

Shipbuilder's contributions in digital shipping era

29 August 2019

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A. Introductions

- I. Company Profile
- II. Organization chart of Mitsubishi Heavy Industries Group

B. Support system for safer ship operation

- I. Navigation support system(Super Bridge)
- II. Cargo oil handling support system(Super Cargo)

C. Advanced security product

- I. Intelligent monitoring by satellite observation (BRAINS)
- II. Unmanned vigilance system(CoasTitan)
- III. Cyber Security(InteRSept)

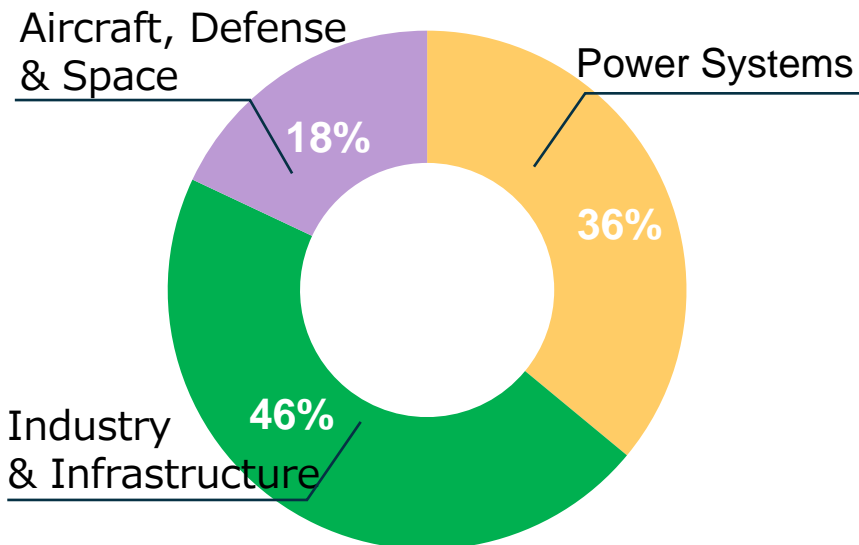
D. Learning from other industry

- I. Digital solution for power plant(MHPS-TOMONI)

E. Conclusions

A-I. Company profile

- ✓ Net Sales : **37 Billion USD**
- ✓ Sales Outside Japan : **54%**
- ✓ Employees Worldwide : **80,700**
- ✓ Sales Ratio by Business Domain (FY2017)



A-II. Mitsubishi Heavy Industry Group



Organization Chart (as of April 1, 2019)

Board of Directors

President and CEO

Executive committee

CSO

GC

HR

CFO

CTO

Chief regional officers

Latin America

Europe, Middle East & Africa

China

India

Asia Pacific

Nagasaki Shipyard & Machinery Works

Shimonoseki Shipyard & Machinery Works

Hiroshima Machinery Works

Mihara Machinery Works

Kobe Shipyard & Machinery Works

Takasago Machinery Works

Nagoya Aerospace Systems Works

Nagoya Guidance & Propulsion Systems Works

Iwatsuka Plant

Yokohama Dockyard & Machinery Works

Sagamihara Machinery Works

Power Systems

Corporate Planning & Administration Div.
Quality Assurance Integration Division
Power & Energy Solution Business Div.
Nuclear Energy System Division
Renewable Energy System Division

Mitsubishi Hitachi Power Systems, Ltd.

Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd.

Mitsubishi Heavy Industries Aero Engines, Ltd.

Mitsubishi Heavy Industries Compressor Corporation

Industry & Infrastructure

Business Strategy Department
Administration Department
High speed railway Department

Mitsubishi Shipbuilding Co., Ltd.

Mitsubishi Heavy Industries Marine Structure Co., Ltd.

Mitsubishi Heavy Industries Engineering, Ltd

Mitsubishi Heavy Industries Forklift, Engine & Turbocharger Holdings, Ltd.

Primetals Technologies, Limited

Mitsubishi Heavy Industries Thermal Systems, Ltd.

Mitsubishi Heavy Industries Machinery Systems, Ltd.

Mitsubishi Heavy Industries Machine Tool Co., Ltd.

