

NYK's IoT Platform - SIMS's Data Acquisition to Visualization -

22nd April 2021

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MTI Co., Ltd.

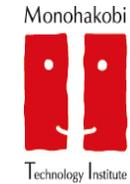
Outline

1. Introduction
2. IoT and big data in shipping – identify right issues to solve
3. Performance in actual seas
4. Visualization of data – application to remote diagnosis center
5. System integration and open collaboration

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Company Profile



NYK LINE

- Head Office: Tokyo, Japan
- Founded: September 29, 1885
- Business Scope
 - 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
 - Offshore Service
- Employees: 34,857 (as of the end of March 2020)
- Revenues: \$ 16.7 billion (Fiscal 2019)
- Fleet: 784 vessels (as of the end of March 2020)

MTI (R&D Arm of NYK LINE)

- Established : April 1, 2004
- Equity capital : JPY 99 million
- Stockholder : NYK Line (100%)
- Number of employees : 69 (as of 1st April, 2020)



NYK/MTI's path toward smarter ship and operation

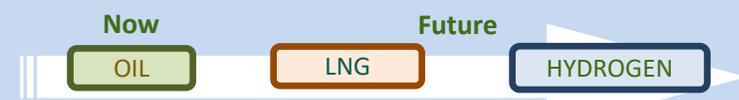
Smarter ship and operation in NYK/MTI

(Hardware)

Ship

(Software)

Operation



Alternative Marine Power

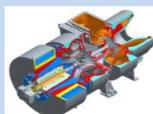
Wind Resistance Reduced MT-COWL



Super Eco Ship2030



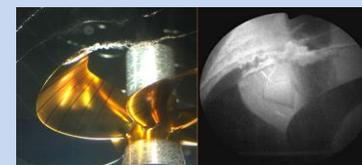
30% Energy Saving PCTC



Hybrid T/C Shin Koho



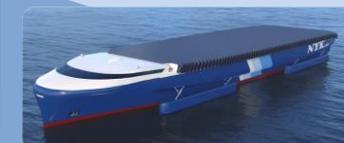
LNG-Fueled Tugboat Sakigake



Measurement around propeller



LNG-Fueled PCTC Delivery in 2016



Super Eco Ship 2050 carbon free concept ship



Wind Power Generator Andromeda Leader



Solar Panel Auriga Leader



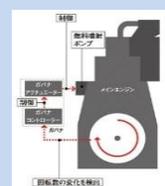
Air Lubrication System YAMATO, YAMATAI



Innovative Air Lubrication System SOYO



Electronic Controlled Engine



Improved Governor Controller



MT-FAST



Hybrid Electric Power Supply Auriga Leader



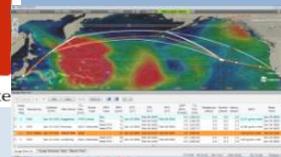
LNG Bunkering Vessel Delivery in 2016



Unmanned Autonomous Ship Trial Project (MEGURI)



NYK's own safety and Environment standard NAV9000



Prediction of Current



Fuel Consumption Indicator FUELNAVI



Integrated Operation Management System NYK e-missions'



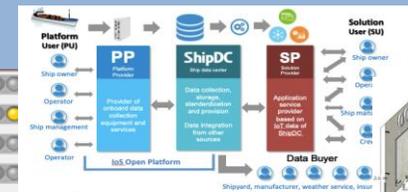
IBIS Project Onboard Broadband NYK SATCOM Project



LIVE Operation Portal Site



Detection of Mach. Trouble with monitoring data



ShipDC & IoT-OP



24/7 Engine Plant Monitoring Center

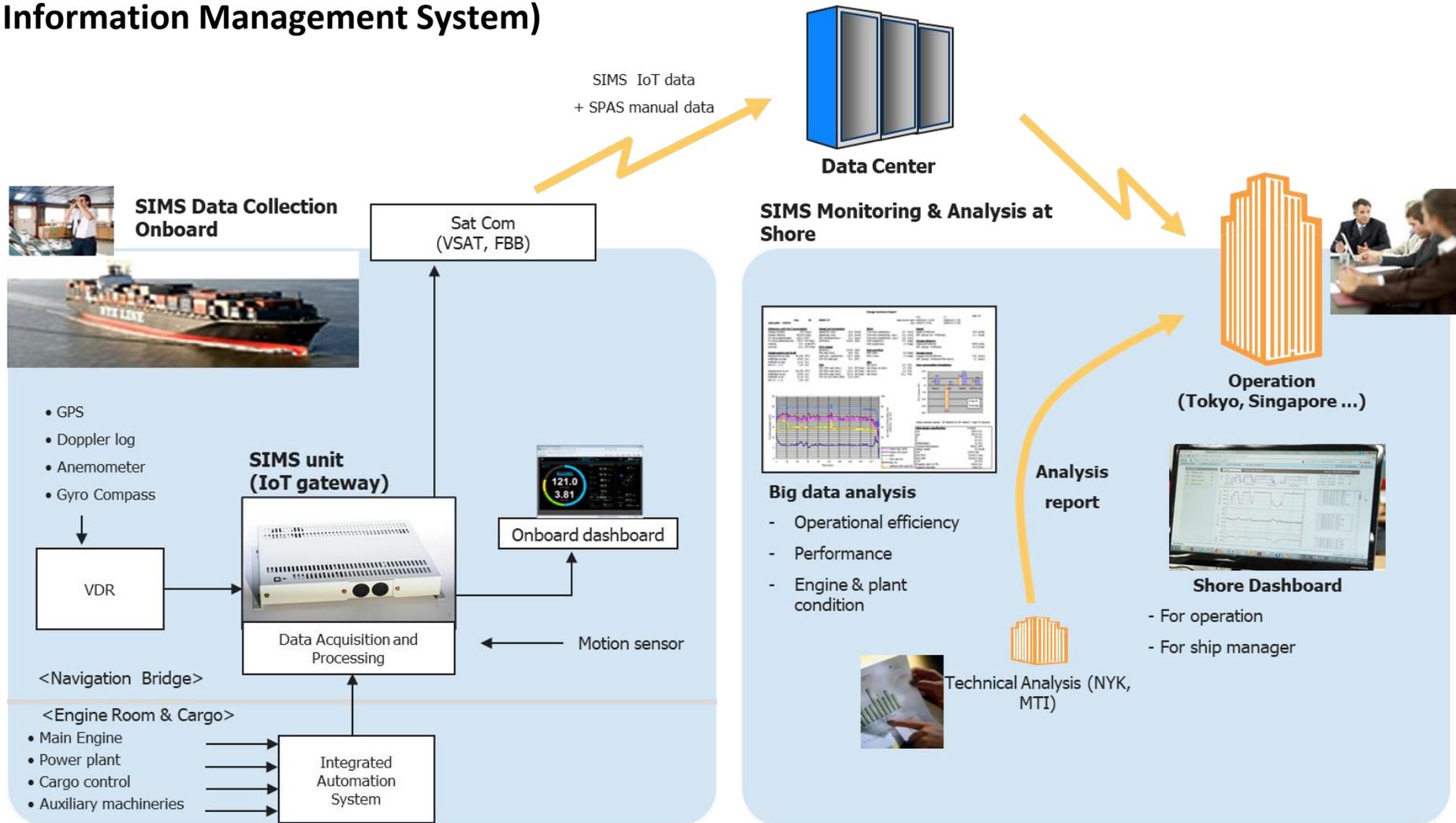
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

