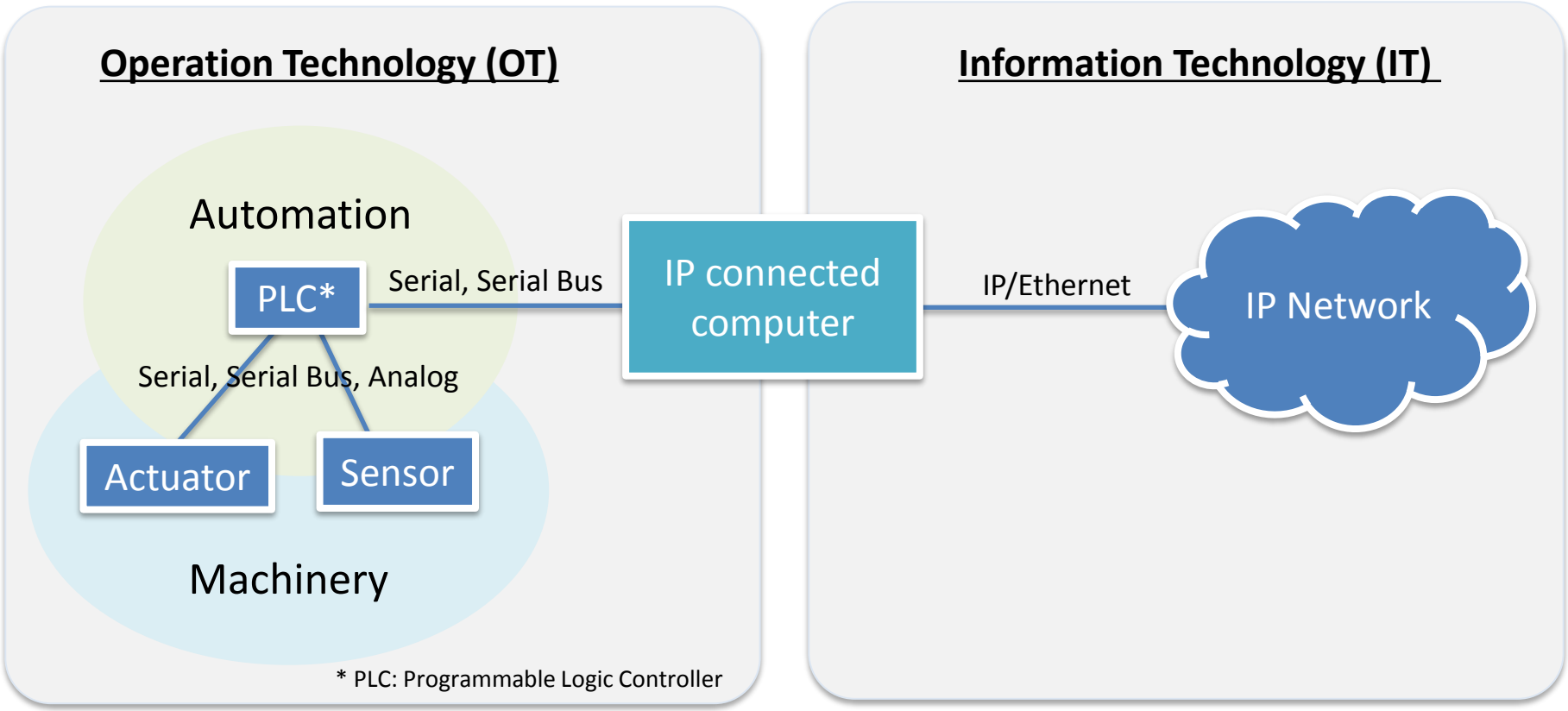
Reference)

Martin Stopford, Shipping's Next Techno-Econ
(http://www.jpmac.or.jp/forum/pdf/106_1.pdf

Smart-shipping toolbox

1. Telematics (≒ IoT)
2. Satellite communications
3. Data storage & analysis
4. Smart phone style apps
5. Information systems
6. Automation

IoT (Internet of Things)



"Operation Technology (OT)" and "Information Technology (IT)" are to be bridged.
The era of "transparency" where user can access field data.