Aircraft, Defense & Space

Integrated Defense & Space systems

Commercial Aviation Systems

MRJ Division

Mitsubishi Aircraft Corporation

B-I. Navigation support system / Super Bridge

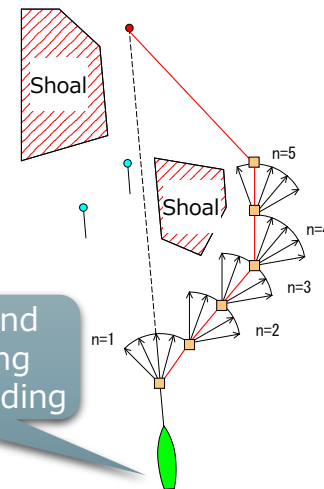
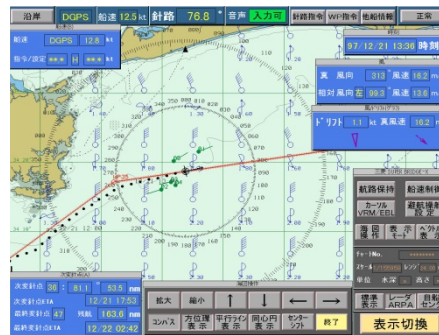
Demands for system	Major functions	Effects
Support functions to Captain	Voyage planning	Prevent human error and casualties
	Automatic maneuver	
	Collision/grounding avoidance	
Support functions to radar operator and helmsman	Navigation conditions of own ship	Reduce burdens on navigators
	Situation awareness	
Emergency measures	Bridge dead-man alarm	Prevent casualties
	Changeover to manual steering	
Improve efficiency	Optimum navigation planning	Reduce the fuel oil consumptions and environmental impact

- More than 60 vessels have been installed and operated since 1993.
- Collision and grounding avoidance algorithm and man-machine interface have been matured by 26 years' experiences.

Voice control system



Course, speed, etc.



Altering course and speed for avoiding collision and grounding

Contacts;

- ☐ Super Bridge for ocean going vessels: Mitsubishi Shipbuilding
- ☐ Super Bridge-X for domestic vessels: MHI marine engineering

B-II. Cargo handling support system / Super Cargo

Demands for system	Major functions	Effects
Support functions to operators	Expert cargo planning	Prevent human error and causalities
	Loading / Unloading simulation	
	Loading calculation	Reduce burdens on crews
	Automatic control	
Emergency measures	Safety messages	Prevent causalities
Lack of skilled crews for dangerous cargo	Offline training	Train skilled crews for safer operations.

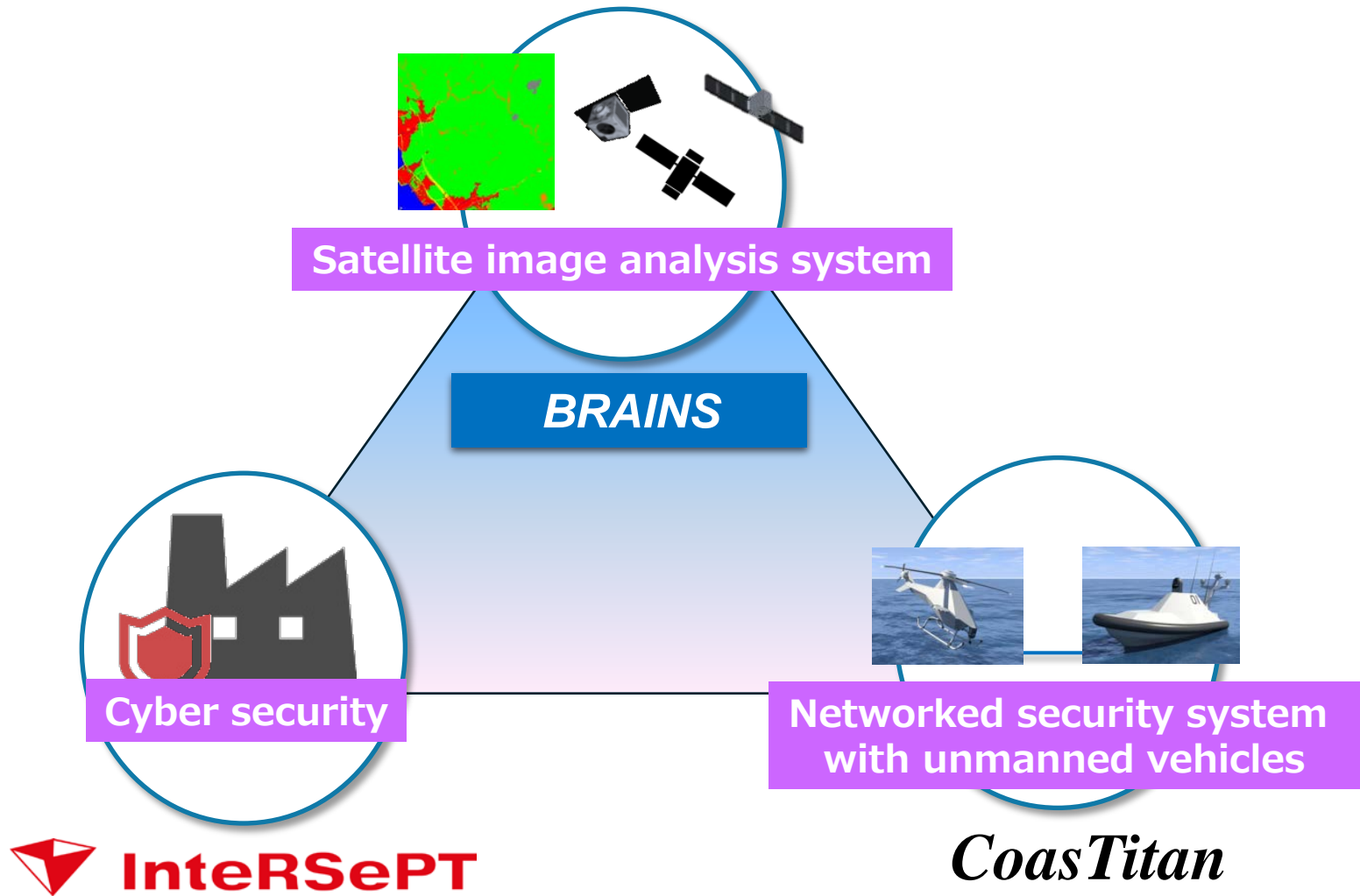
- Super Cargo is a highly advanced Cargo and Ballast management system for single or multi-grade vessels.

