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Implementing Fleet Digitalization:

Systems, applications and lessons learned

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Propulsion Analytics

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Digital Transformation / shipping companies

Propulsion Analytics

EURONAV is a Large tanker company

2014 -> FDM (Fleet Data Monitoring) platform in place
Collecting data from vessels + Communication to shore offices

- Accrued benefit now: Domain knowledge & experience in “Digital transformation”
- But original FDM system was now loaded to capacity!

➢ New platform FAST (Fleet Automatic Statistics & Tracking)

Conceived 2018 to replace original FDM system

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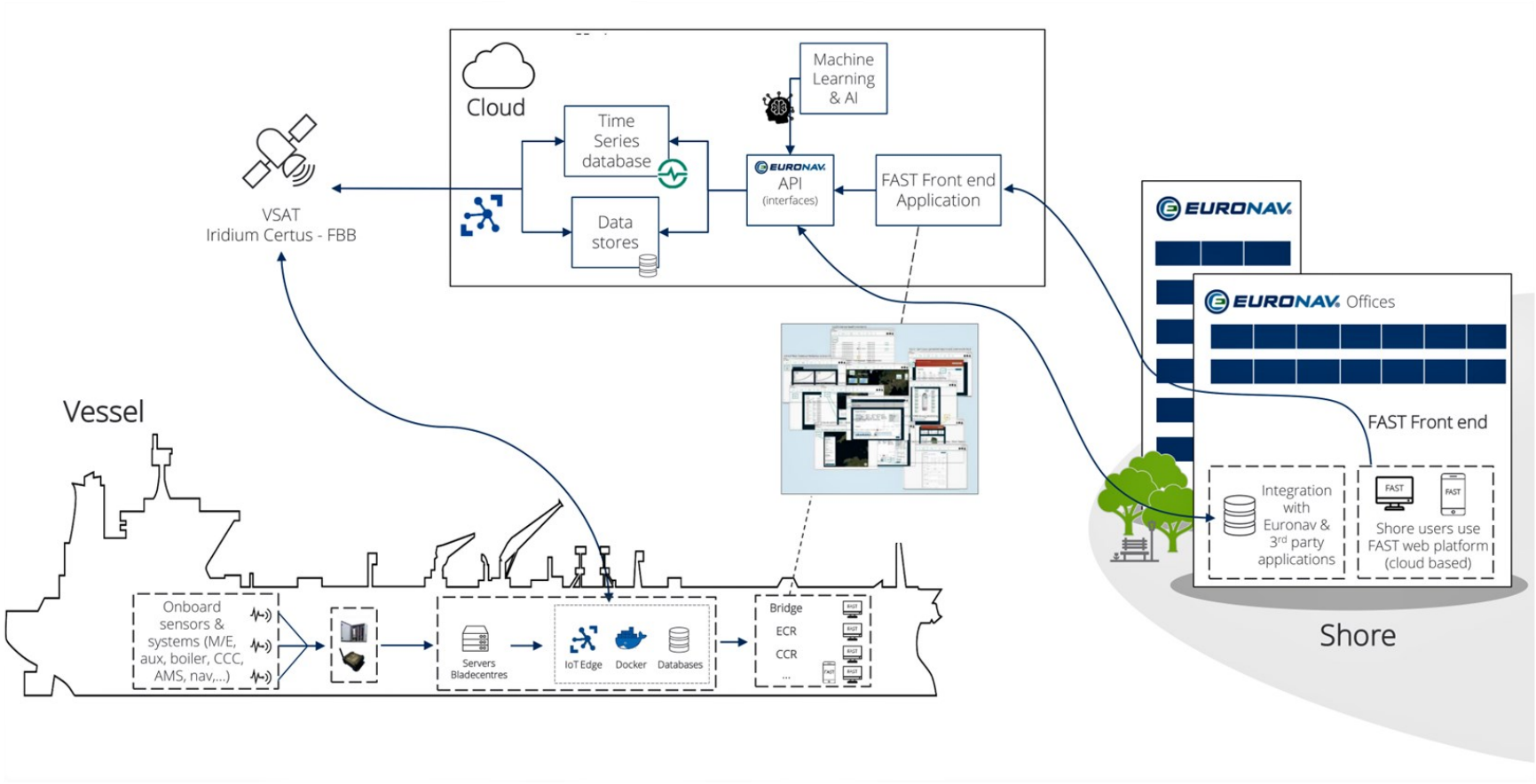
Approach

Propulsion Analytics

- New end-to-end solution

FAST platform (Fleet Automatic Statistics & Tracking)



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Digital Transformation / shipping companies

Propulsion Analytics

Digital system and tools

- Complete system can be complex
- Full specification of complete new system is difficult at start
- Concept is linked to people & their individual perceptions/ideas
- Time to complete such system is long -> People & ideas change
- Inhouse vs outsourcing dilemma