Coming IoT of Ship

Target

- Prevent unpredicted downtime (**owner**)
- Reduce maintenance cost (**owner**)
- Energy efficiency in operation (**operator**)

Measure

- Condition monitoring
- Big data analysis
- Support service engineer
- Intelligent machinery
  - Self diagnostics

Change way of working

Digital Twin

- Real world individual product will be modeled in computer -

Real
(Product, Plant…)

IoT data →

← Information

Virtual
(3D model, simulation)

Reference) http://www.gereports.com/post/119300678660/wind-in-the-cloud-how-the-digital-wind-farm-will/

IoT and Big data application areas

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

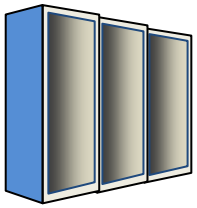
Other partners in value chains, such as cargo owners, shipyards, equipment manufacturers, and class societies, have also interests in ship IoT and Big data.

IoT platform of NYK

SIMS (Ship Information Management System)

SIMS IoT data

+ SPAS manual data



Data Center

SIMS Data Collection Onboard

Sat Com (VSAT, FBB)

- GPS
- Doppler log
- Anemometer
- Gyro Compass

SIMS unit

Onboard dashboard

VDR

Data Acquisition and Processing

Motion sensor

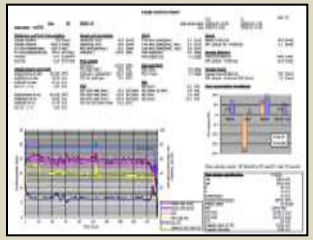
<Navigation Bridge>

<Engine Room & Cargo>

- Main Engine
- Power plant
- Cargo control
- Auxiliary machineries

Integrated Automation System

SIMS Monitoring & Analysis at Shore



Performance Analysis

- Long term analysis
- In service performance

Analysis

Operation Center (Tokyo, Singapore ...)

Shore Dashboard

- For operation
- For ship manager

Technical Analysis (NYK, MTI)

