Maritime Digitalization Summit China 2019

NYK's Approach To Maritime Digitalization

26th June 2019

Jungo Shibata
MTI (NYK Group)

Outline

1. **Introduction**
2. IoT and Big data in Shipping
3. NYK's Activities for digitalization
4. Open Platform and Standardization
5. Way forward

NYK Corporate Profile

NYK LINE NIPPON YUSEN KAISHA

- NYK LINE (Nippon Yusen Kaisha)
  - 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

NYK Head Office in Tokyo

- Employees: 35,711 (as of the end of March 2019)
- Revenues: $ 20.5 billion (Fiscal 2018)

NYK Fleet (as of the end of March 2019)

NYK LINE
NIPPON YUSEN KAISHA

Container vessels
(including semi-container ships and others)
63 vessels

Bulk Carriers (Capesize)
105 vessels

Bulk Carriers
(Panamax & Handysize)
194 vessels

Wood-chip Carriers
44 vessels

Cruise Ship
1 vessel

Car Carriers
118 vessels

Tankers
56 vessels

LNG Carriers
75 vessels

Others
42 vessels

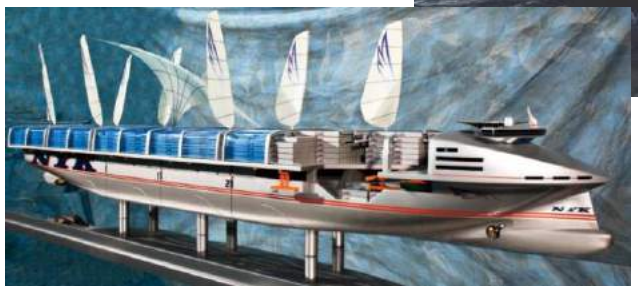
757 vessels
(Owned 334 vessels)

MTI Company Profile

- MTI is “Monohakobi (= quality transport) Technology Institute”
- Established : April 1, 2004
- Equity capital : JPY 99 million
- Stockholder : NYK Line
- Number of employees : 70 (as of end of March, 2019)
- Head office : 2-3-2 Marunouchi, Chiyoda-ku, Tokyo, 100-0005, Japan
- URL : www.monohakobi.com/en/

Monohakobi Technology Institute

NYK SUPER ECO SHIP 2050
(Emission-free Concept ship for future)



NYK SUPER ECO SHIP 2030
(69% less CO_2 emission Concept ship for future)

SINGAPORE BRANCH

1 Harbourfront Place #13-01
HarbourFront Tower One
Singapore 098633)

YOKOHAMA LAB.

(Transportation Environment Lab.)
5-32-84, Sugita, Isogo-ku, Yokohama,
Kanagawa, Japan

Monohakobi Technology Institute

NYK GROUP

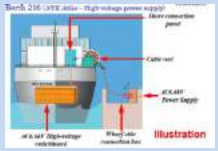
Smarter ship and operation in NYK/MTI

Now → Future: OIL → LNG → HYDROGEN

Ship (Hardware)

Super Eco Ship 2050

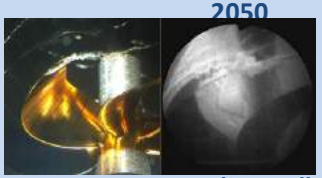
Wind Resistance Reduced
MT-COWL



Alternative Marine Power

Super Eco Ship2030

30% Energy Saving PCTC



Measurement around propeller

Wind Power Generator
Andromeda Leader

Solar Panel
Auriga Leader

Hybrid T/C
Shin Koho

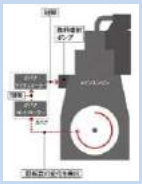
Innovative
Air Lubrication System
SOYO

LNG-Fueled Tugboat
Sakigake

LNG-Fueled PCTC
Delivery in 2016

Air Lubrication System
YAMATO, YAMATAI

Electronic Controlled Engine



Improved
Governor Controller

MT-FAST

Hybrid Electric Power Supply
Auriga Leader

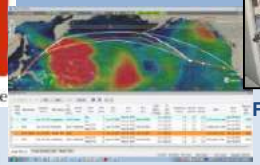
LNG Bunkering Vessel
Delivery in 2016

Operation (Software)

Monohakobi Technology Institute

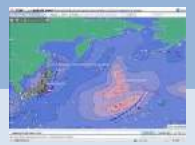
MTI Founded

NYK's own safety and Environment standard
NAV9000



Prediction of Current

Fuel Consumption Indicator
FUELNAVI



Integrated Operation Management System
NYK e-missions'

IBIS Project

IBIS Project
Onboard Broadband
NYK SATCOM Project

LiVE
Operation Portal Site

Detection of Mach. Trouble with monitoring data

ShipDC &
IoS-OP

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

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What is IoT and big data in shipping

Examples of IoT and bigdata in shipping

Voyage data

- Automatically collected data (IoT)
- Noon report

Machinery data

- Automatically collected data (IoT)
- Manual report data
- Maintenance data / trouble data

AIS data

- Satellite AIS / shore AIS (IoT)

Weather data

- Forecast / past records
- Anemometer / wave measurement (IoT)

Business data

- Commercial data
- Market data

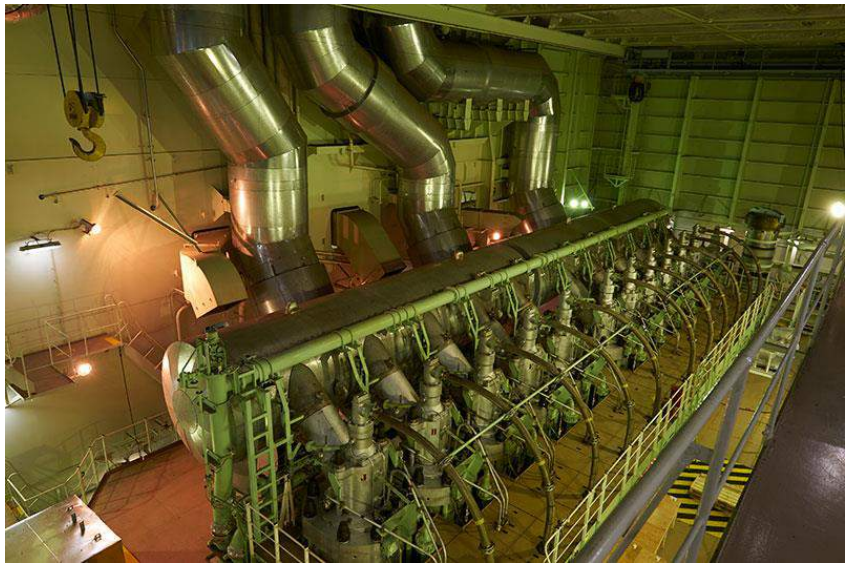
Utilize IoT data in shipping

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
- Digital twin



Change way of working !