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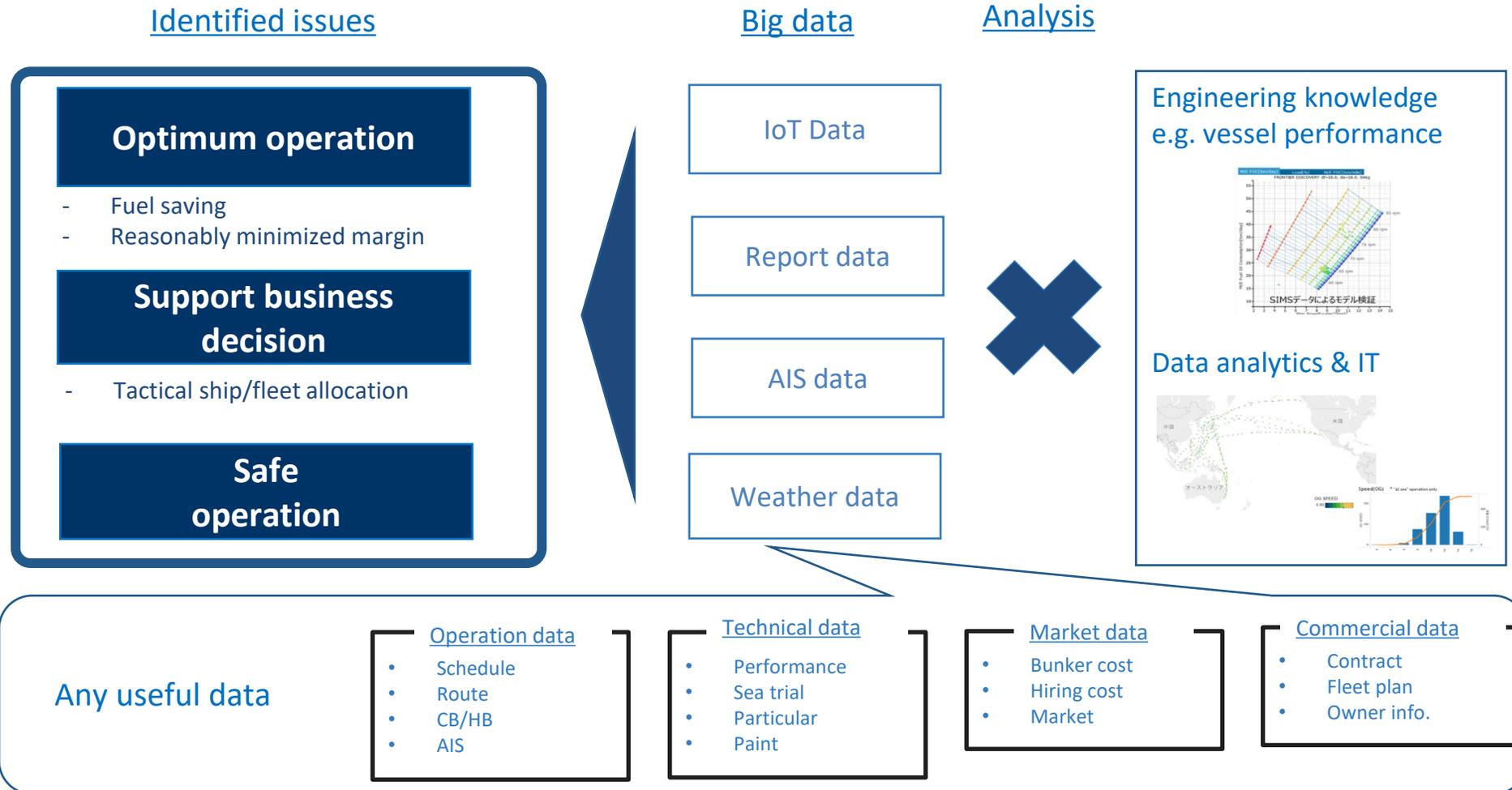
IoT Platform of NYK

SIMS (Ship Information Management System)



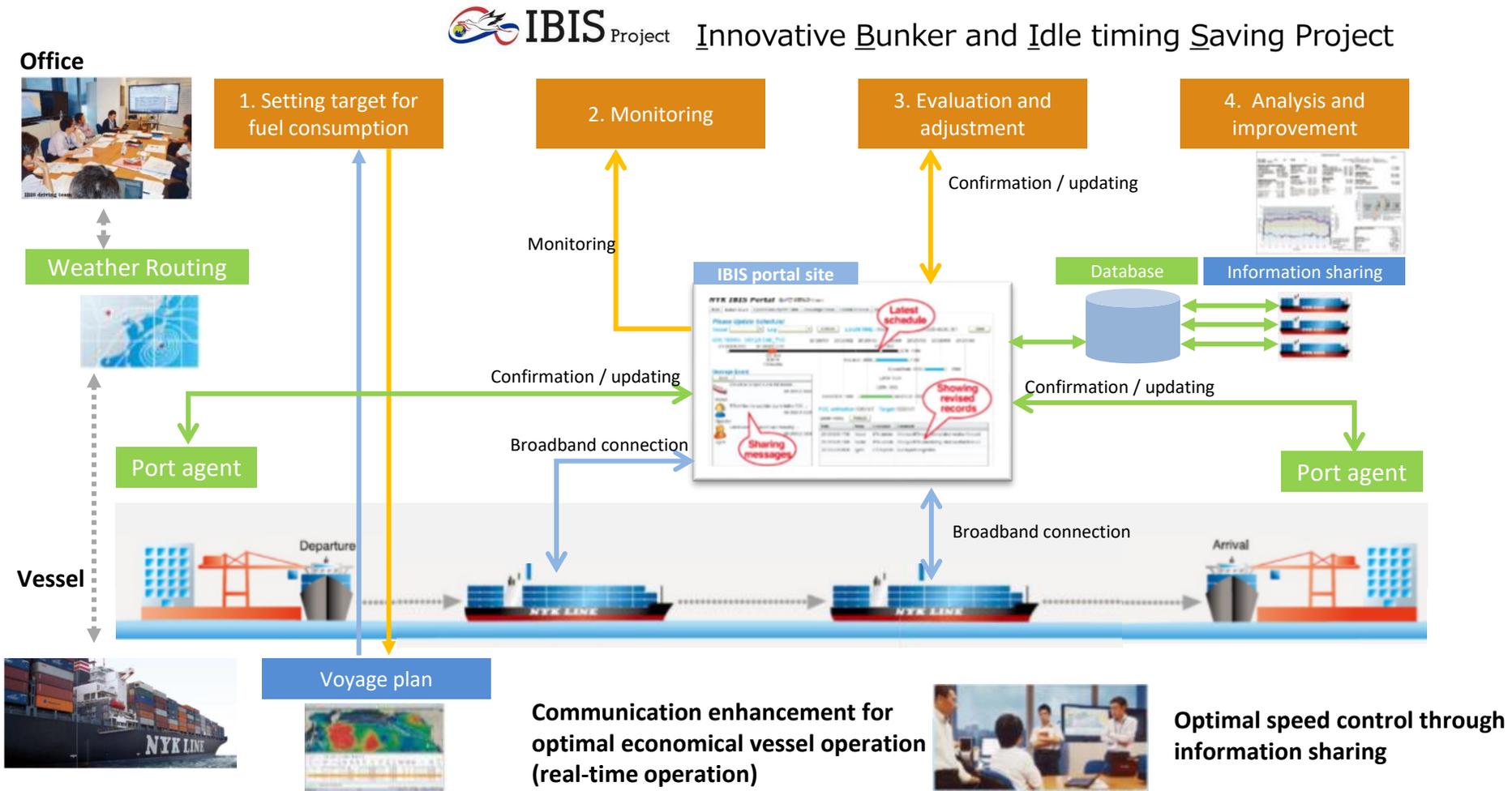
Utilizing big data and IoT for shipping

- Identify right issues to solve -



IBIS Project

- Project for optimum operation by domain expert-



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Performance in actual seas

Evaluation of ship's performance

Present: performance on plain water (no wind / no wave)