- The system provides full automatic control of operations, and incorporates planning, simulation and training facilities to support one-man control room operations.

- The system has proven ability as experienced on more than 30 vessels.



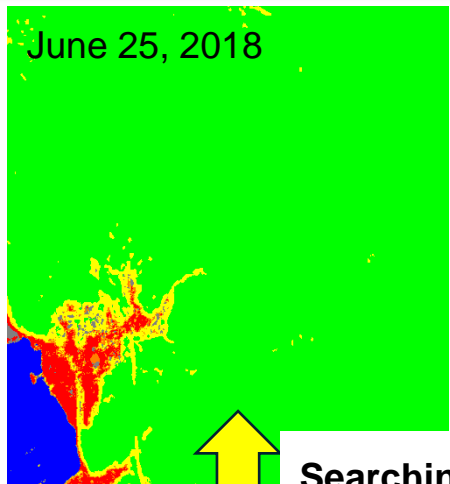
- Contacts;
- Super Cargo-XL for ocean going vessels: Mitsubishi Shipbuilding
 - Super Cargo-X for domestic vessels: MHI marine engineering



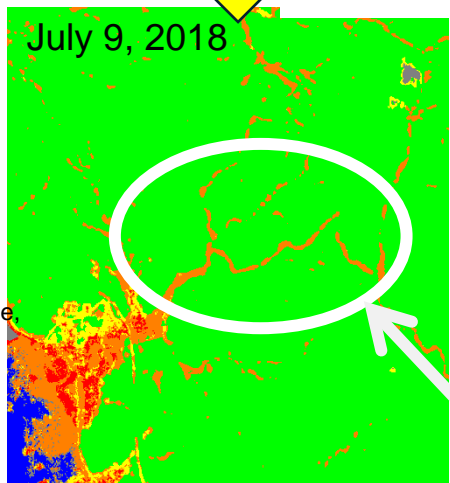
• **BRAINS™** analyzed satellite images in western Japan heavy rain in July 2018.



Western Japan Heavy Rain in July 2018

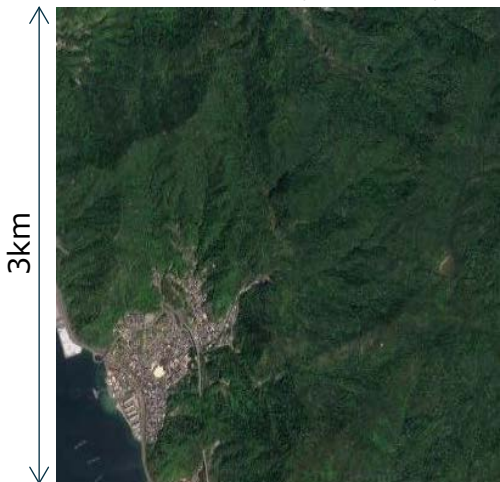


Searching changed parts before and after disaster



You can know damage areas rapidly with AI.