Methods of utilizing Big data #1

Identifying issues with deep domain knowledge, skill of data analytics and Big data

Identified issues

Optimum operation

- Fuel saving
- Reasonably minimized margin

Support business decision

- Tactical ship/fleet allocation

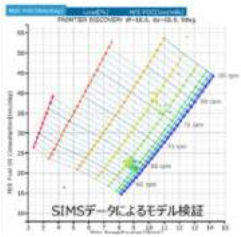
Safe operation

Big data

- IoT Data
- Report data
- AIS data
- Weather data

Analysis

Engineering knowledge
e.g. vessel performance



Data analytics & IT

Any useful data

Operation data
- Schedule
- Route
- CB/HB
- AIS

Technical data
- Performance
- Sea trial
- Particular
- Paint

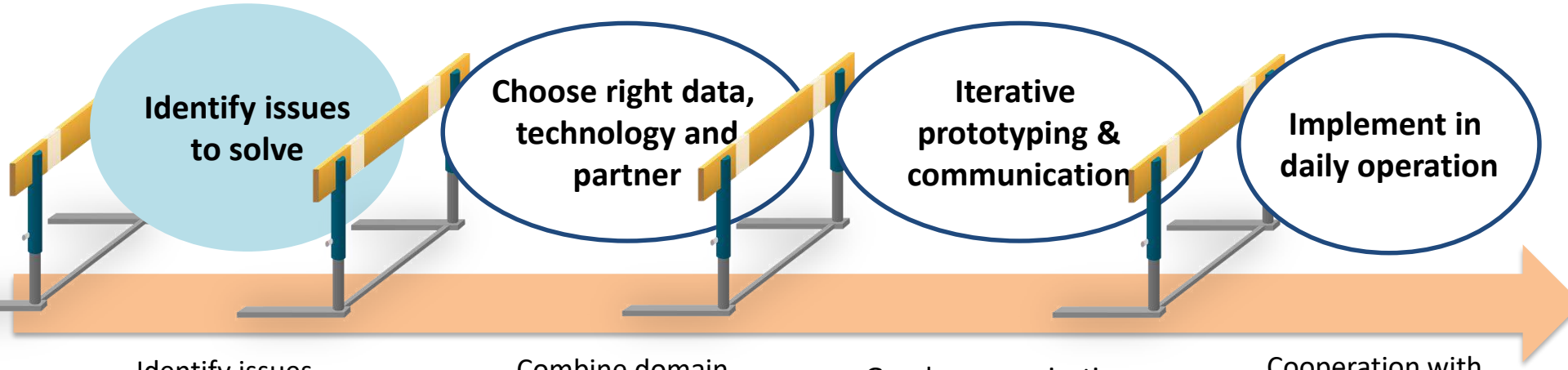
Market data
- Bunker cost
- Hiring cost
- Market

Commercial data
- Contract
- Fleet plan
- Owner info.

Methods of utilizing Big data #2

The process of issue solving with domain knowledge, skill of data analytics and iterative prototyping.

--> It is a collaborative process.



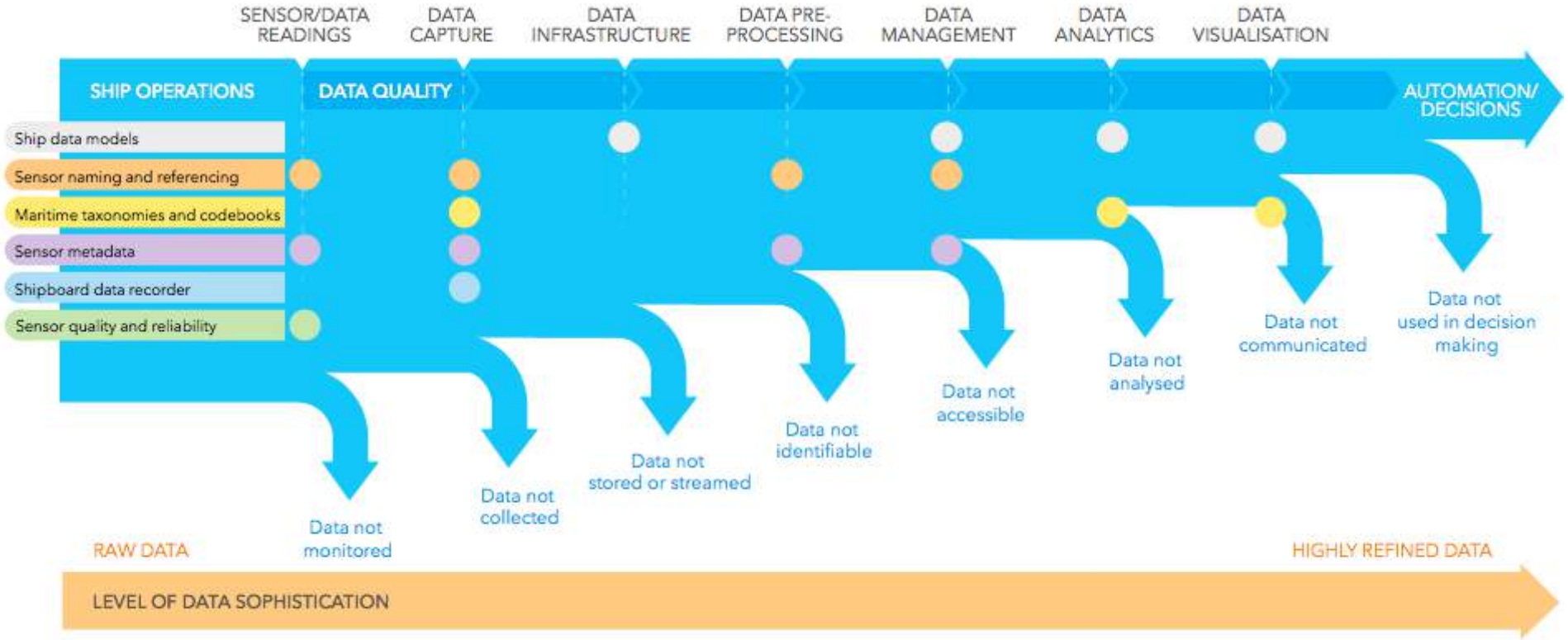
Identify issues with rich domain knowledge	Combine domain knowledge & skill of data analytics	Good communication Between technicians and users	Cooperation with user dept., IT dept. and other cooperate dept.

To realize the issue solving process, “Organizational Support” is necessity.

Methods of utilizing Big data #3

Operate and maintain data managing infrastructure

E.g. Data collection, error handling, data quality and data standardization.



Reference) DNV-GL, STANDARDISATION AS AN ENABLER OF DIGITALISATION IN THE MARITIME INDUSTRY, GROUP TECHNOLOGY & RESEARCH, POSITION PAPER 2017