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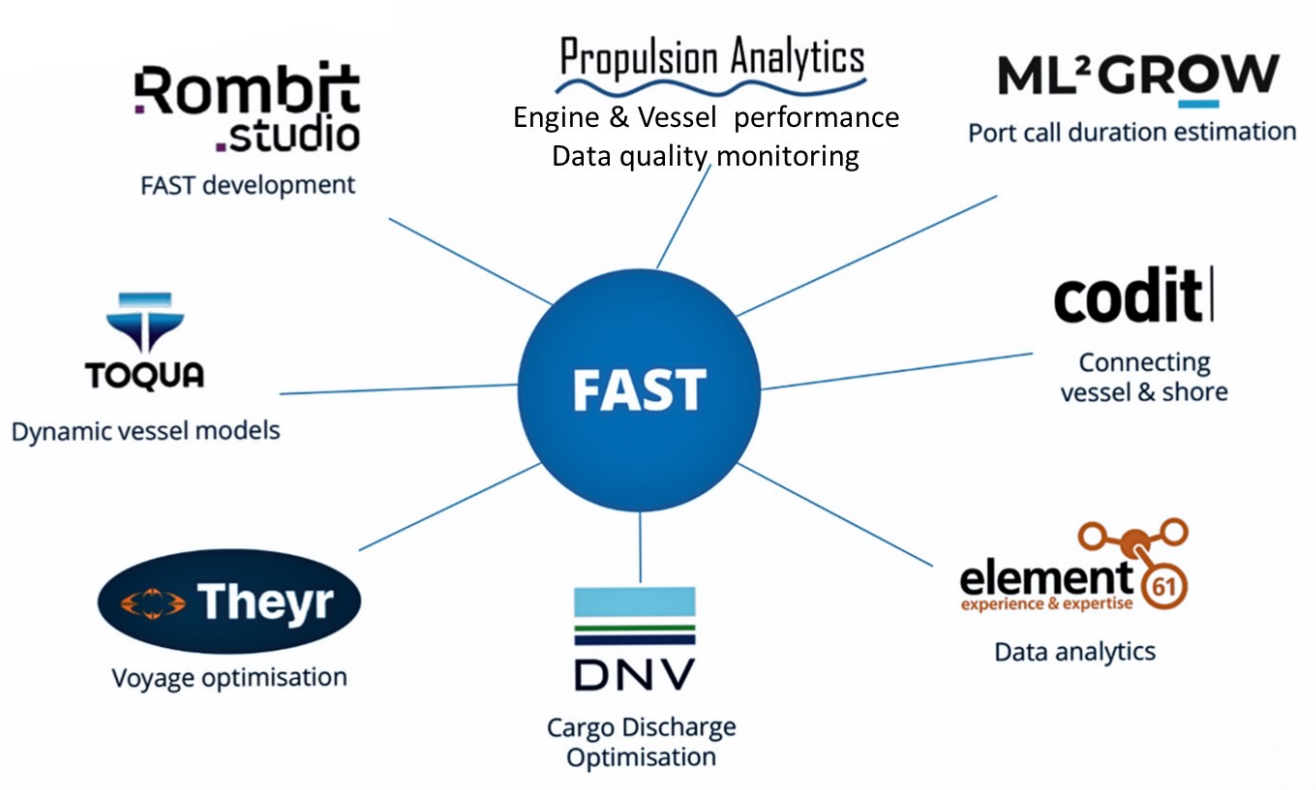
Approach

- Euronav partnership with specialist vendors
  - → Flexibility
  - → Selection
  - → Complex project management



Approach

- Retrofitting Euronav vessels, offices etc. with digital tools → challenging

  Schedule of vessels/drydockings/ (pandemic)

- Increased volume of data → complex to manage

  Signal quality

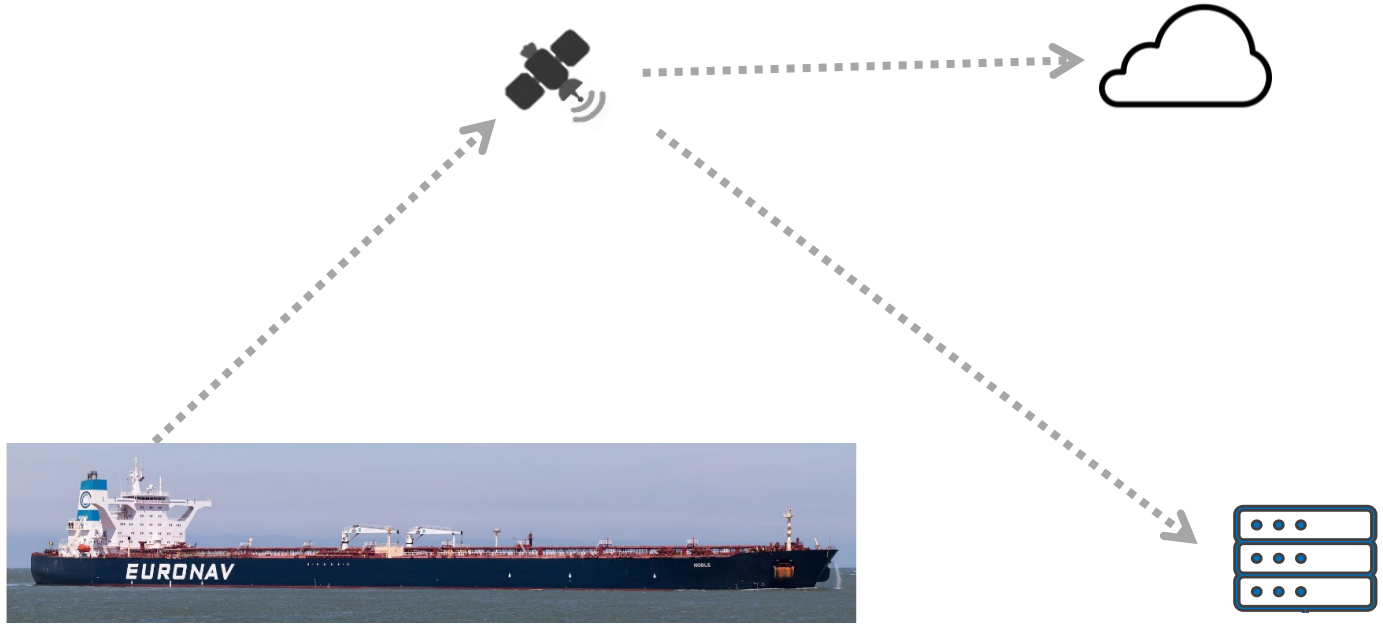
  Date rate optimization ~600 individual signals

  Filtering & validation, → FDQM special app.