Color Legends	Color
Water	Blue
Cloud	Grey
Vegetation	Green
Road	Yellow
Rail Track	Brown
Concrete	Pink
Building	Red
Earth and Sand	Orange



Image©2018 CNES / Airbus, Digital Earth Technology, DigitalGlobe

Hiroshima Prefecture Aki-gun Sakamachi

The above is Google Maps of the analyzed area
 Note: We used satellite images instead of Google map for analysis.

Image Analysis Example by AI

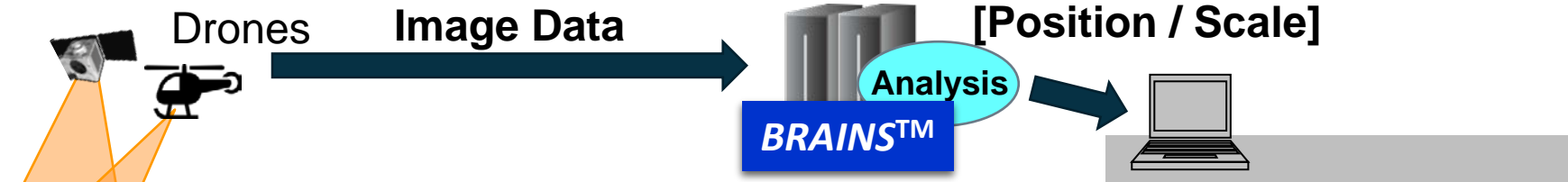
Satellites

Drones

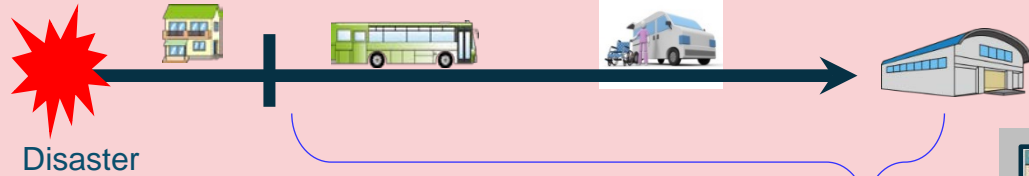
Image Data

Damage Area Information

[Position / Scale]



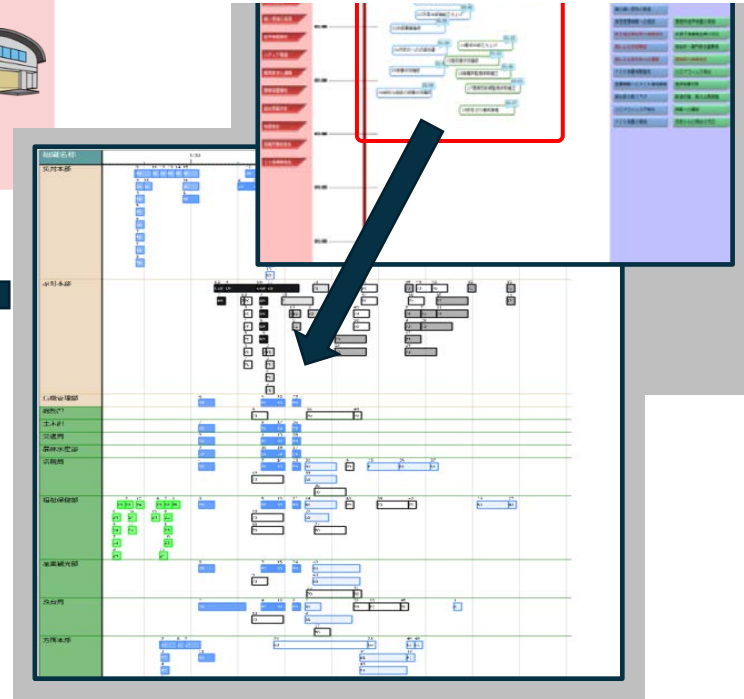
Evacuation Directive



Disaster

Sending Rescue

Planning Disaster Response



BRAINS™ contributes to identification of damage areas and disaster relief.