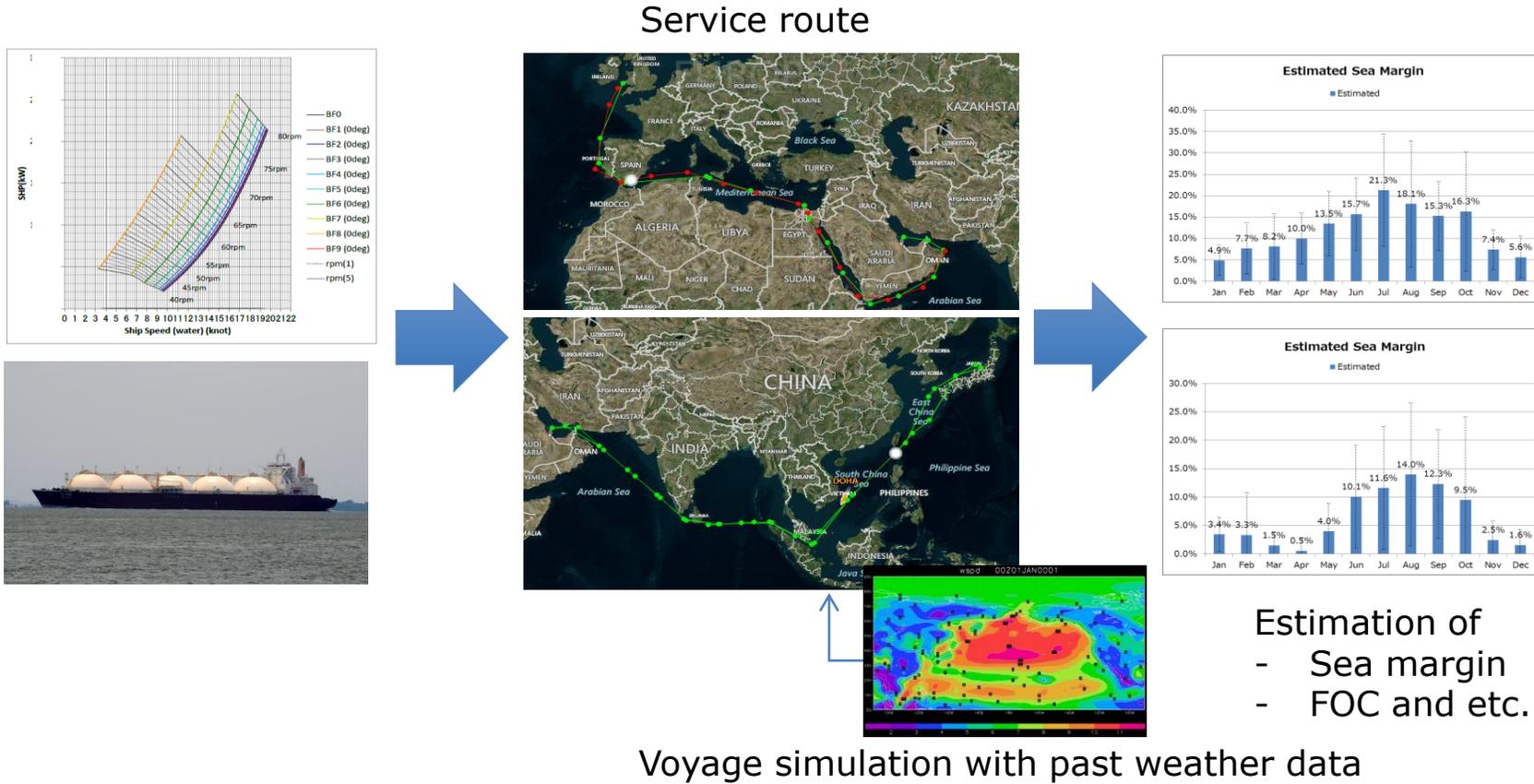


Not real situation of ship's operation

Next: performance in actual seas

Understanding seasonal operation risk

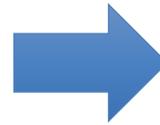
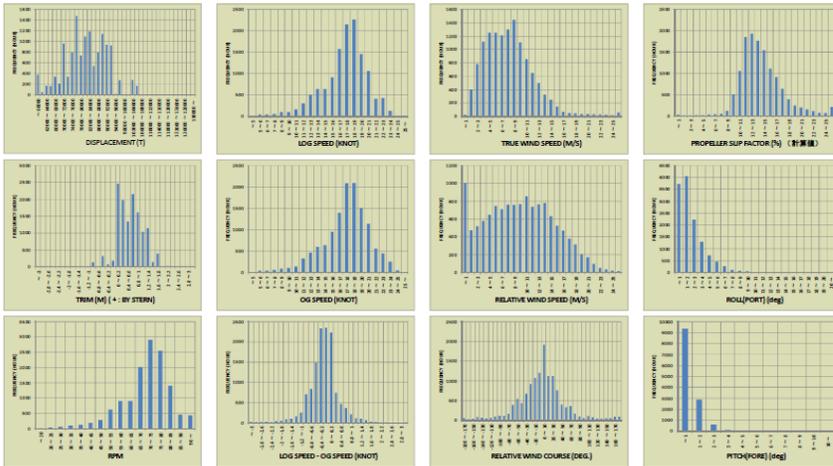
- Identify right issues to solve -



Combine ship performance model with weather data to optimize ship services

Improving ship's performance

- Identify right issues to solve -



23 % CO2 reduction
was confirmed

Operational profile

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

Energy saving modification

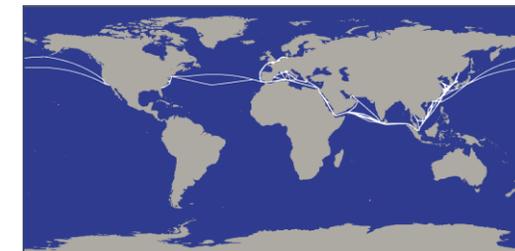
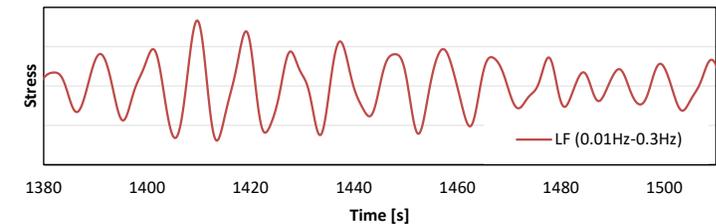
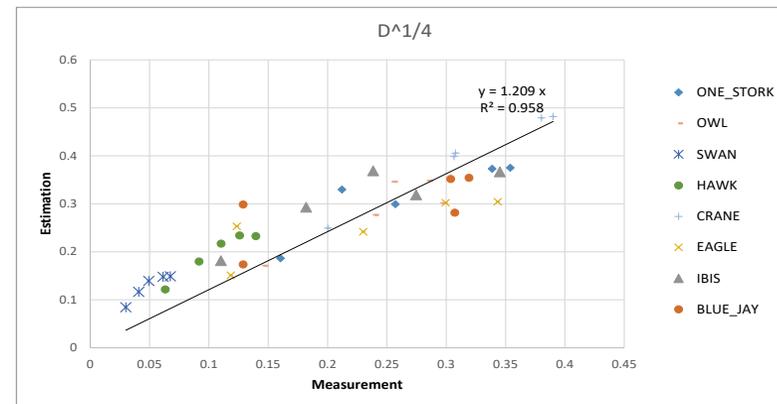
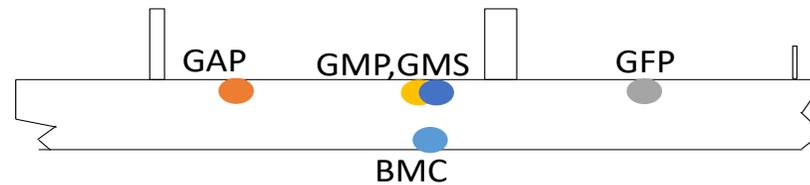
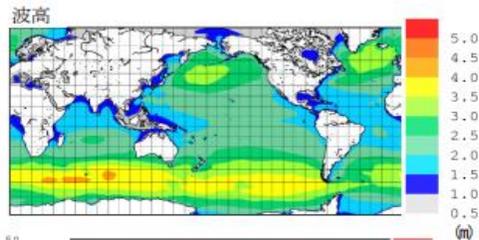
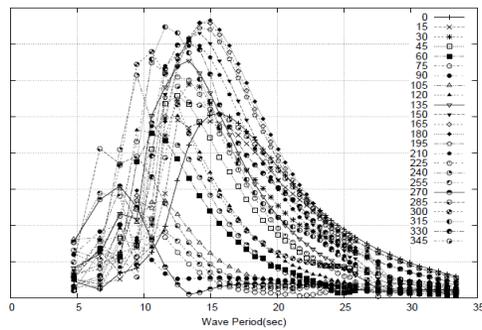
- Bulbous bow modification
 - Install energy saving device (MT-FAST)
 - Replace propeller
 - Engine de-rating
- Modifications were conducted on 40 ships