FDQM- Data Quality Monitoring

Propulsion Analytics

- 100s of signals are collected onboard, transferred ashore and stored



- Sensor errors and drift can **reduce the quality** of stored data:
  - Reduction of high-quality **data availability**
  - Increase in **time/cost** for data **analysis**
  - Increase in **data storage costs** for unusable data

Use of 4 methods
(min/max, statistics, engineering, ML)
to evaluate
Signal Completeness and **Quality** KPIs

FDQM

Propulsion Analytics

- ✓ **Immediate** identification and alerting of **sensor drift/errors** and data acquisition issues
- ✓ **Evaluation and tagging** of data quality for further use
- ✓ Simple **overview** of **fleet data** quality

→ **Reduction of analysis and storage cost**

Decision support systems in FAST platform

Propulsion Analytics

Operations support systems

- Demurrage forecaster
- Port-cost estimator
- Chartering Assistant
- Off-hire assistant

Voyage Performance Management

- Voyage speed optimization
- Weather routing-safety & efficiency
- Trim/Drift/Autopilot optimization
- Voyage Emissions assessment

Condition Based Surface Maintenance (CBSM)

- Hull/Propeller condition assessment
- Vessel performance evaluation, prognostics
- Hull/Propeller roughness management-when/where

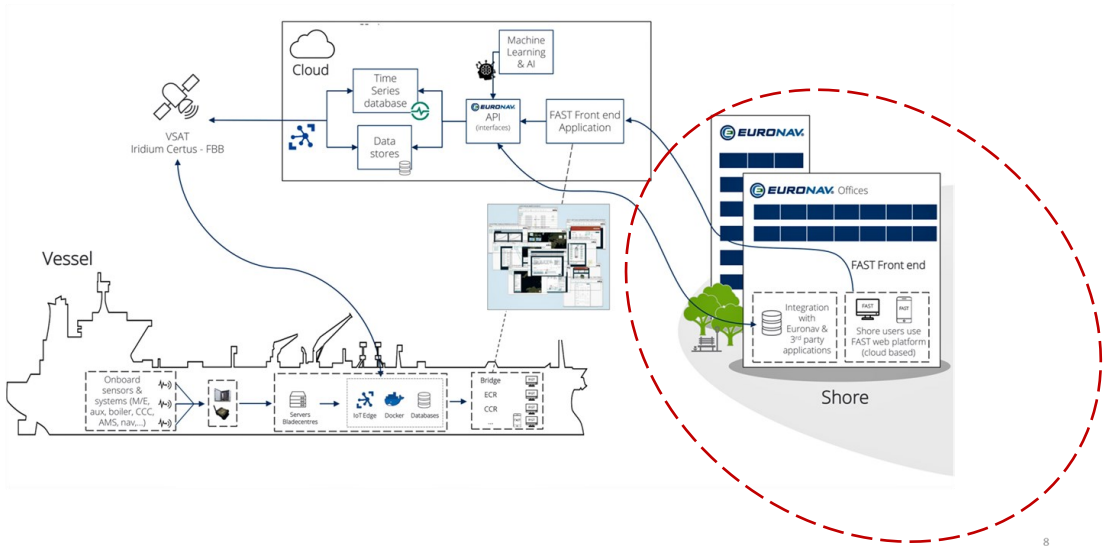
Ship System Management

- Efficiency-Emission-Economy 3E optimization
- Cargo Heating/Boiler optimization
- Energy improvement retrofit device assessment