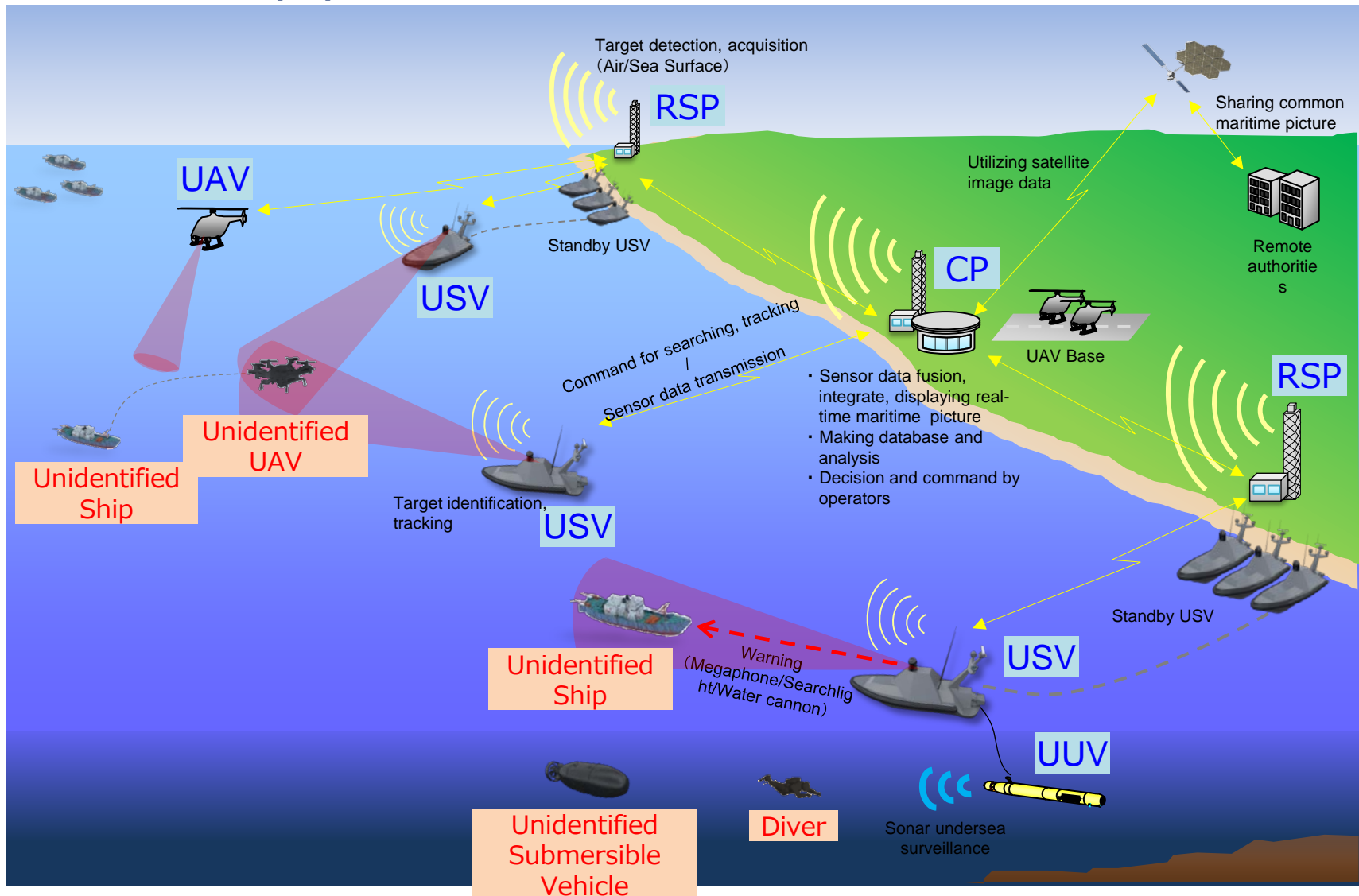
Other Use Case

- Maritime Domain Awareness
- Border Security
- Industrial Trends Monitoring

Bigdata Realtime AnalyzING System

C-II. System Concept for *CoasTitan*TM