Data and simulations played important roles to optimize ship design

Hull Stress Monitoring Project

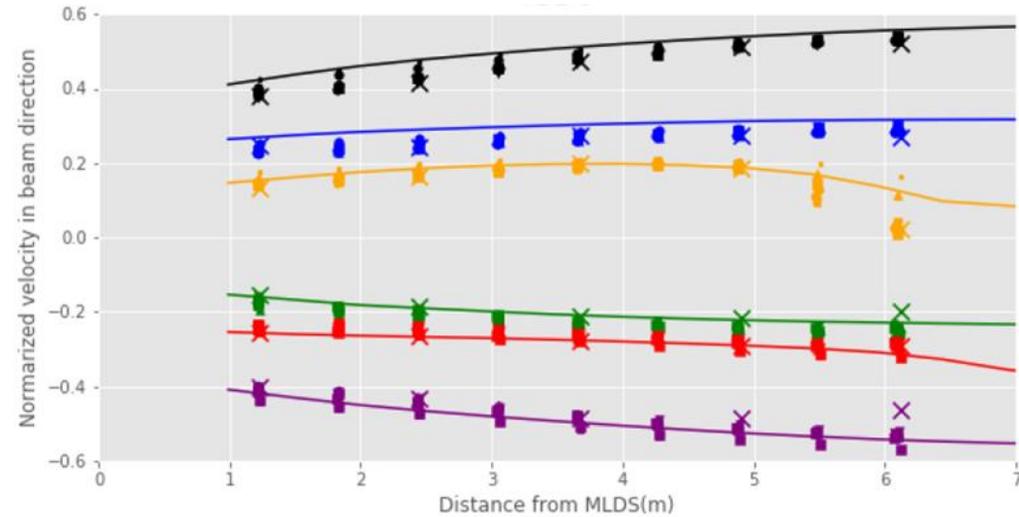
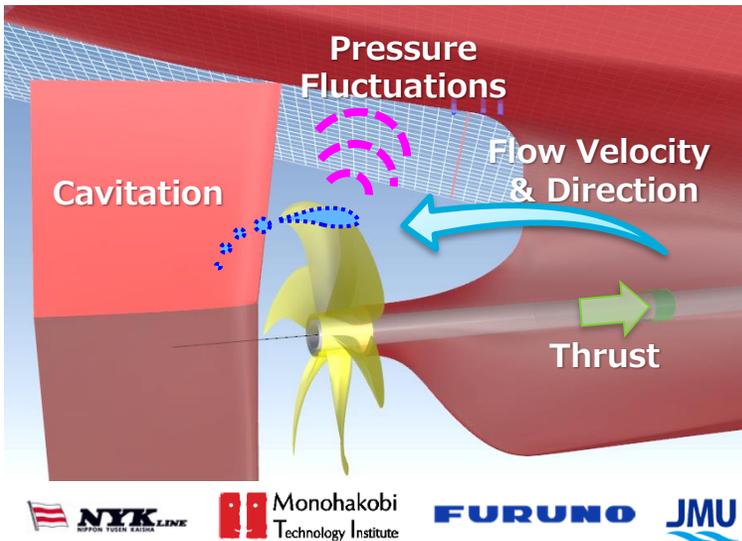
- Identify right issues to solve -

- National research project 14k TEU Container Carrier x 10 ships for 5 years
- Objectives for development
 - Data correction of ship in actual seas
 - Estimation of stress on hull structure
 - Estimation of accumulated fatigue
 - Hull structure stress monitoring system from users' point of view



Grasping flow field in actual seas

- Identify right issues to solve -



- Direct measurement of flow field around stern of ship in service
- More punctual calibration of full-scale CFD



Further design improvement for propeller, energy saving device and hull form

Estimation and Evaluation in Actual Sea - OCTARVIA Project -

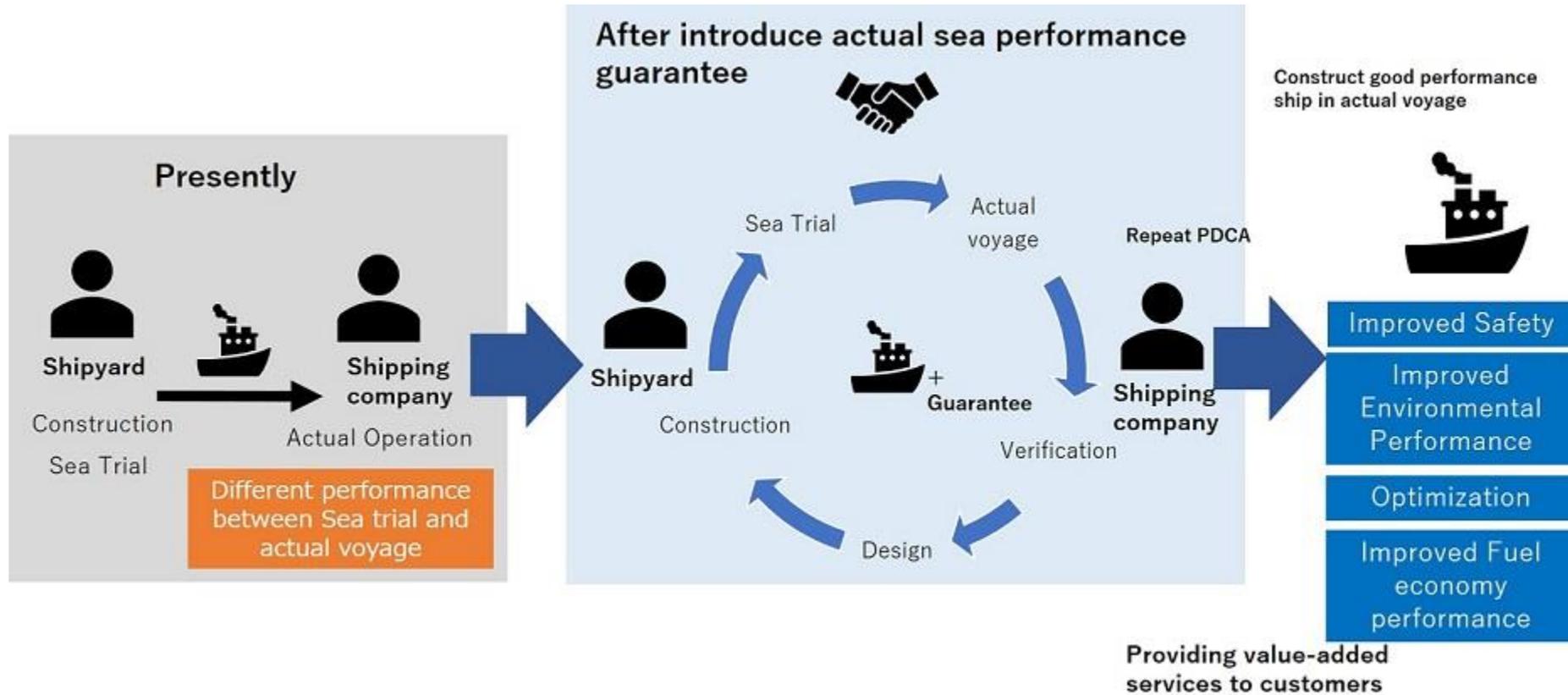


- Ship performance monitoring method
- Estimation method of ship performance in actual seas
- Evaluation of ship performance in actual seas