Engine & Machinery health

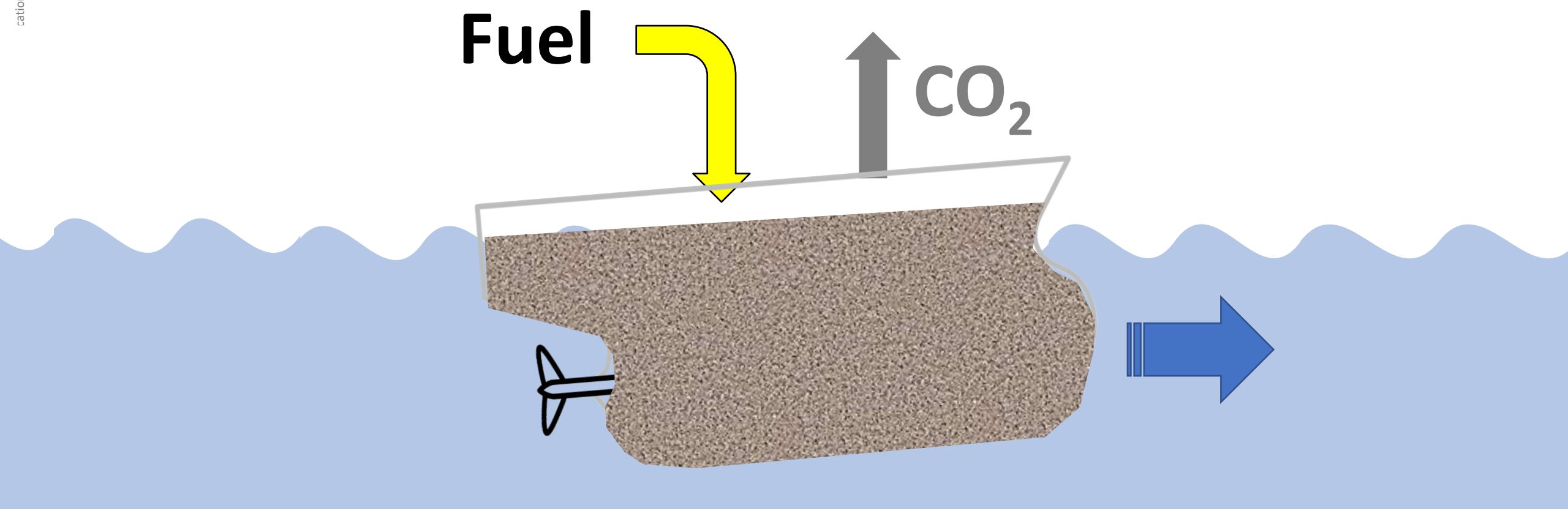
- Maintenance/Repair when/where
- CBM/PMS
- Spares management/Replenishment assistant
- Main engine performance evaluation
- A/E performance evaluation & Optimization

FAST platform (Fleet Automatic Statistics & Tracking)



The **Vessel Performance** issue

Propulsion Analytics



➢ Vessel fouling & Bad weather

Input: more Fuel (+ more Emissions)

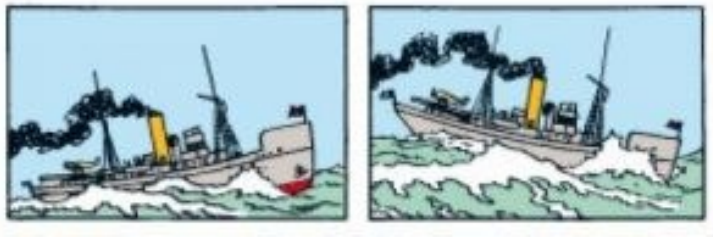
Output: sustained Speed

QUAD

Propulsion Analytics

Vessel Performance Evaluation Software

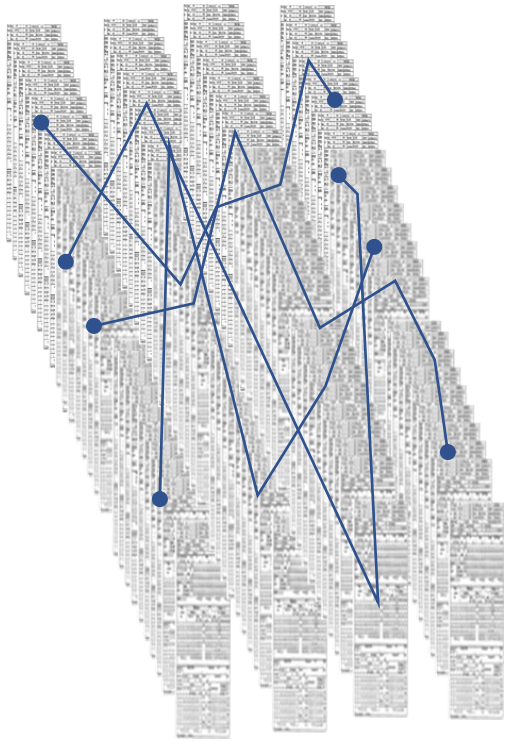
Core technology



For each
sailing condition

- Time
- Torque
- RPM
- A/F Draft
- Trim
- Rudder
- Heading
- Weather
- Environment
- FO flow
- SOG/STW
- Long./Lat.

Snapshots of instantaneous parameter sets



Machine Learning on all sets
(Respecting Naval Arch. Principles)