Networked security System with unmanned vehicles

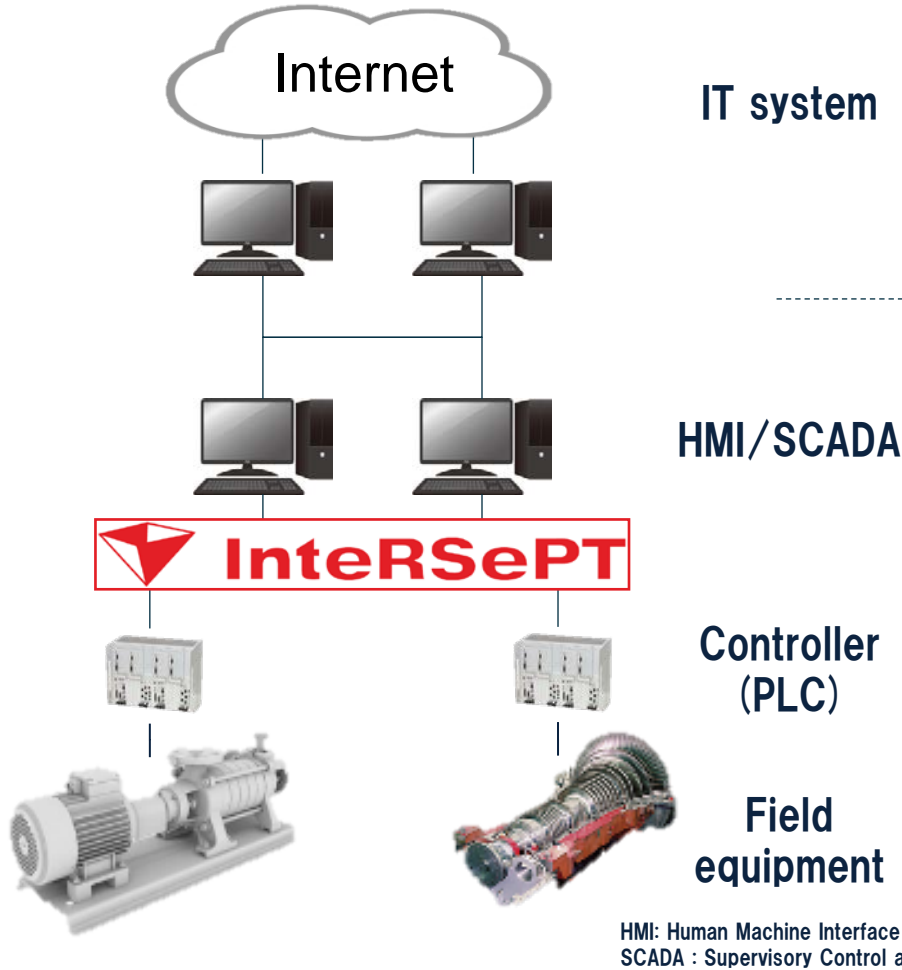


CP : Command Post, RSP : Remote Sensor Post, USV : Unmanned Surface Vehicle, UUV : Unmanned Underwater Vehicle, UAV : Unmanned Aerial Vehicle