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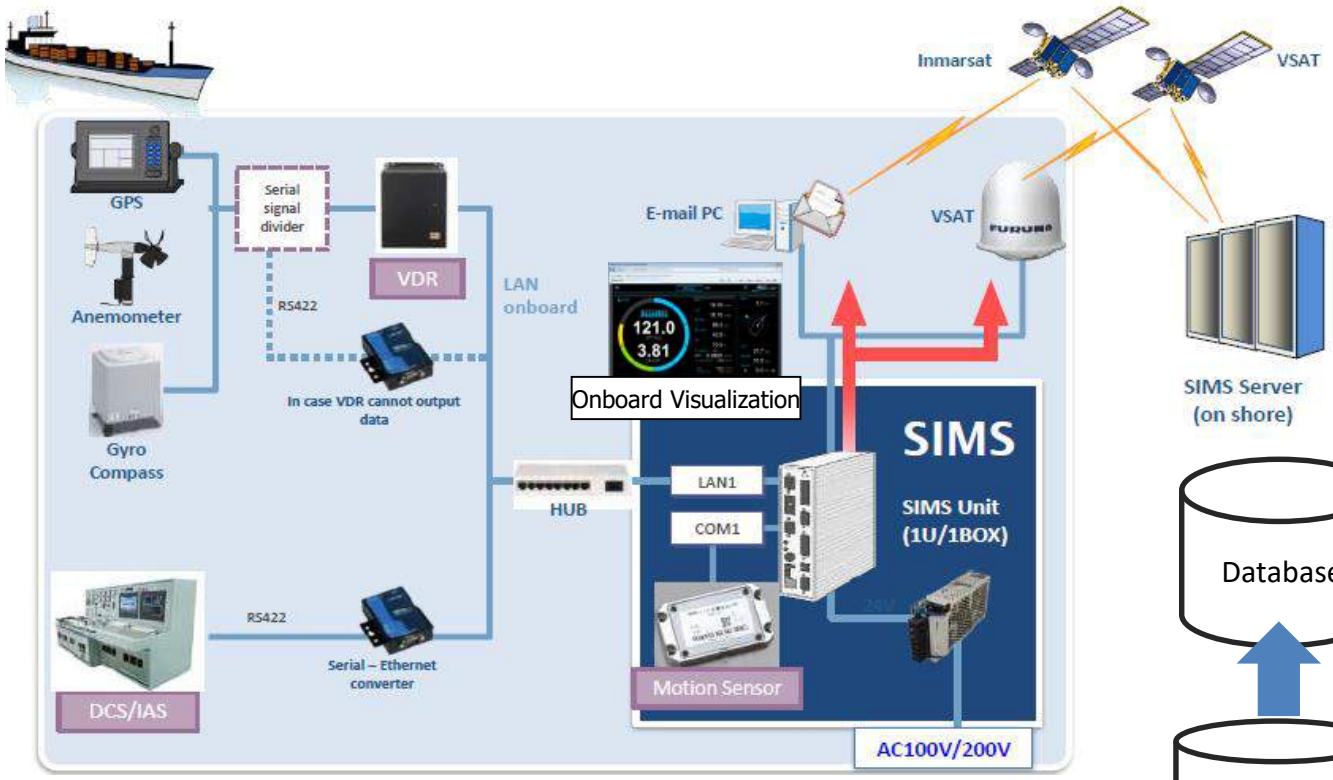
IoT Platform of NYK - Data Acquisition and Visualization -

Data Acquisition → Data Cleansing → Communication → Data Integration → Visualization



SIMS (Ship Information Management System)

Case1

Ship performance in service

6000TEU Container Ship

Wave height 5.5m, Wind speed 20m/s

BF scale 8, Head sea @ Trans-Pacific (Oakland, US – Tokyo, JP)

@ engine rev. 55rpm

<**Calm sea** performance>

speed: 14 knot

FOC*: 45 ton/day

* FOC: Fuel Oil Consumption

<**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)

Case1
In-service ship performance model

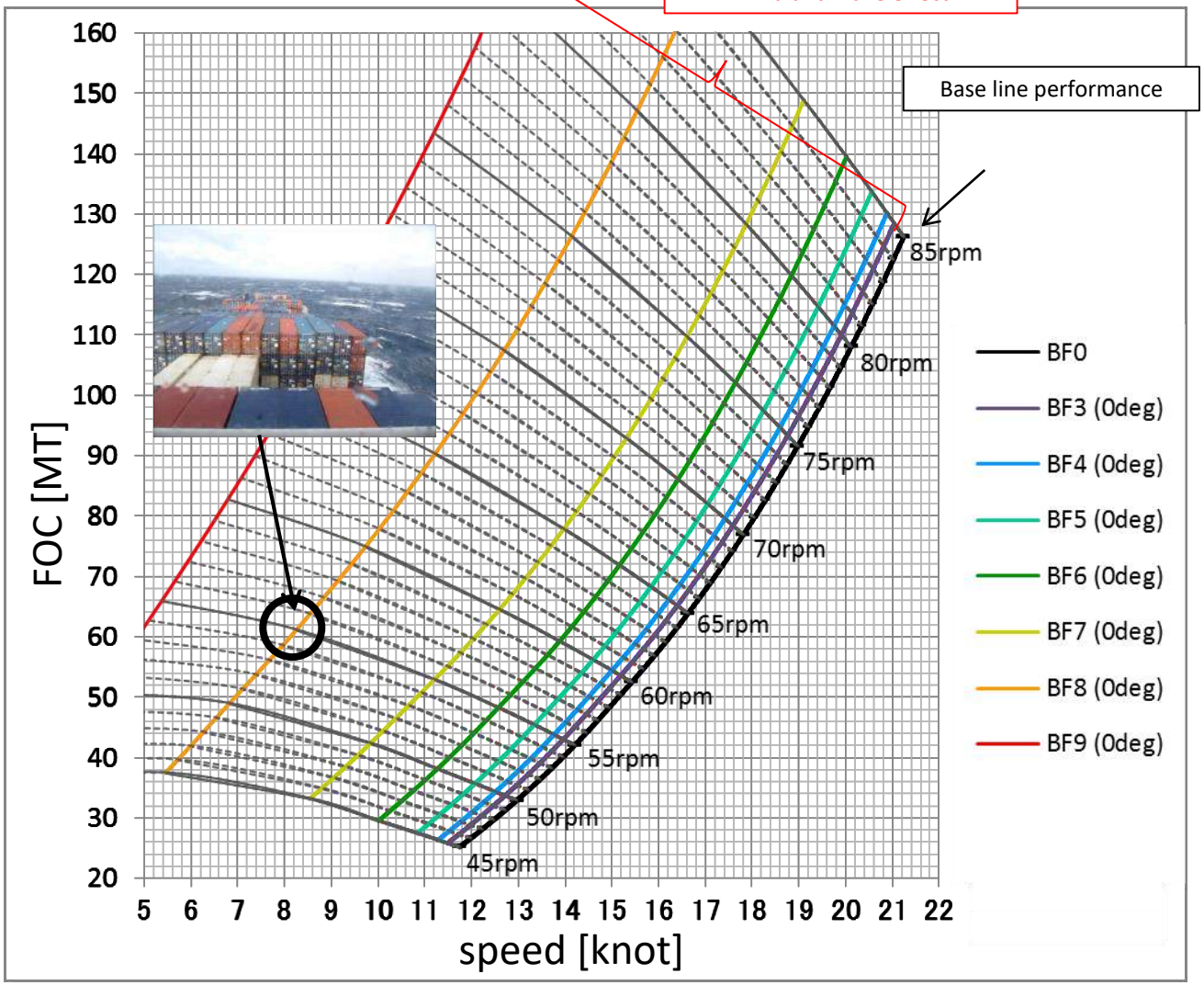
<Target vessel>
6000TEU Container
Draft 12m even