Common SCALE in actual seas condition

Guarantee in Actual Sea Conditions



- Preparation of common SCALE
- Better ship by common SCALE

Collaborative Area
Competitive Area

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LiVE for Shipmanager



Latest information for Vessel Efficiency

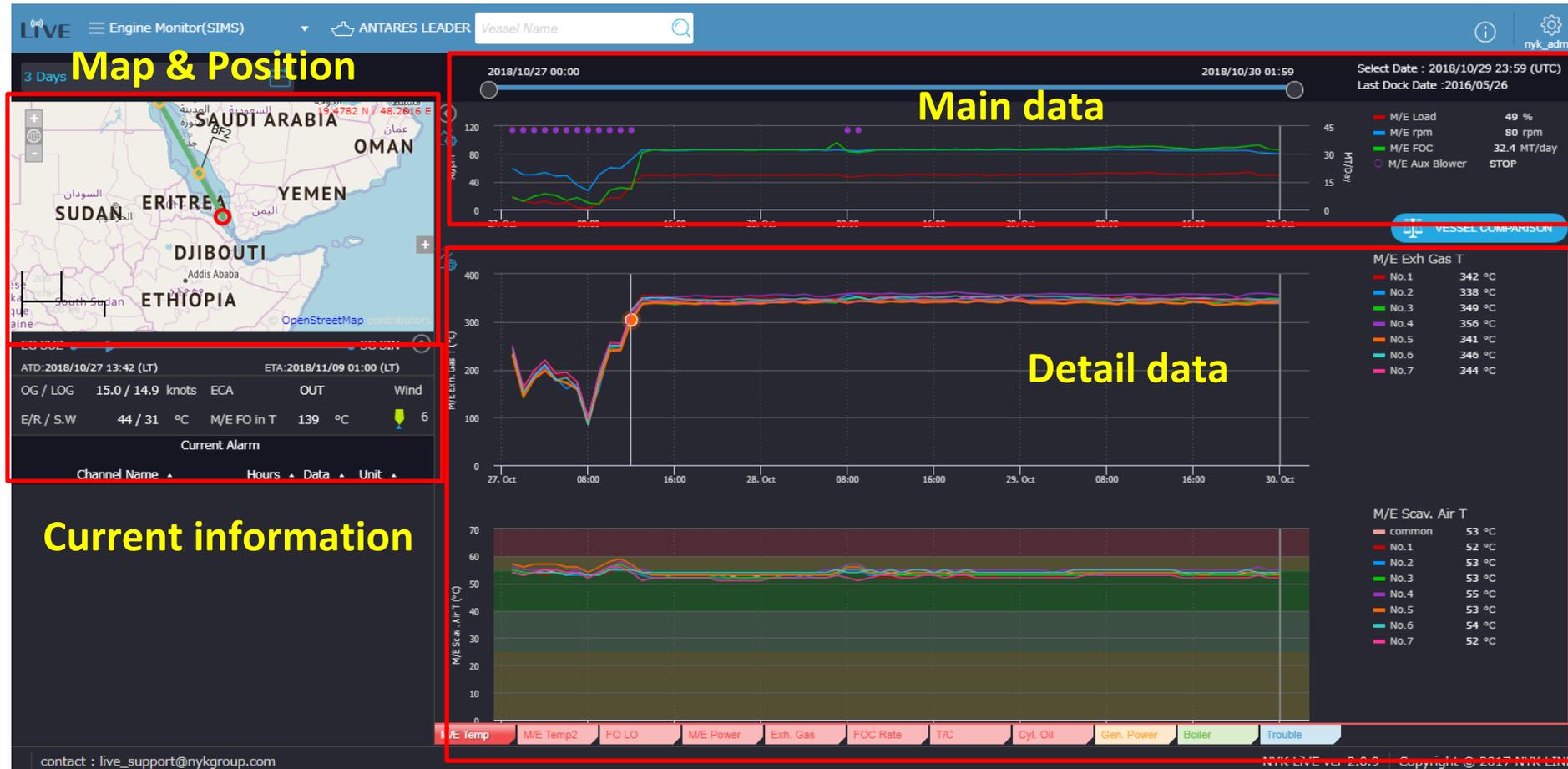
| Latest Update (UTC) | Advanced | Condition | Alarm | Repose |
|---------------------|----------|-----------|-------|--------|
| 2018/10/15 03:59 | ● ● ● | ● ● ● | 11 | 75 |
| 2018/10/29 06:59 | ● ● ● | ● ● ● | 0 | 21 ⚠ |
| 2018/10/29 03:59 | ● ● ● | ● ● ● | 0 | 17 ⚠ |