Ship performance in service

6000TEU 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

<**Rough sea(BF8)** performance>

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 model

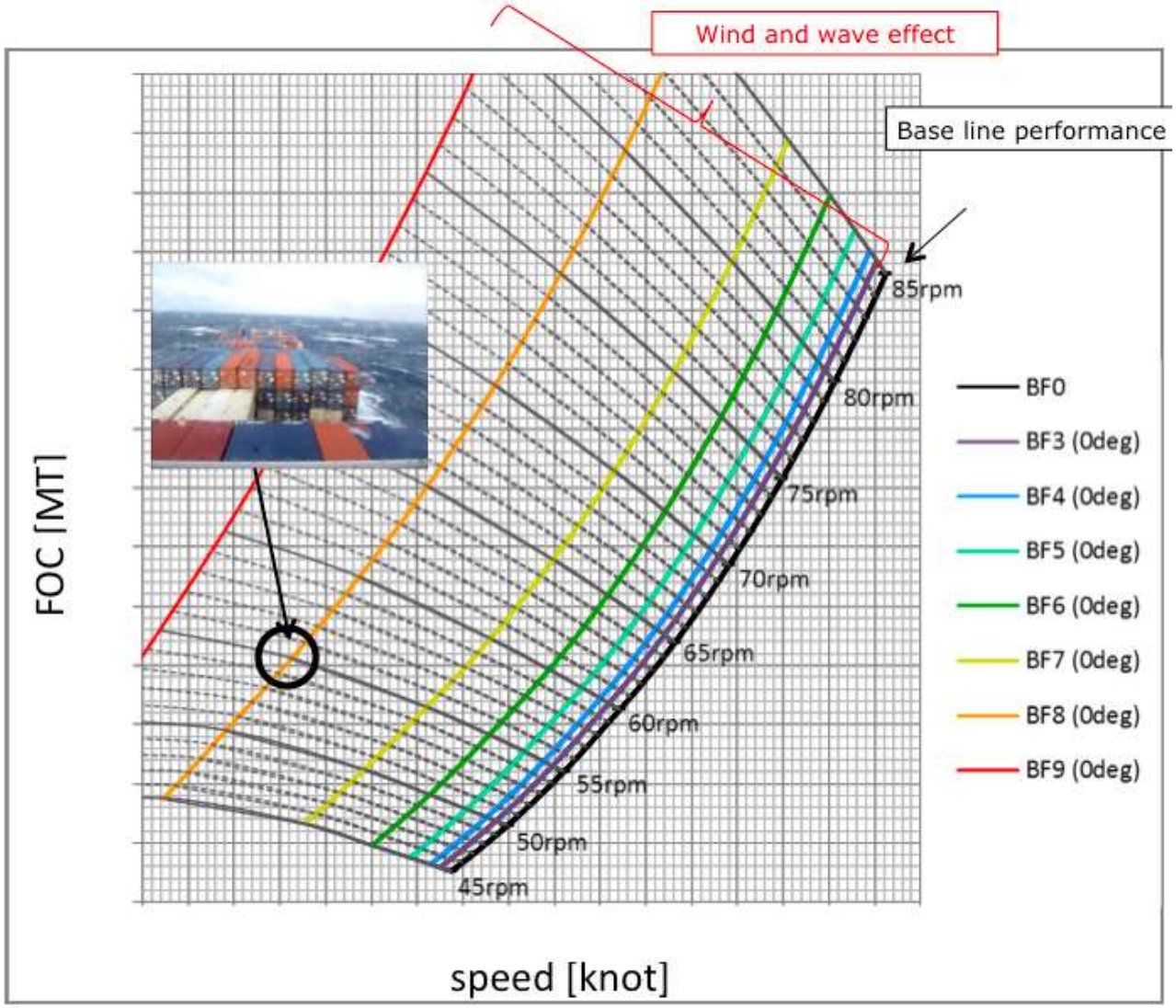
6000TEU Container
Draft 12m even

Sea condition

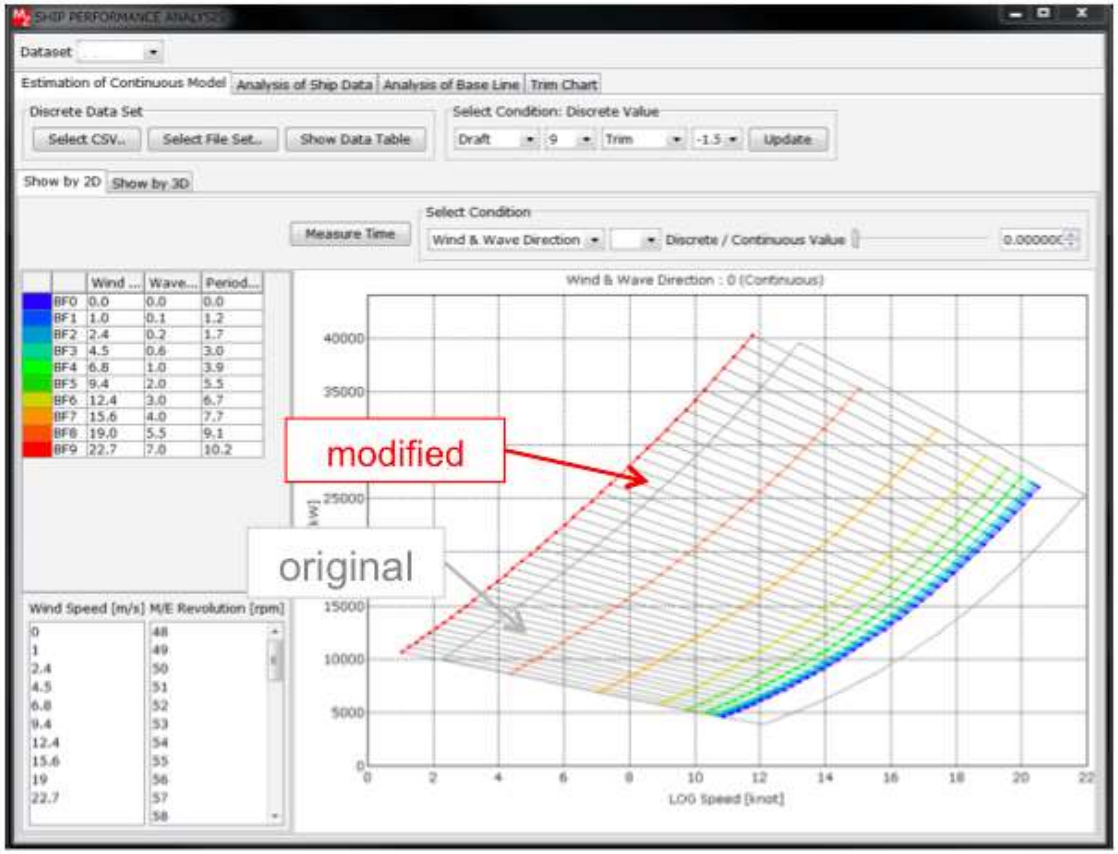
Beaufort scale

	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

0 deg (wind, wave) – head sea

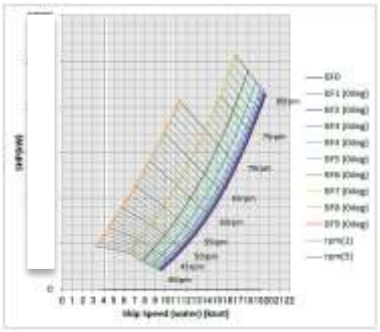


Ship performance model in service