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

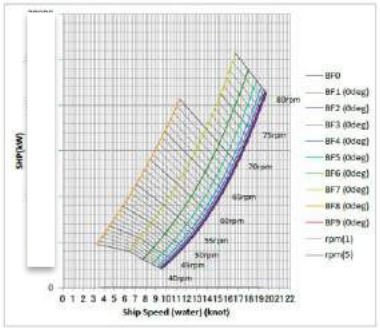
0deg (wind, wave) – head sea



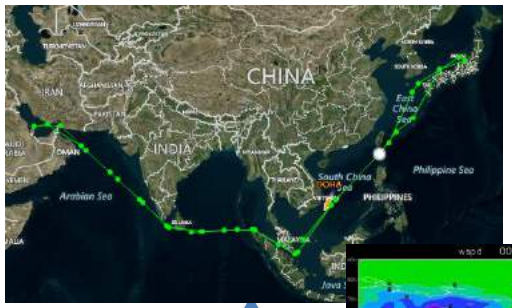
Case1

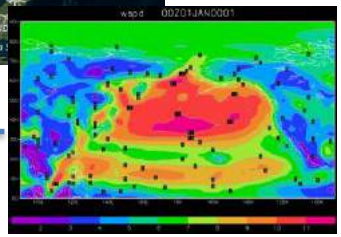
Operation optimization

Ship performance model

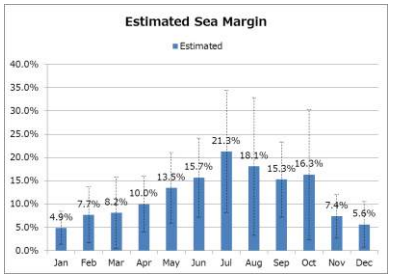


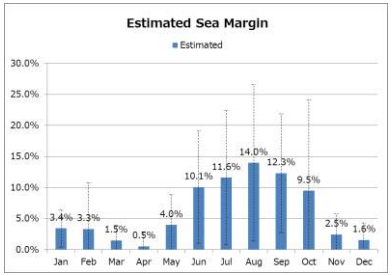
Service route with past weather





Estimate data





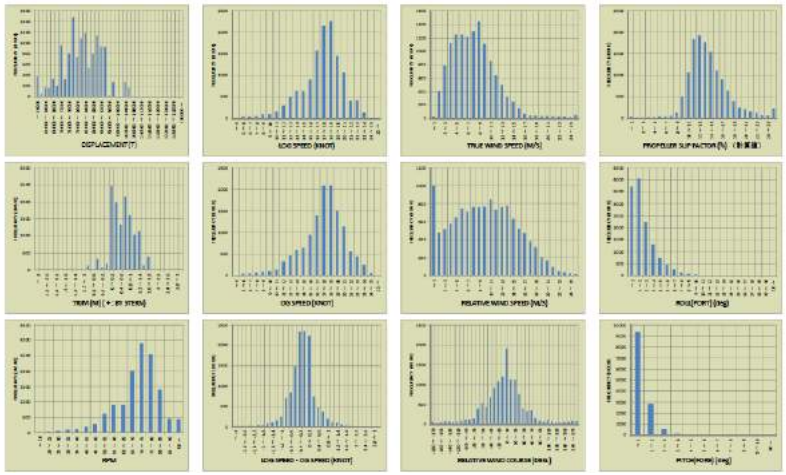
Estimation of
- Sea margin
- FOC and etc.

Voyage simulation with past weather data

Combine ship performance model with weather data to optimize ship services

Case2

Improve bad performance ship



23 % CO2 reduction was confirmed

Operational profile

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

Energy saving modification

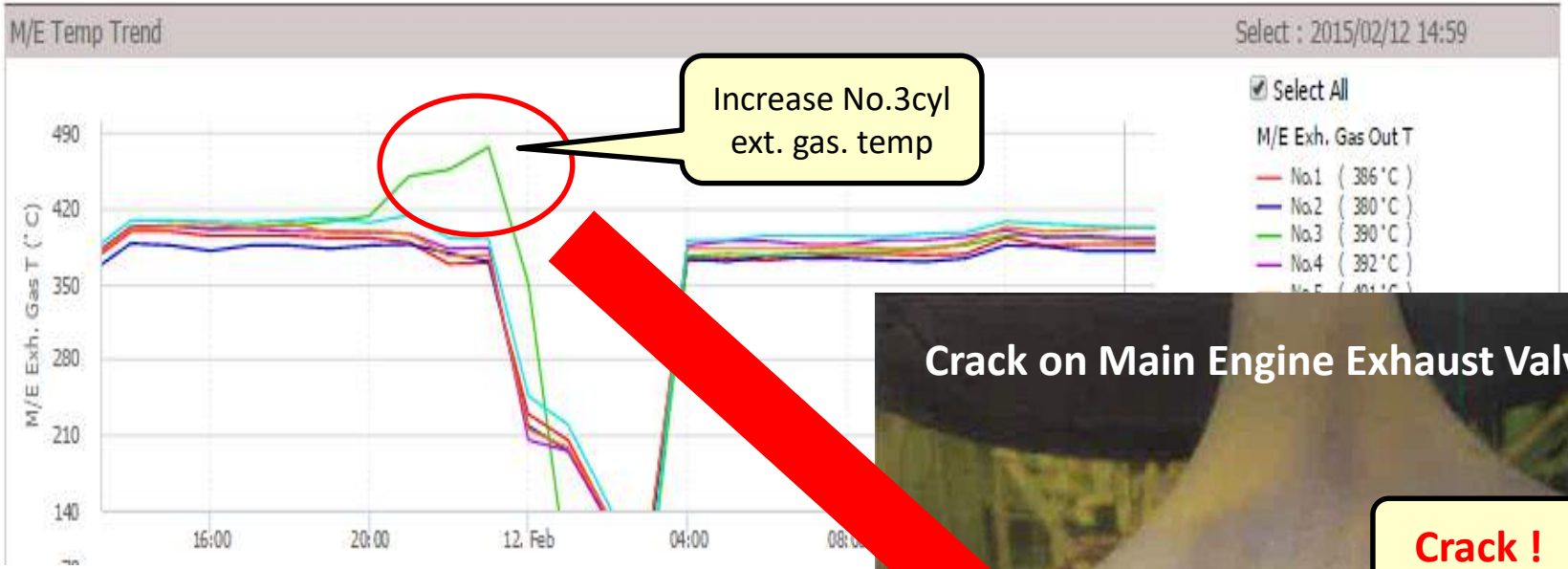
- Bulbous bow modification
- Install energy saving device (MT-FAST)
- Etc.

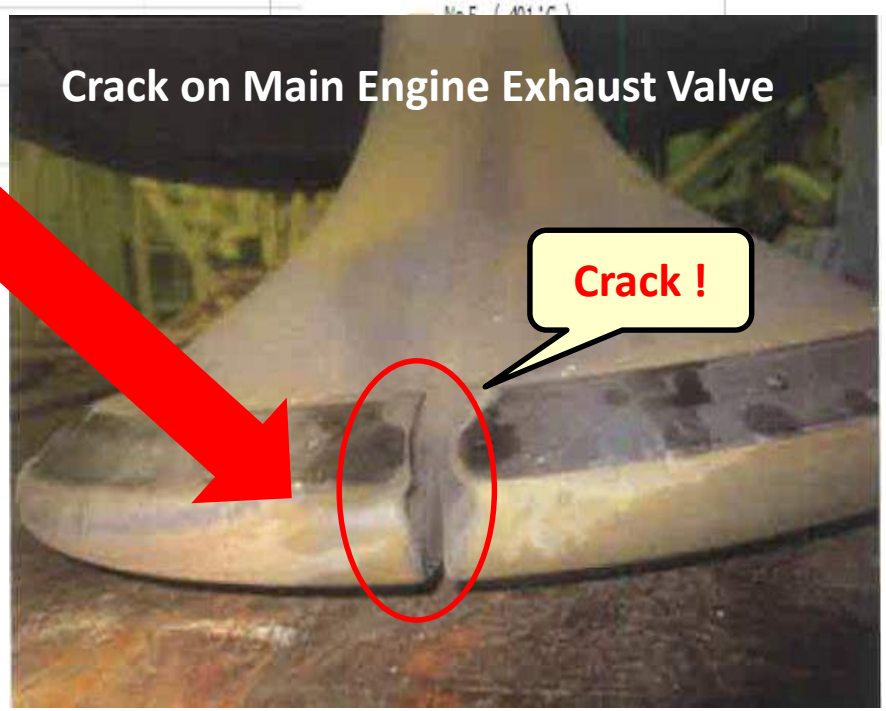
‘Ship IoT data’ will be more used not only for energy efficiency but also for improving safety