Fleet monitoring function shows general alarm status of each ship fleet wise

LiVE for Shipmanager

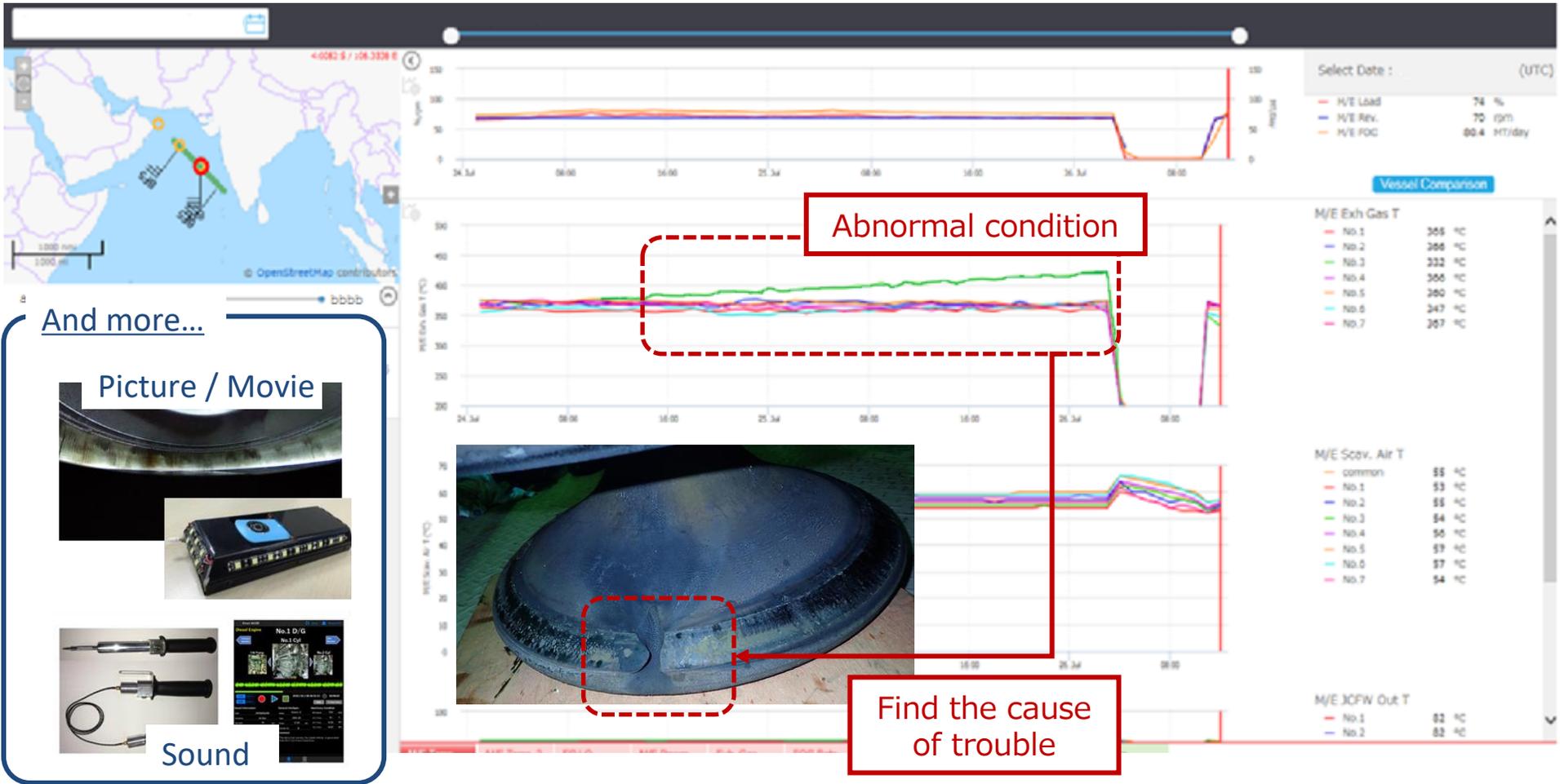


Latest information for Vessel Efficiency



Dashboard shows details of ship's data such like M/E data, position data etc.

Anomaly Detection – utilization of data -



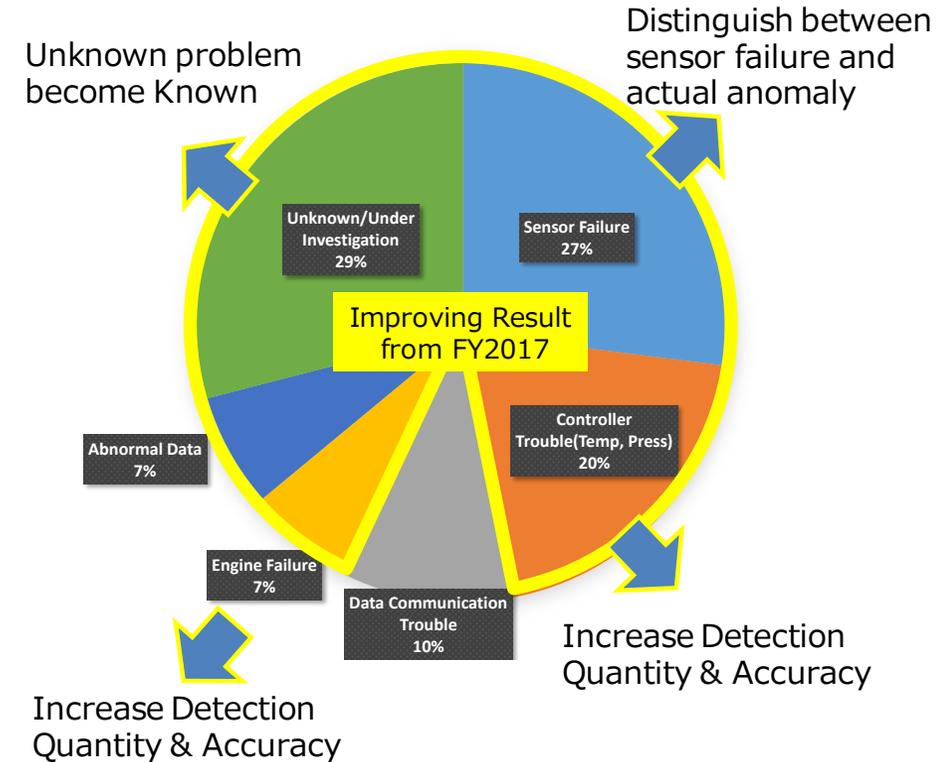
Utilizing big data and ICT for prevention of engine room troubles

Anomaly Detection – utilization of data -

LIVE



- Real-time detection linked to SIMS data
- Anomaly list reference function for Super-User
- Integration of anomaly detection module into LiVE application



- Detect the known problems
- Improve detection accuracy, quantity and efficiency

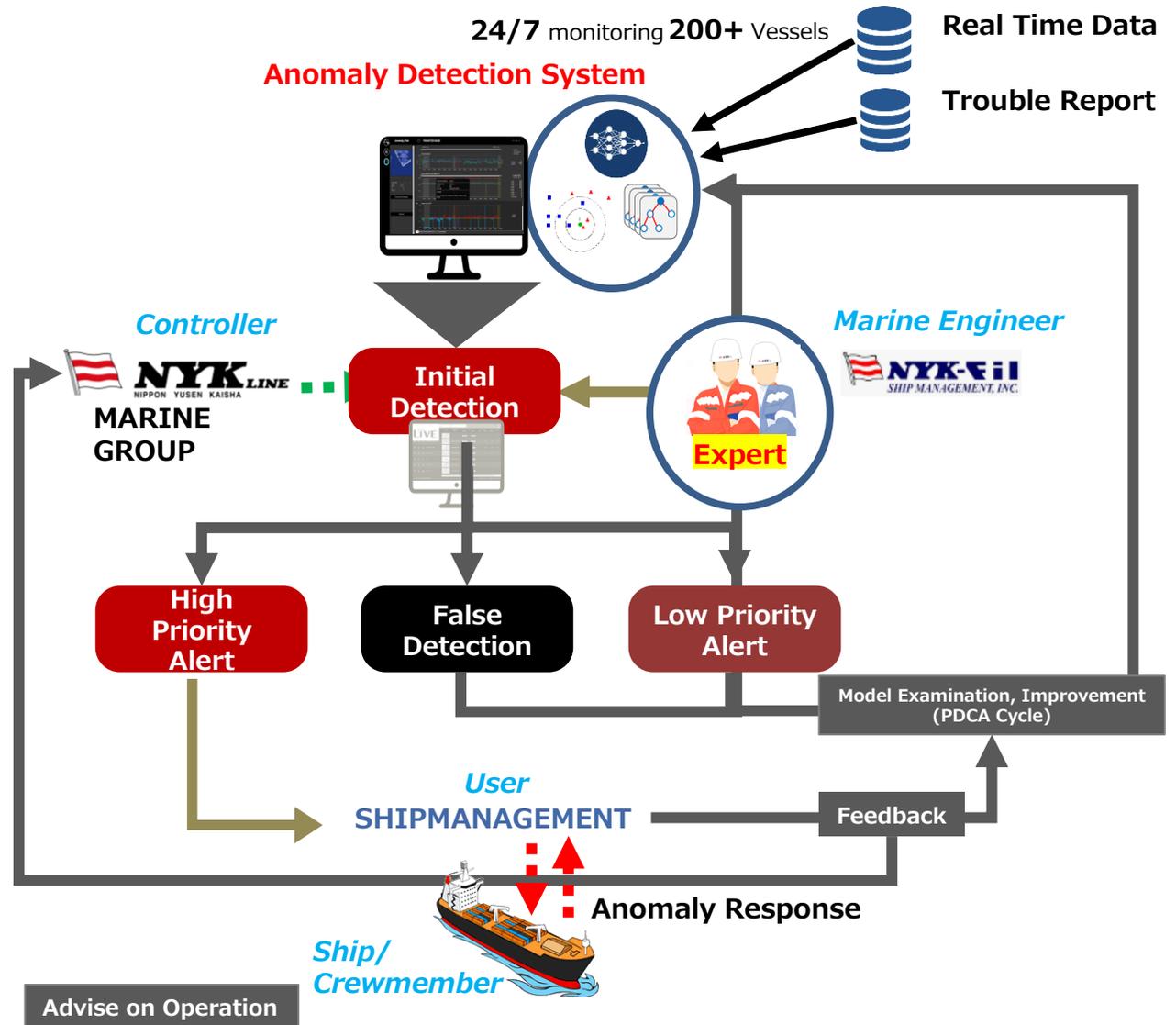
Remote Diagnosis Center

The benefit of Expert-in-the-Loop are

- Less detection misses
- Less false positive result
- Stricter threshold
- More learning data
- More explainable result