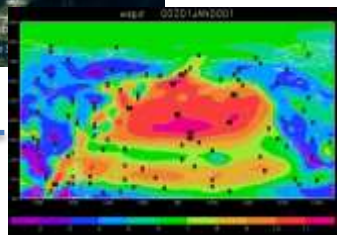
- *Digital Twin* of ship performance in-service
- Performances under all possible conditions (draft, trim, wind and wave)
- IoT data are used for correction of the model.

Operation optimization

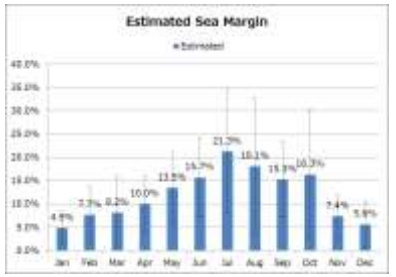


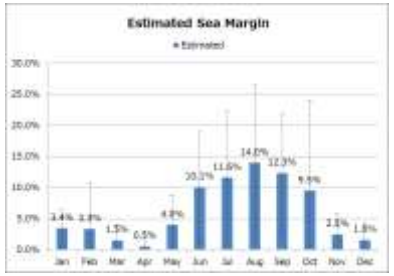
Ship performance model

Service route



Voyage simulation with past weather data

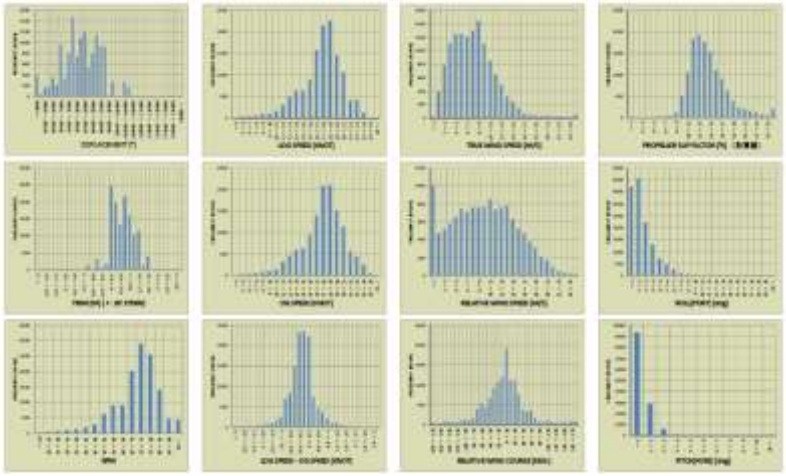




Estimation of
- Sea margin
- FOC and etc.