Case3
Anomaly detection from IoT data

- Find trouble phenomenon in engine & power plants -

Case) M/E (Main Engine) No.3 cylinder abnormal exhaust gas temperature

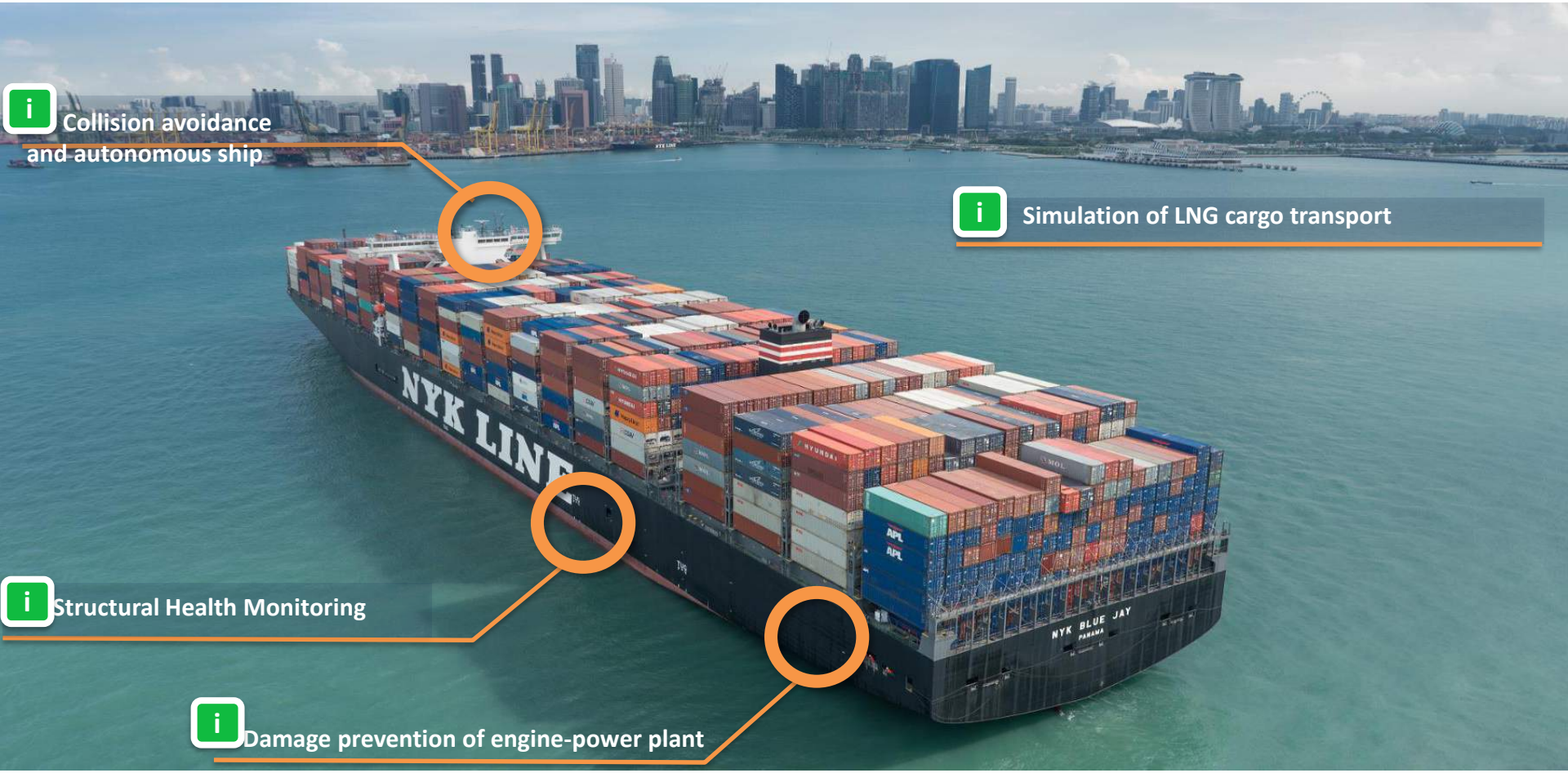




1. Visualize IoT data
2. Analysis with domain experts knowledge (marine engineer) . Accumulate cases.
3. Implement **automatic anomaly detection** function by using the accumulated data.

Case4 Utilizing IoT data for safer operation

- Open collaboration with industry partners -



MLIT Ministry of Land, Infrastructure, Transport and Tourism

ClassNK

i i-Shipping(Operation): Japanese government funding R&D projects – IoT for safety (2016-2020)
Joint research with ClassNK

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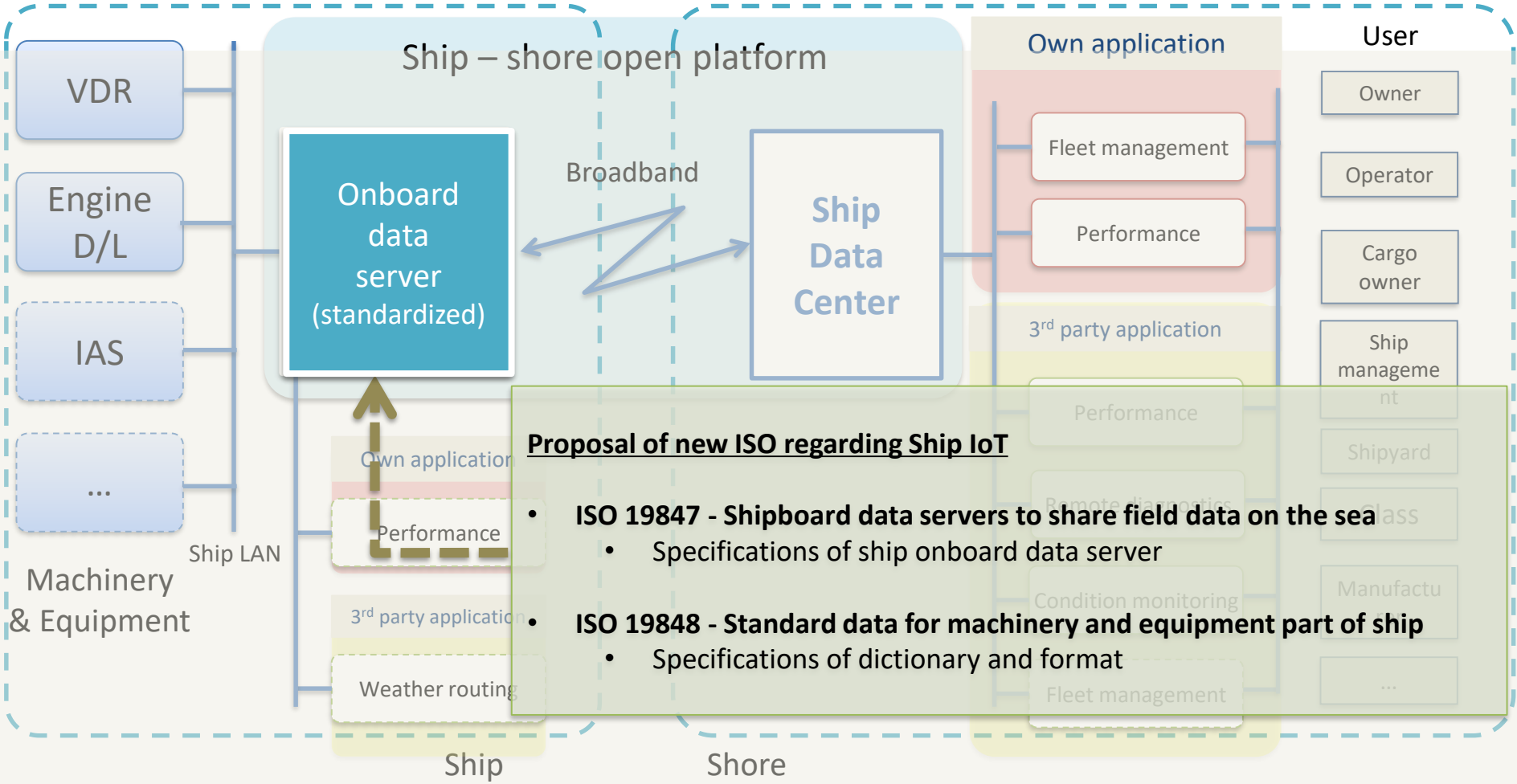
Standardization activities of Ship IoT platform