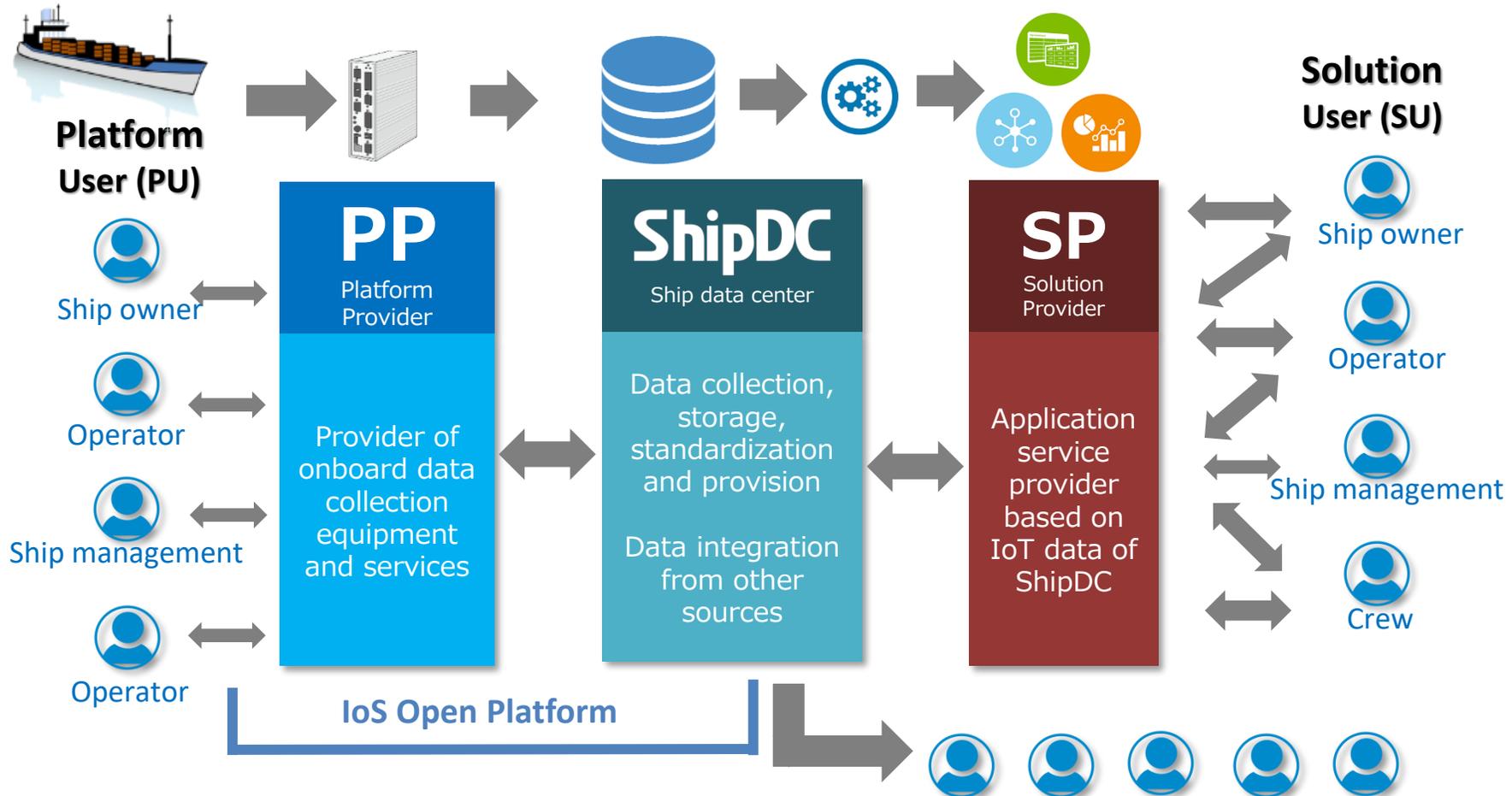
Remote Diagnostic Center (Manilla)



Ship DC – IoS platform

Roles are defined and each player provides their expertise on the Internet of Ship(IoS) platform.

Data governance and business rules have been built by IoS OP Consortium under ShipDC.