The Ultimate Solution for Control System Network Cyber Attack 「InterSePT®」

Integrated Resilient Security and Proactive Technology



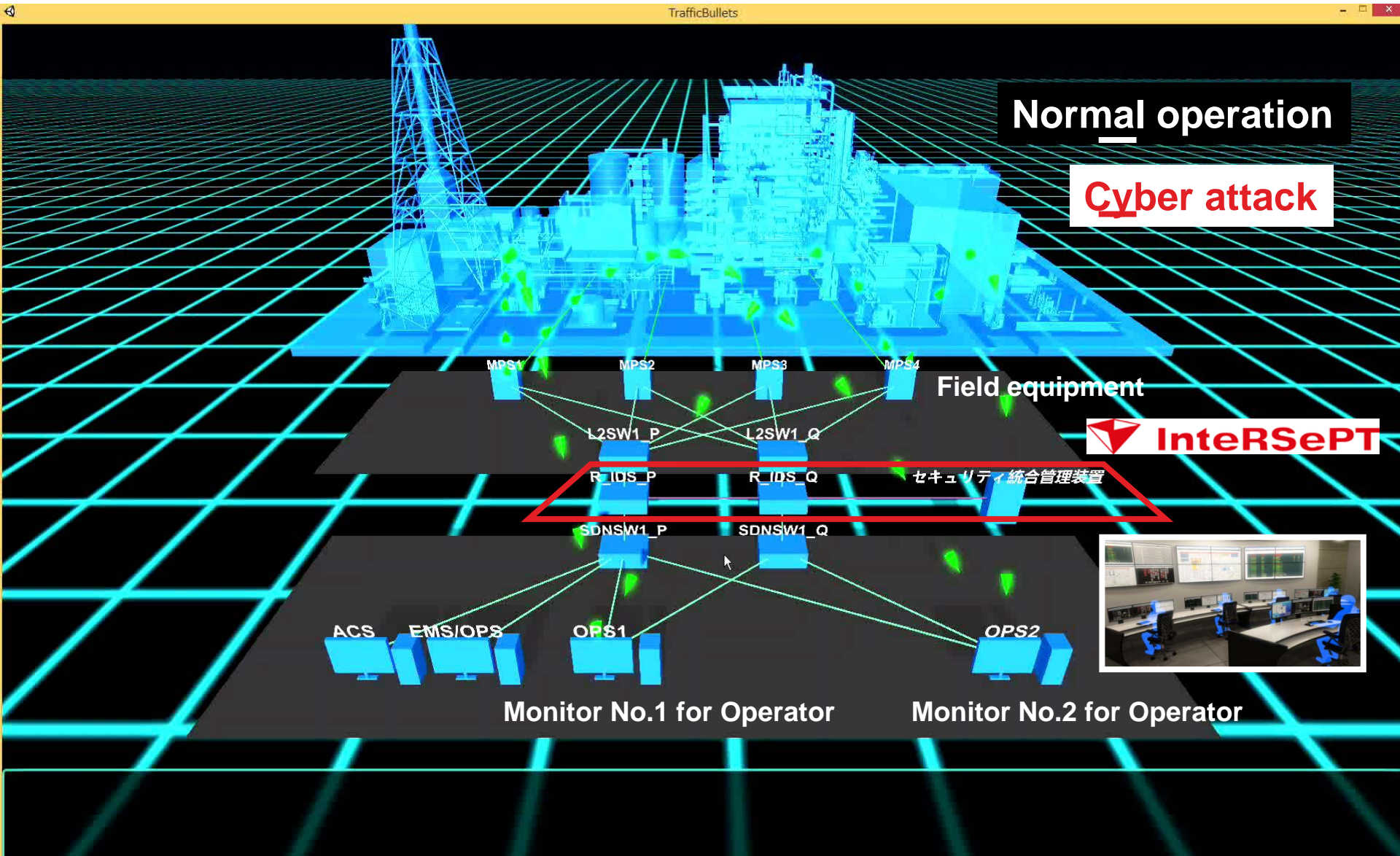
HMI: Human Machine Interface
SCADA : Supervisory Control and Data Acquisition

Existing Security Systems for IT systems

- Antivirus software
- Firewall
- Encryption
- Authentication

New Chain Link in Cyber Security

- Real time anomaly detection
⇒ A first quick anomaly detection by monitoring the network protocol
- Anomaly detection by behavior analysis
⇒ Detect security anomalies by comparing normal behavior and actual operation data



D. Digital solution/MHPS-TOMONI



Digital Solutions
MHPS-TOMONI™

Autonomous Operation



Advanced O&M



O&M Support



Monitoring

Optimize the overall fleet portfolio

Remote Operation

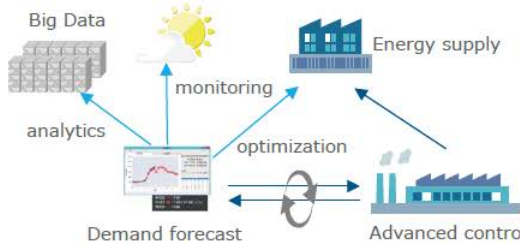
Optimized Performance

Extended Outage Intervals

Shorter Outages

Higher Reliability

EMS -Energy Management System-



Advanced Remote Monitoring

Automated Boiler Combustion Tuning

Global Service Center (Philippines)
Remote monitoring and O&M support

Predictive Analytics by diagnostics of motor current

Benefits

O&M OPTIMIZATION SOLUTIONS

PERFORMANCE IMPROVEMENT SOLUTIONS

FLEXIBLE OPERATION SOLUTIONS

TOMONI is a Japanese word for "Together with"

Solutions

Predictive Diagnosis	Thermal Efficiency Optimization	Start-up Time Optimization
RAM Analysis	Peak Power	Turndown
Performance Diagnosis	Efficient Part Load Operation	Fuel Flexibility
Maintenance Interval Optimization		Grid Response