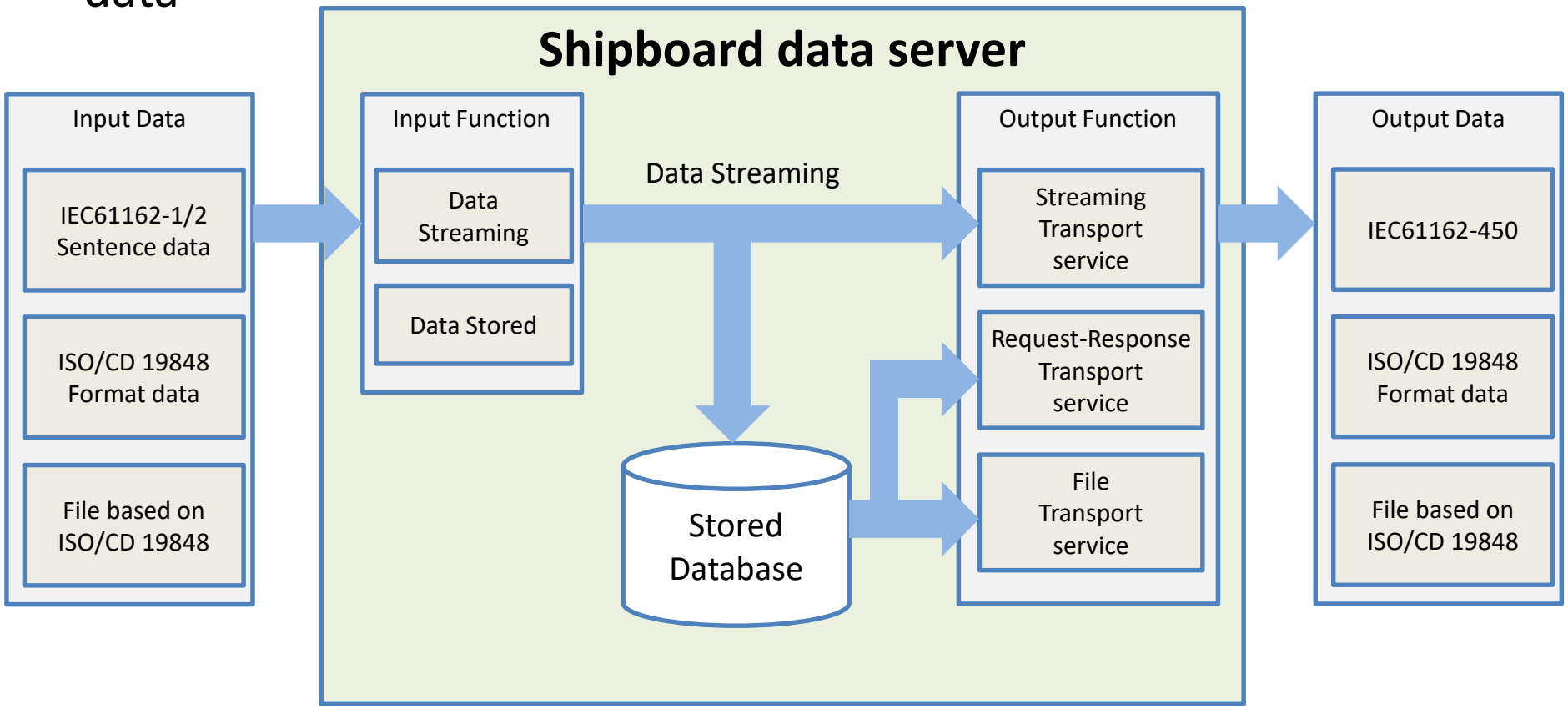
(SSAP3: Smart Ship Application Platform 3 Project by JSMEA)