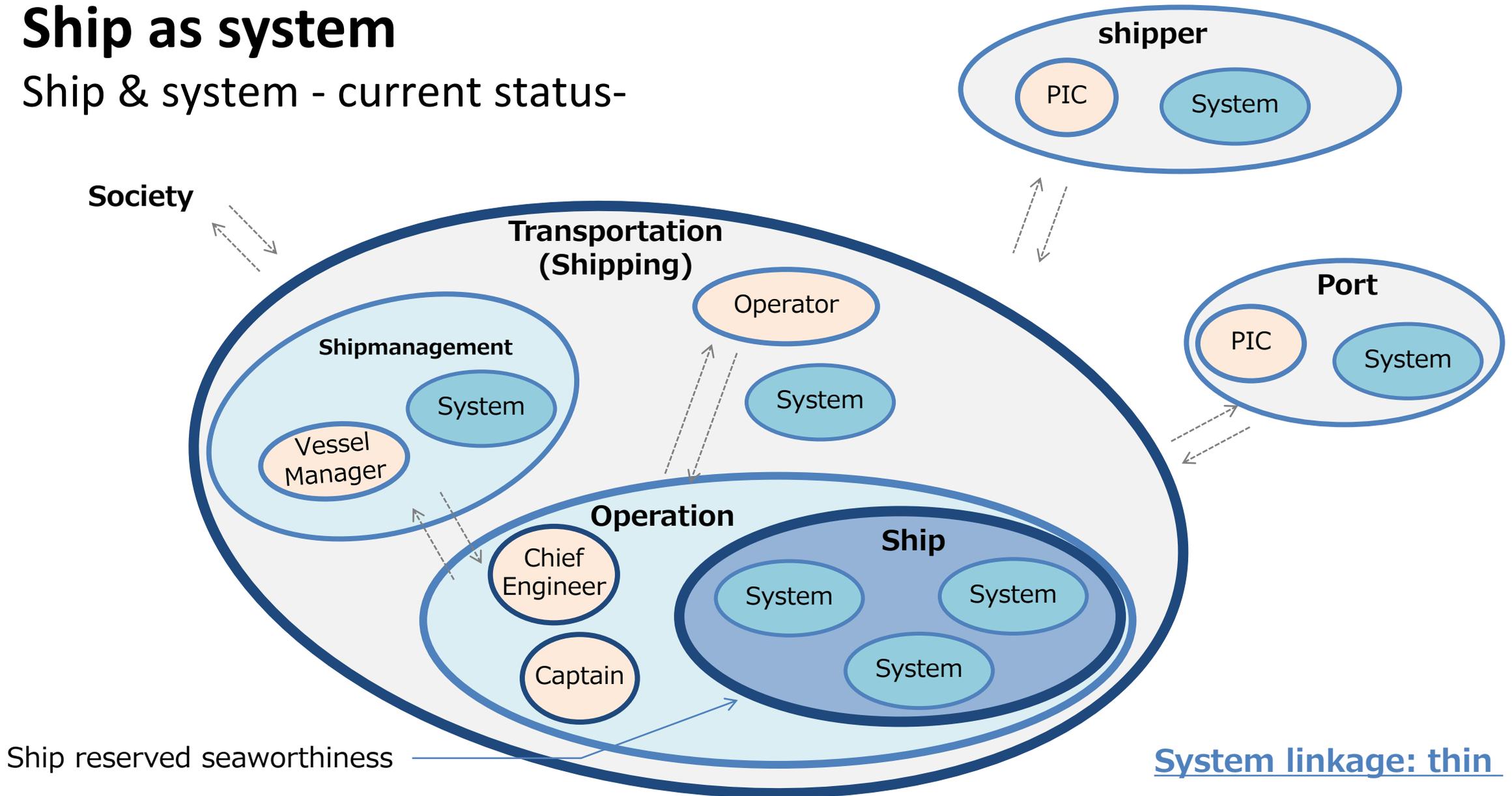


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Ship as system

Ship & system - current status-

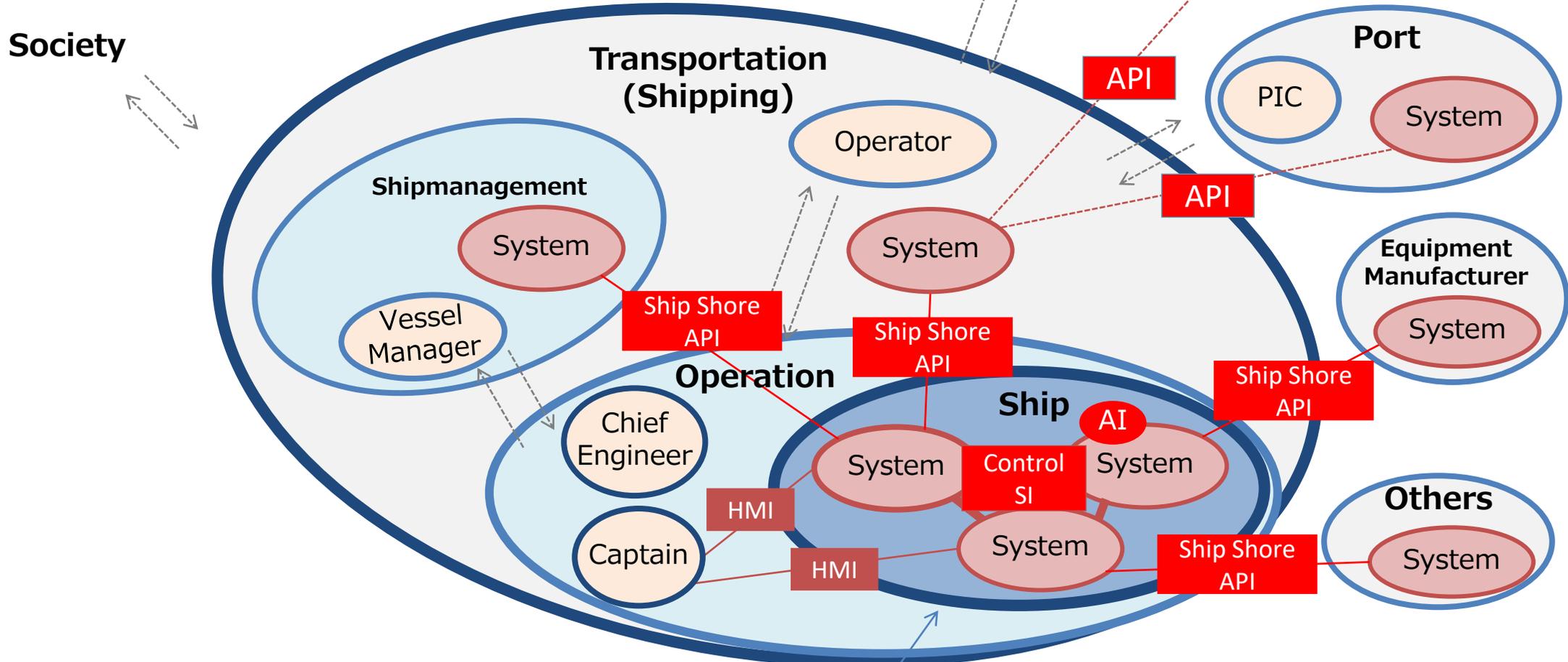


Ship reserved seaworthiness

System linkage: thin

Ship as system

Sophisticated system & ship



Seaworthiness reserved by manufacturer of each system

System linkage: dense

Simulation



www.opensimulationplatform.com



DFFAS Designing the Future of Full Autonomous Ship Project

► Objective

- Demonstrate functions for full autonomous ship

► Project consortium & partners

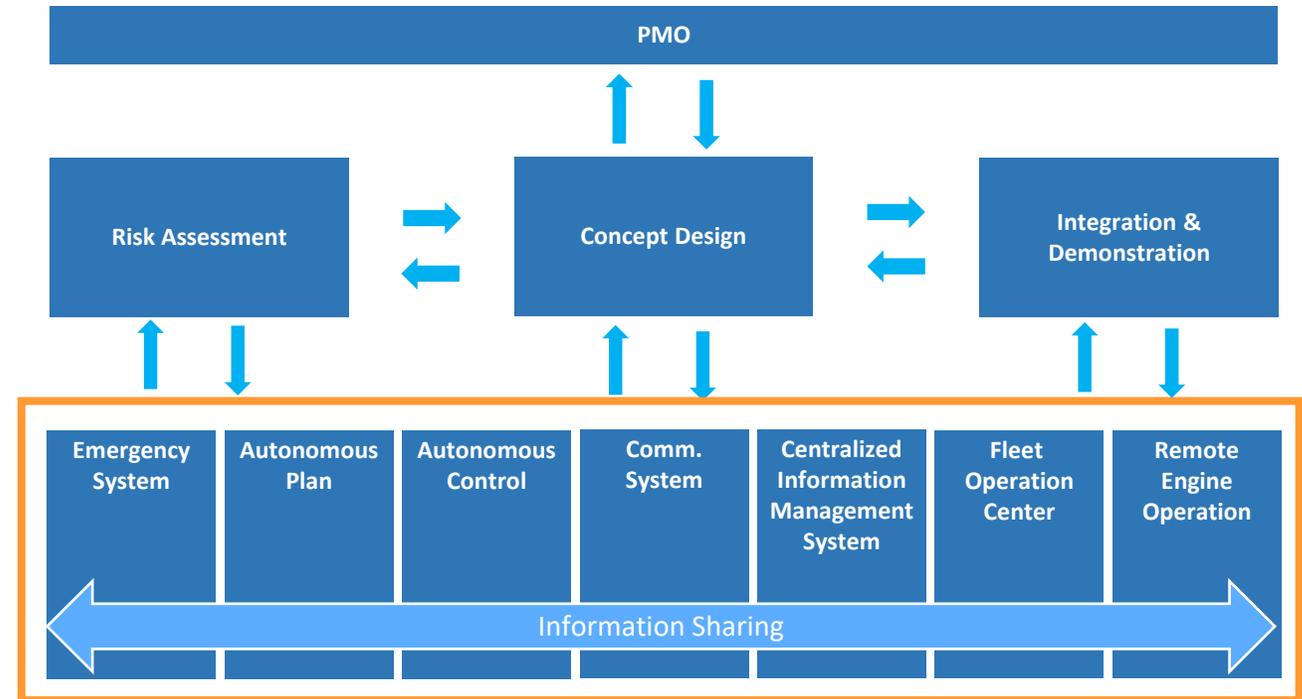
- Consortium: 27 organizations (domestic)
- Partners: 20 organizations (global)

► Target schedule

- Demonstration in Feb 2022 (plan)



Organization chart of DFFAS PJ



Operation Concept (ConOps), Risk Assessment, Model-based Systems Engineering (MBSE), System Reliability Test by using Simulation and Project Management → Development of Open Architecture & Open Process for Open Innovation for future complex system development & operation

Summary

- Identify right issue to solve - better goal to utilize big data
- Performance in actual seas – grasp by big data and simulation
- Expert in the loop – domain knowledge for better accuracy
- Open collaboration - open innovation for system integration

Thank you