Combine ship performance model with weather data to optimize ship services

Energy saving hull modification



23 % CO2 reduction was confirmed

Operation profile

- Speed, RPM, Power
- Draft, trim, displacement
- Weather
- Sea margin
- Etc.

Energy saving modification

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

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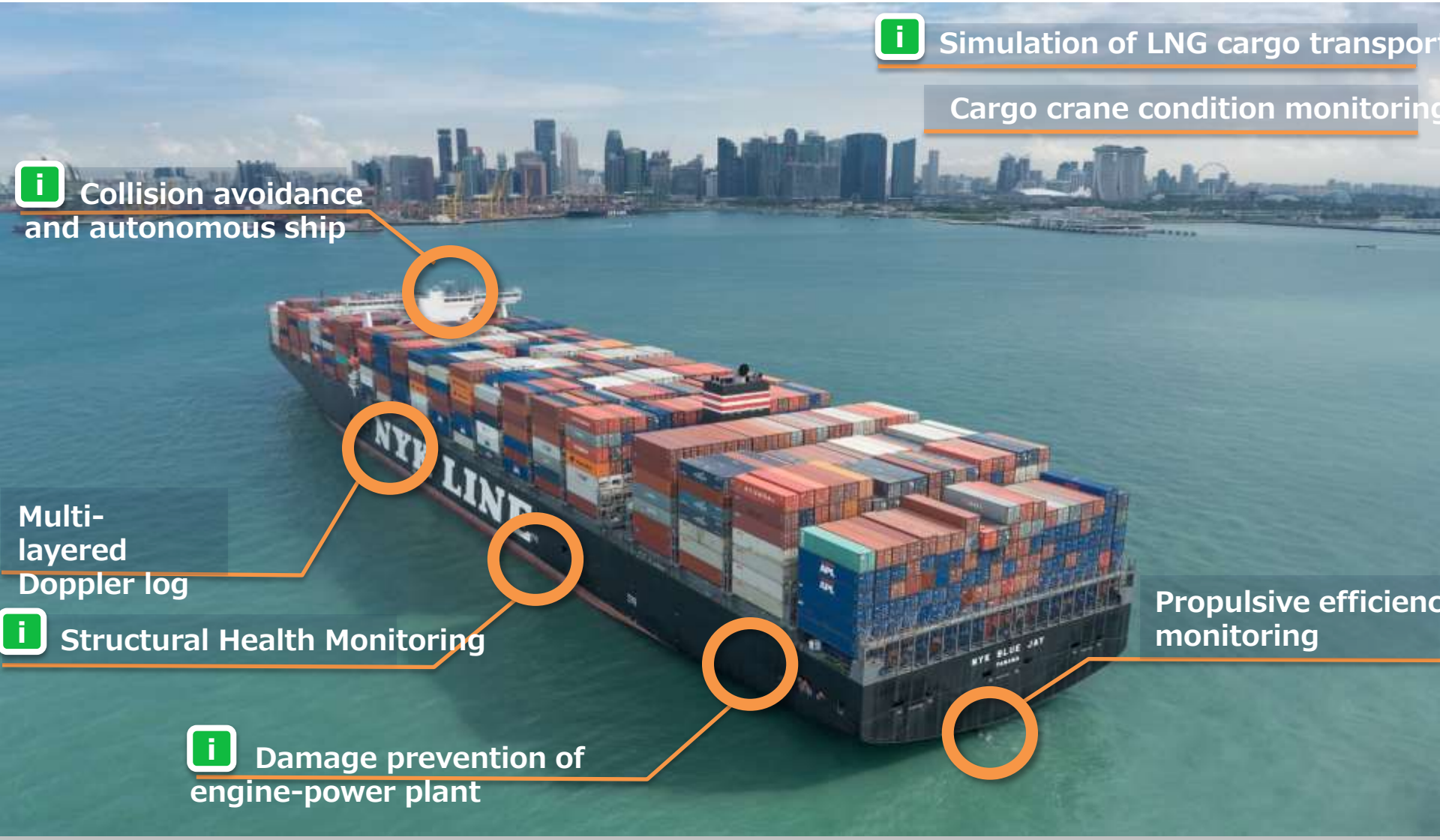
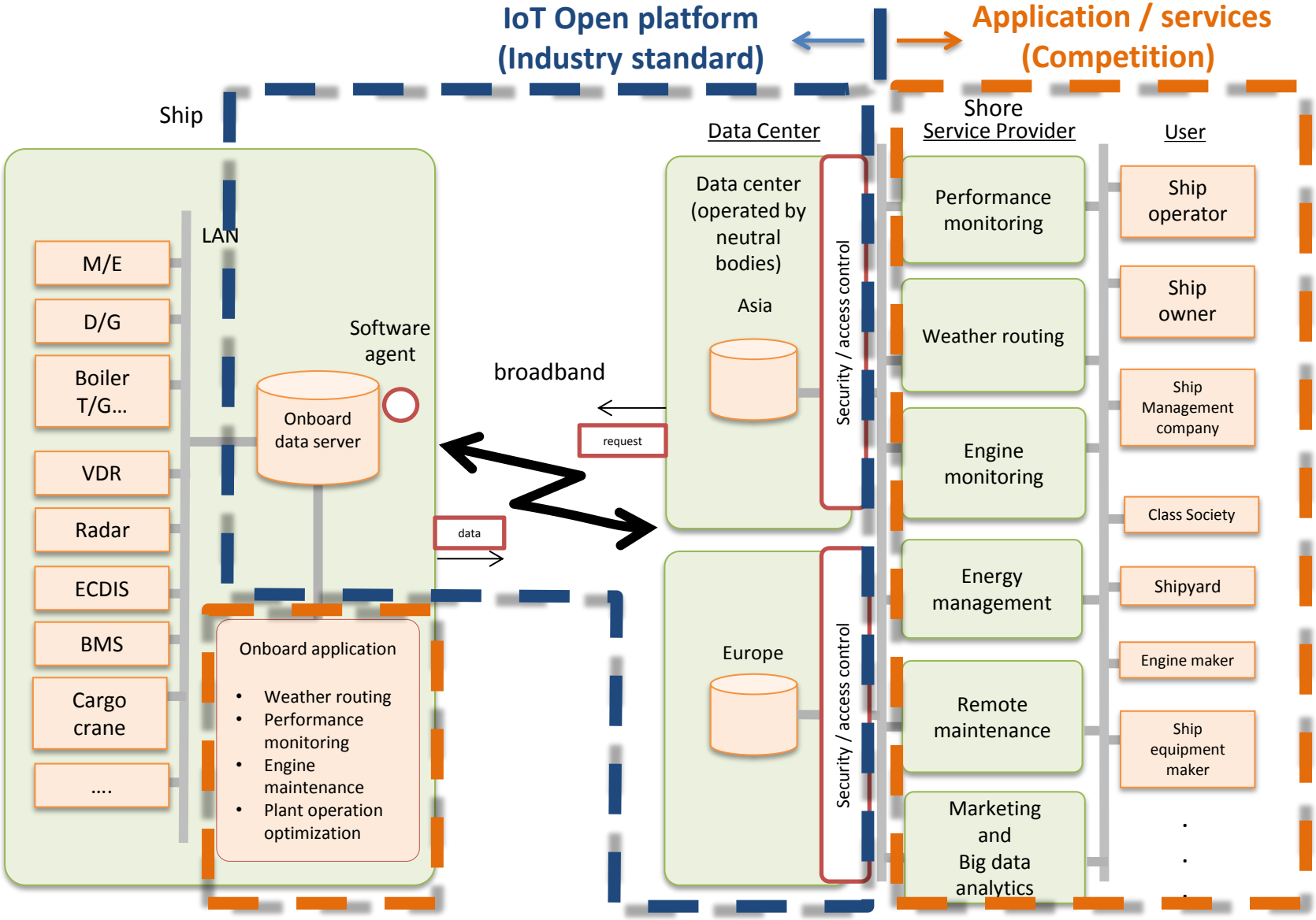
Open collaborations with partners