JSMEA: Japan Ship Machinery and Equipment Association

ISO19847 - Shipboard data servers to share field data at sea -

- Requirements for shipboard data servers to collect and share field data



ISO19848 - Standard data for shipboard machinery and equipment -

Standardized ID of sensors, common data model & format

ID of sensors

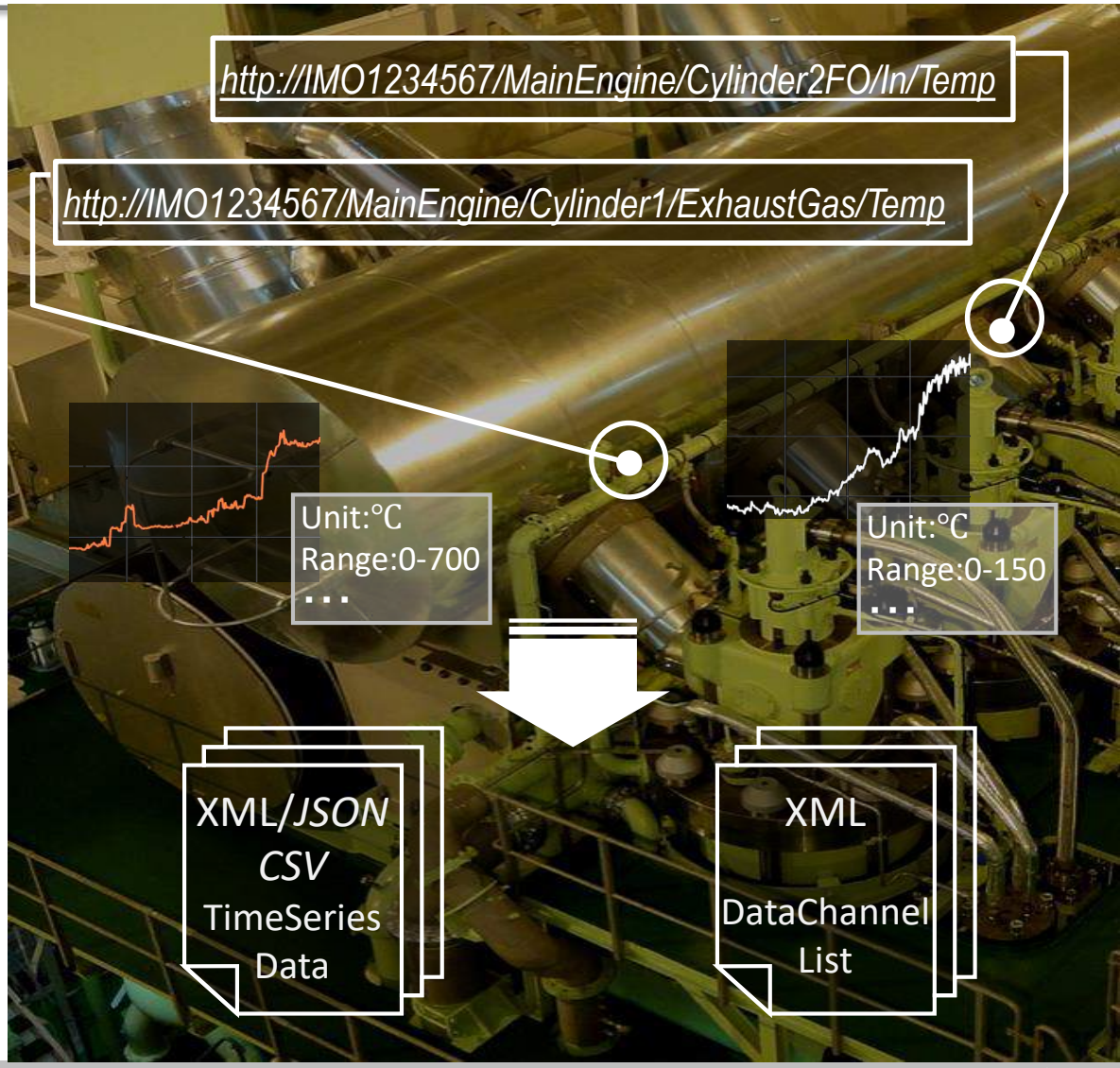
- ***URL*** compliant naming scheme
- Dictionaries (*informative*)
  - JSMEA
  - DNV-GL

Data model

- Data channel list (meta data)
- Time series data (data)

Data format

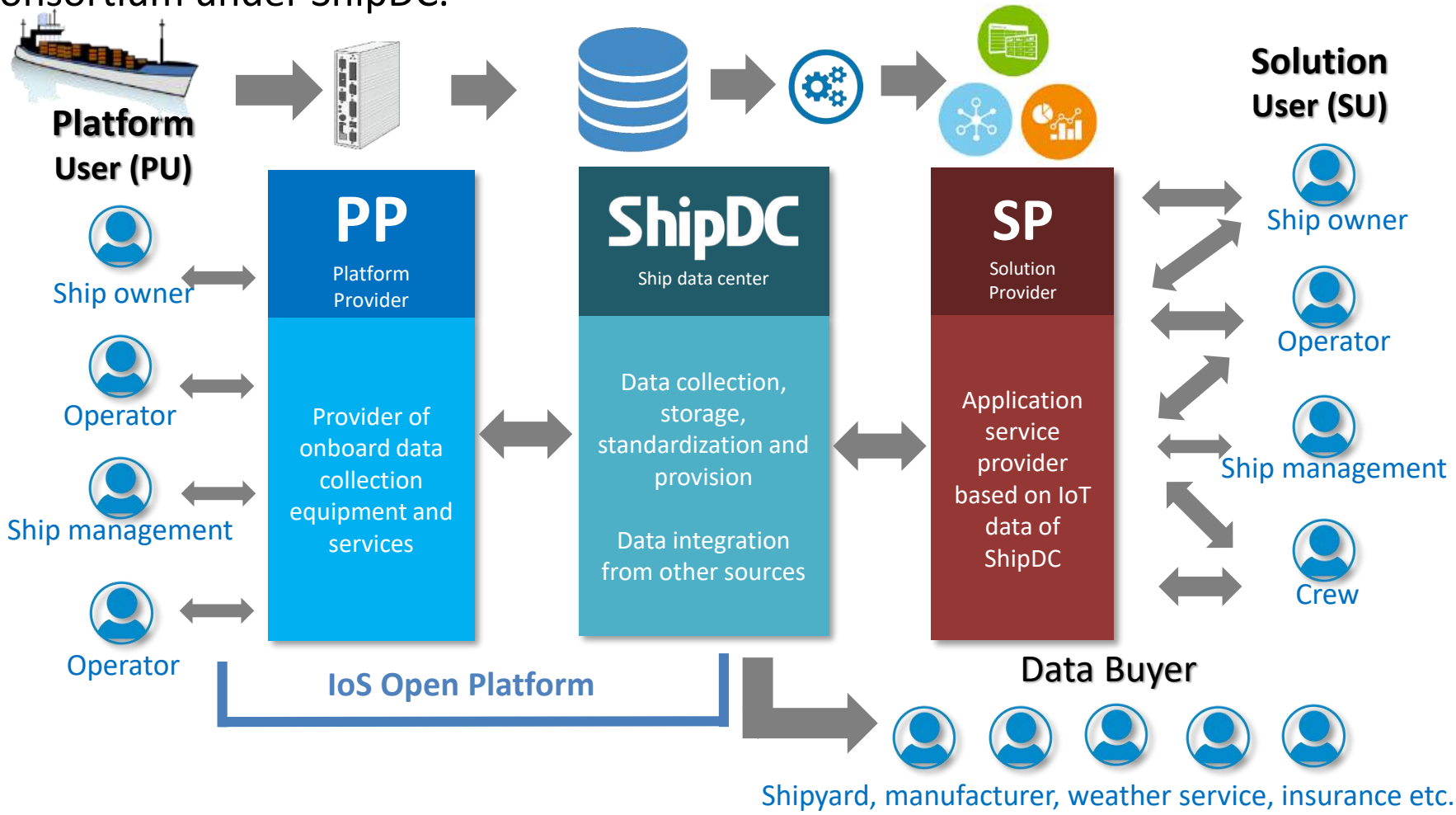
- ***XML*** with schema definition
- *JSON/CSV (informative)*
- *CSV (informative)*



Internet of Ships (IoS) Open Platform

ShipDC

Roles are defined and each player provides their expertise on the Internet of Ships(IoS) platform. Data governance and business rules have been built by IoS-OP Consortium under ShipDC.