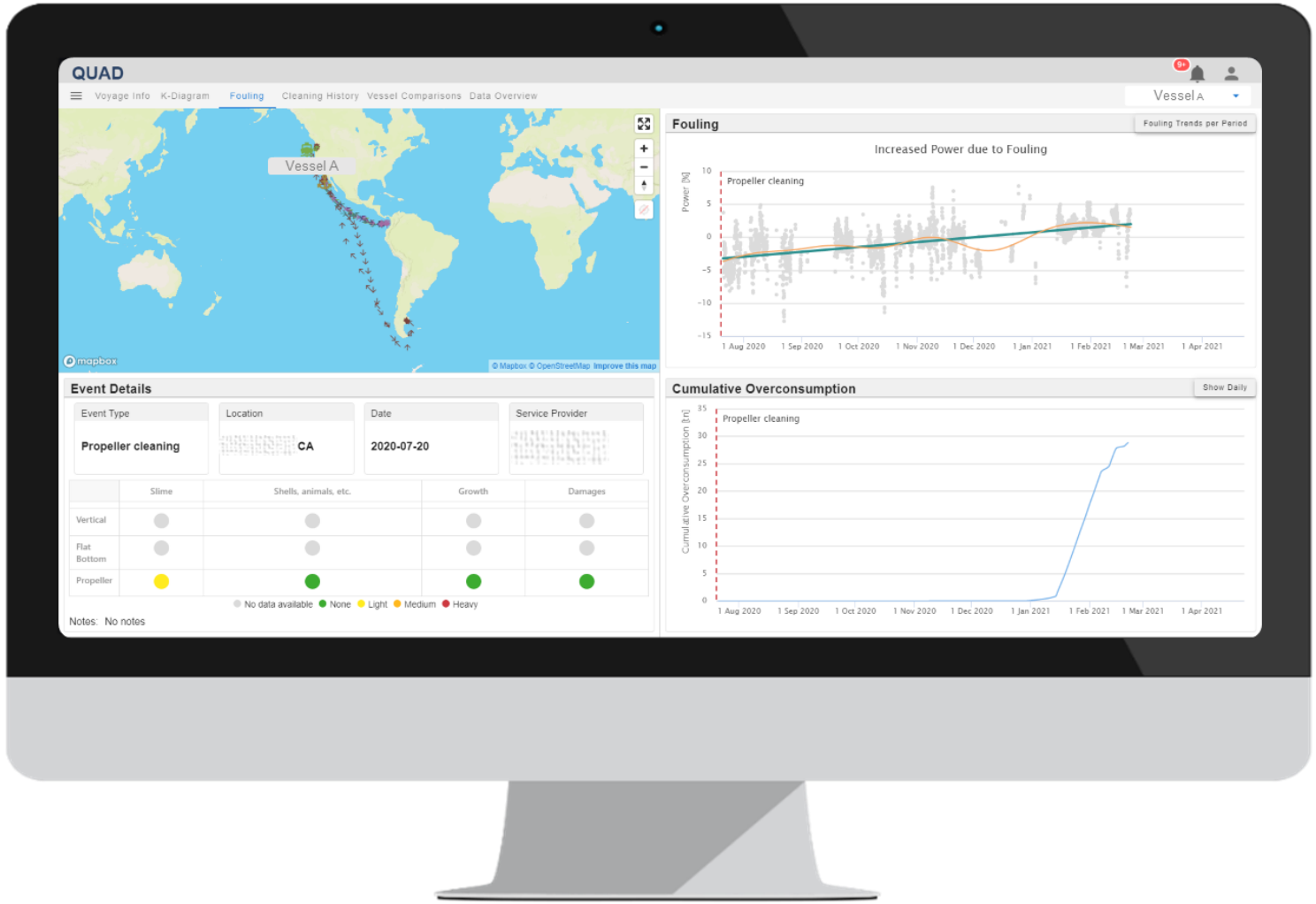
Vessel profile

QUAD

Propulsion Analytics

Vessel Performance Evaluation Software

- ✓ Accurate **current performance of vessel** for weather routing and chartering
- ✓ Detailed **CII analysis** and projections
- ✓ **Comparisons**: eg. Hull paints, Energy-saving devices, Sister vessels
- ✓ Hull/propeller **fouling** and **overconsumption** estimates and **cleaning** decision support