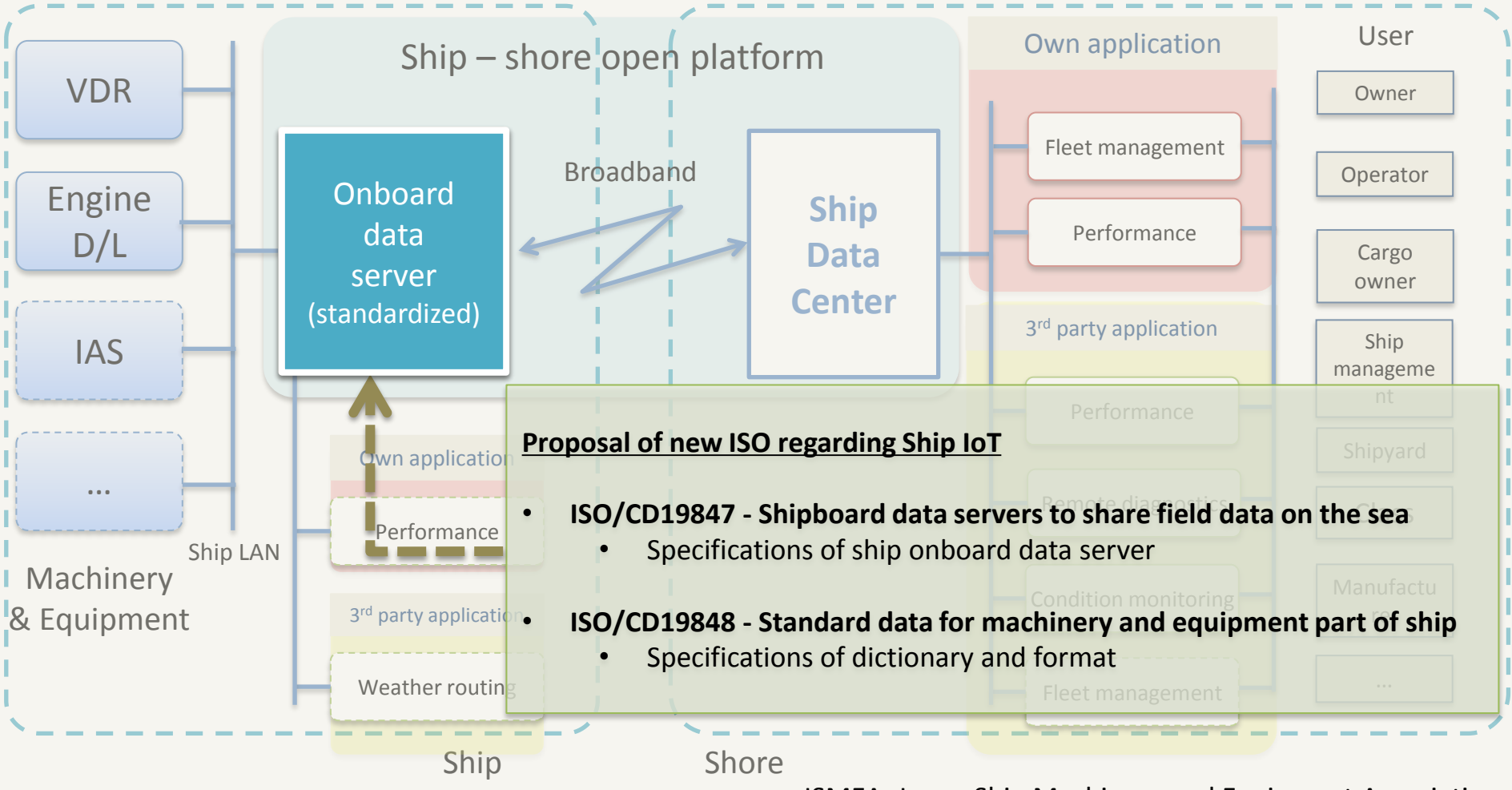
i-Shipping: Japanese government funding projects Ship IoT for safety (2016-2020)



Ship – Shore Open Platform for IoT of Ship



Standardization activities of Ship IoT platform
(SSAP2: Smart Ship Application Platform 2 Project by JSMEA)



JSMEA: Japan Ship Machinery and Equipment Association

Thank you very much for your attention