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Way Future - Integrated bridge operation -

Objective

- Prevent collisions
- Reduce workloads of crews
- Contingency backup

Measure

- Integrated bridge system
- Enhanced situational awareness
- Advanced support system
- Manned Autonomous ship

Infrastructure & regulation are very important


Reference) ULSTEIN BRIDGE CONCEPT

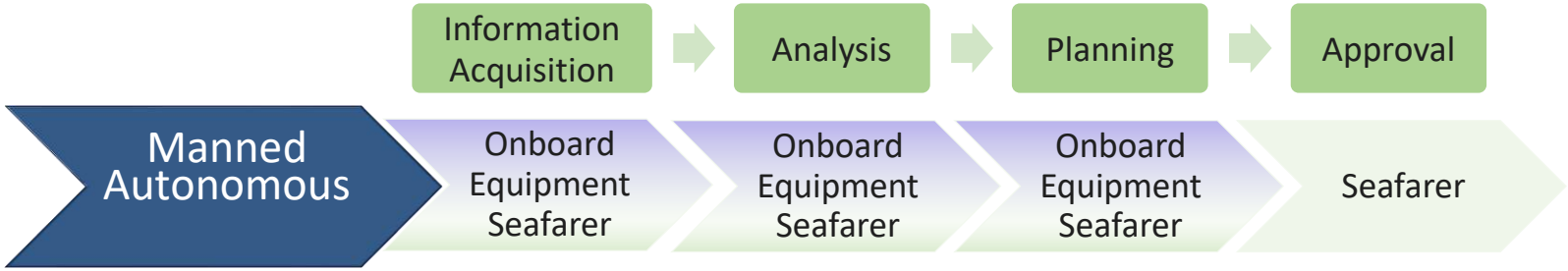
Manned-Autonomous Ship

Provided by Japan Radio Co. Ltd.

AL3

- Cyber access for autonomous/ remote monitoring and control
- onboard permission required
- onboard override possible

- Advanced support system … additional functions to assist cognitive process of human operator based on existing navigation system
- Autonomous operation under approval of human operator



Reference：1) Lloyds Register, “Current and Emerging Cyber Risks facing Maritime Industries”, European Maritime Cyber Risk Management Conference, London, June 2017

Integrated Navigation Support System J-Marine NeCST

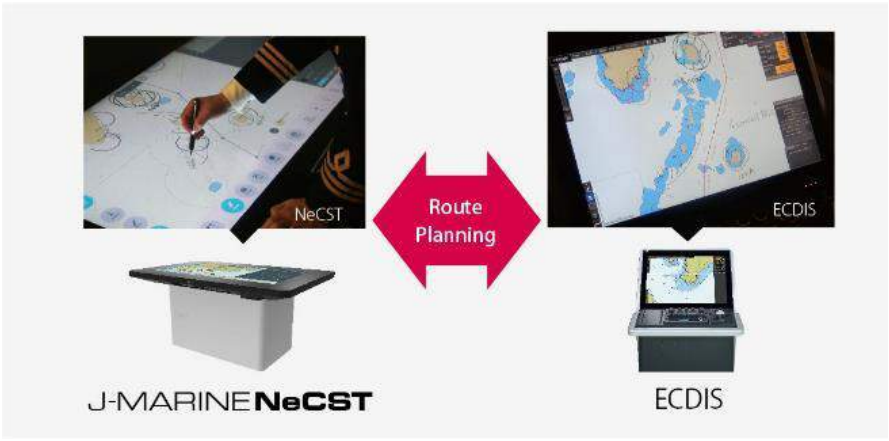
NYK/MTI and Japan Radio Co. Ltd. jointly developed navigation support tool that enables officers to better manage and share navigational information.

(Press Released at 17th May 2017)

- **Gathering all necessary information for navigation by using IoT**
- **Integrated navigation information management system**
- **Contribution to safe & efficient navigation**

<Features of J-Marine NeCST>

1. Handwritten inputs
2. Compatibility with ECDIS
3. Implementation of meteorological and hydrographical forecasts
4. Information sharing with other ships and land
5. Flexible customization



Cyber Security and Cyber Resilient Ship

Cyber risk management will need to be implemented. Protection of Industry Control System is crucial

The Guidelines on Cyber Security onboard Ships - Version 3, BIMCO – Nov 2018

Cyber security guidelines in shipping

- **IMO, MSC (98)** – Cyber risk management onboard ships should be included in SMS as of 1 Jan 2021 (Jun 2017)
- **BIMCO** – the guidelines on cyber security onboard ships – version 3 (Nov 2018)
- **ABS, DNV-GL, LR, BV etc.** – Guidelines and notations of cyber security onboard ships (2016)
- **IEC 61162-460** – Safety and security standards for navigation and radio communication equipment
- **IACS** Maritime Cyber System Recommendations (MCSR)

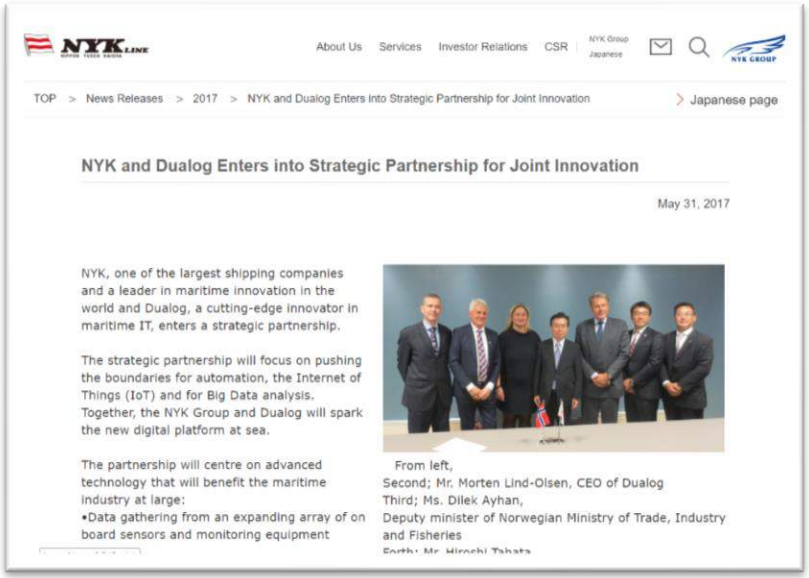
Cyber security guidelines

- **NIST Framework and 800-53** – computer security policies, procedures and guidelines
- **ISO 27001/2** – ISMS: Information Security Management System

Source) BIMCO
https://www.bimco.org/products/publications/free/cyber-security

“Ship-Shore data sharing and Cyber Security Platform” in collaboration with Dualog

1. Realization of secure and efficient data-sharing platform between ship and shore.
2. Raise of on-board cyber risk management level through ship and shore cooperation



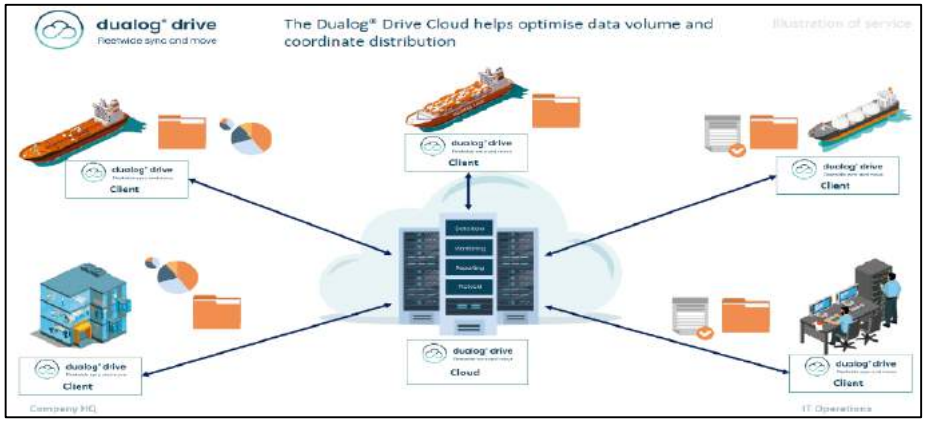


Fig.. Image of the ship-shore data sharing system

Source) NYK LINE
(https://www.nyk.com/english/news/2017/20170531_01.html)

Thank you very much for your attention