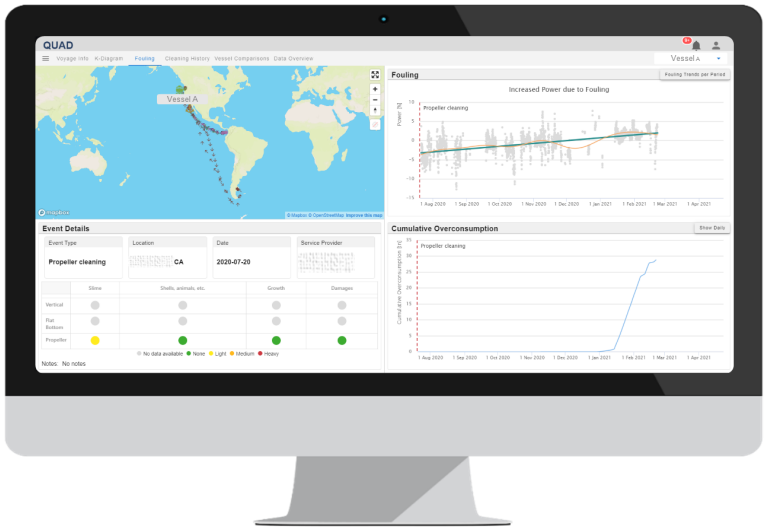


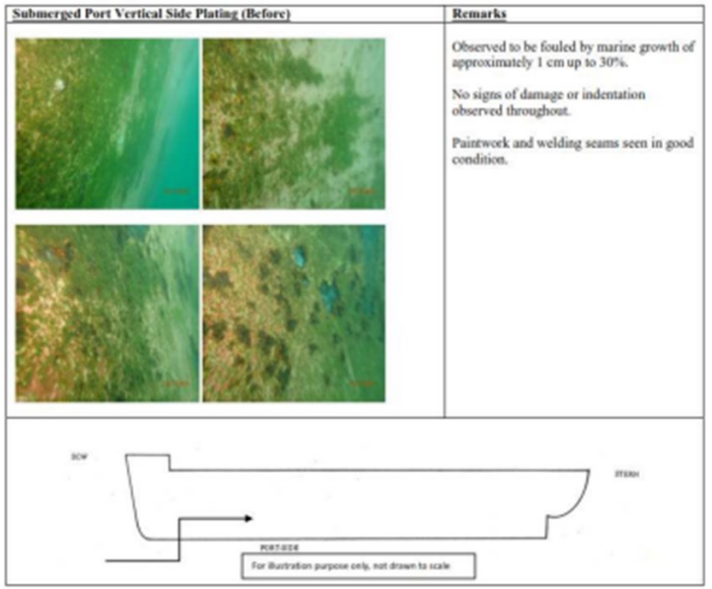
QUAD

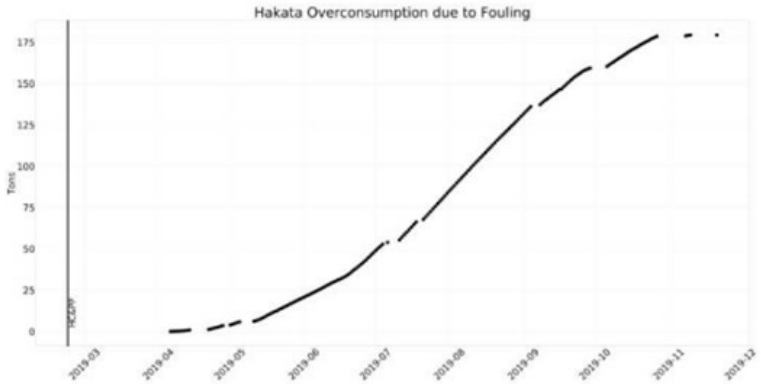
Propulsion Analytics

Vessel profiling allows *Fouling predictions*.

(Estimates repeatedly verified by divers reports.)







➢ Accurate overconsumption predictions for decision support

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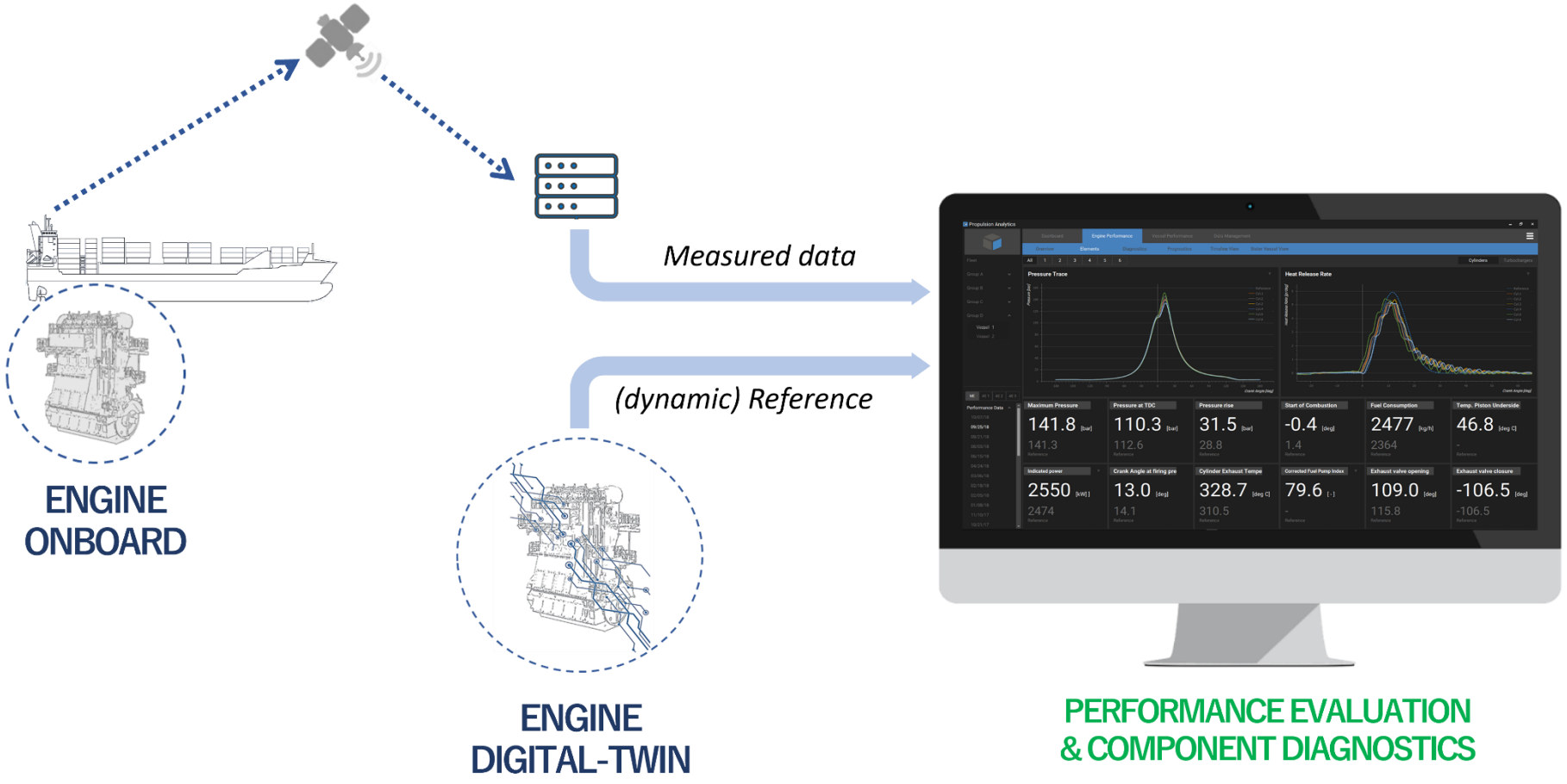
Engine Performance Evaluation