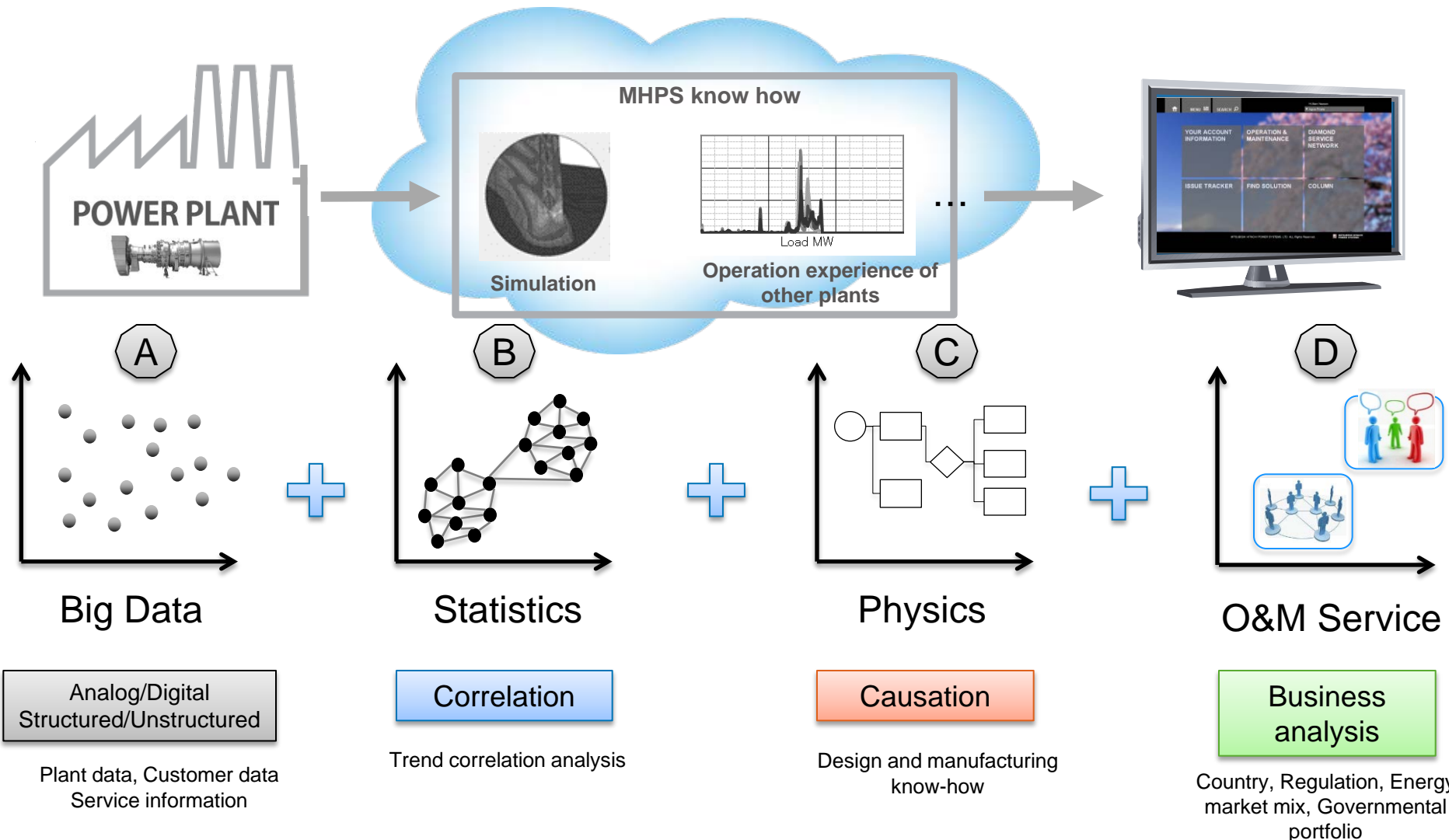
D. Digital solution/MHPS-TOMONI

®



Digital Solutions
MHPS-TOMONI™

- Data Analytics and Diagnosis by Data Physics and **OEM Knowledge**
- Best Solutions for Customers' Value Maximization.



1. Available technologies of MHI-group such as support system for safer operation, security systems, and big-data utilization are introduced.
2. To determine the time line, road map of power industry might be a good reference;
Firstly, Big-data utilization business
Finally, Automated & autonomous operation
3. Shipbuilder of OEM provider can contribute to analyze big data utilizing knowledge of each component and their physical laws.
4. Mitsubishi Shipbuilding is willing to be a total system and service provider cooperate with other MHI group companies and also to establish a collaborative relationship with technology providers outside.



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HEAVY INDUSTRIES