Propulsion Analytics



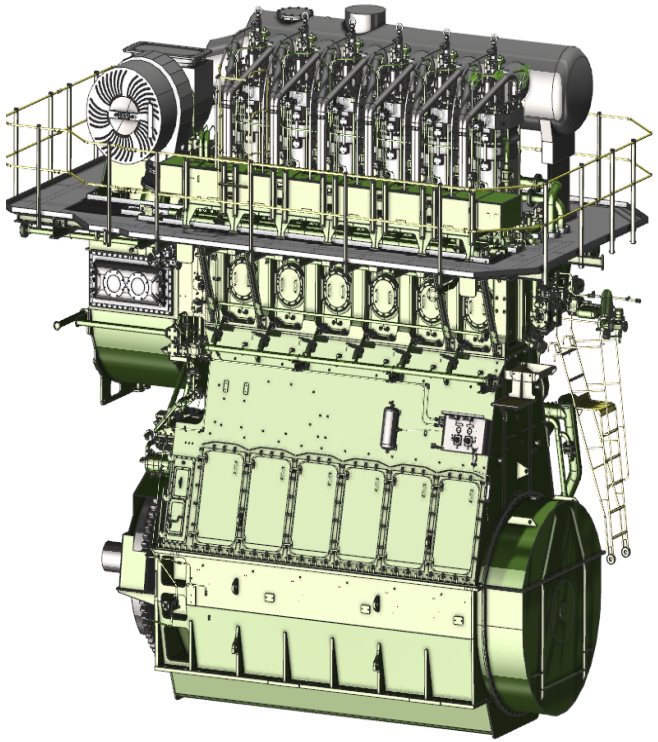
Engine Hyper Cube®

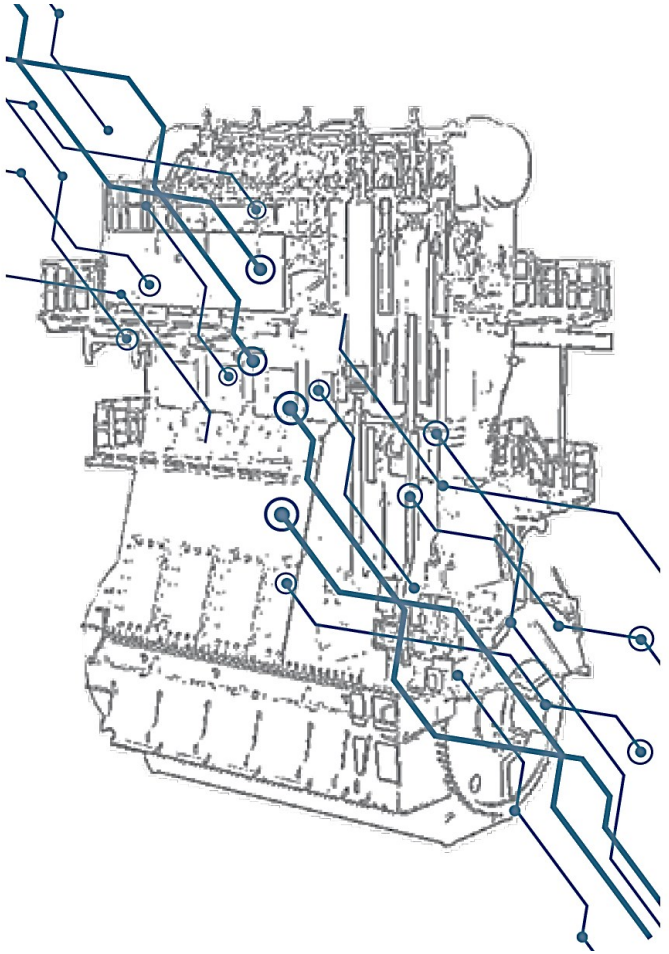
Engine Performance Evaluation Software

Propulsion Analytics

Core technology

The Thermodynamic Digital Twin of **each** individual engine
provides the "reference" values of
all performance parameters
at *any* operating condition,
leading to accurate diagnostics and predictions

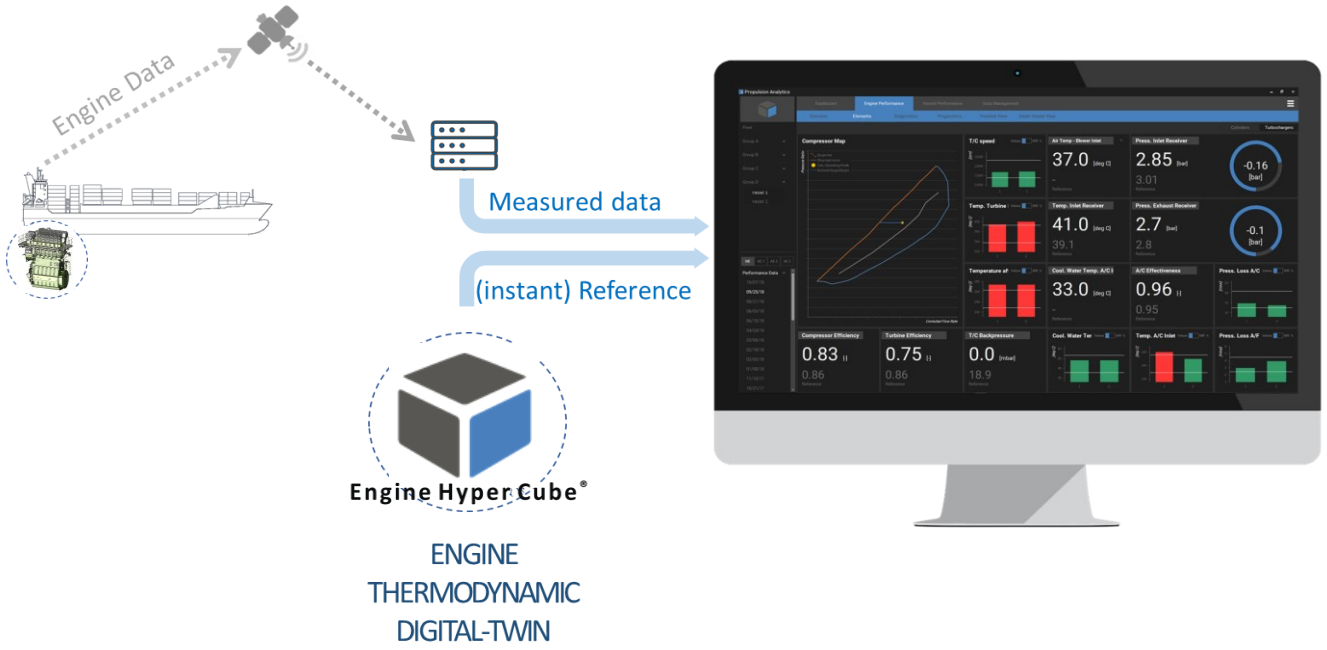




Engine Hyper Cube®

Engine Performance Evaluation Software

Propulsion Analytics



- Engine Health Monitoring and Prognostics
- Engine Performance Optimization
- Virtual (torque, FOC) Sensor

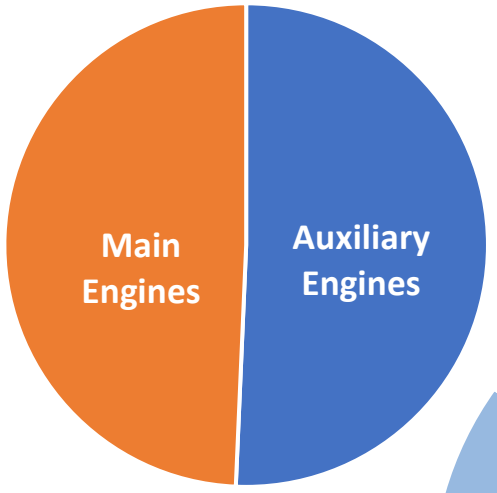
Engine Hyper Cube®

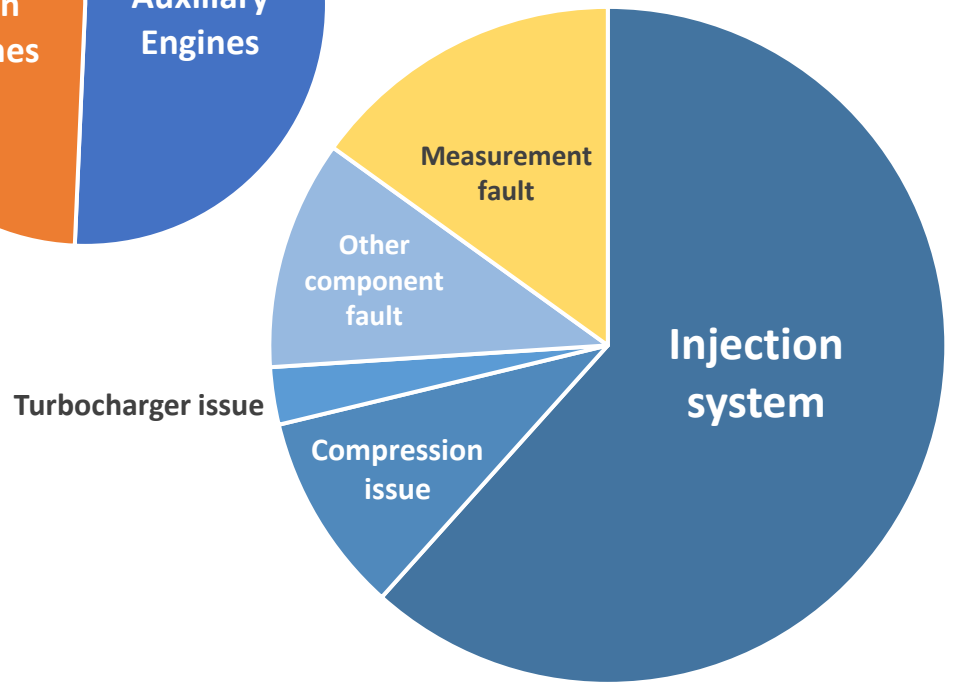
Fault Statistics

Propulsion Analytics

Engine Fault Statistics for ~20 vessels for 36 months

- Average 2 faults per vessel per year
- Even split between M/E and A/E issues
- >50% of faults in the injection system
- 12% are measurement faults, from incorrect DAQ or faulty sensors





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Engine Hyper Cube®

Propulsion Analytics

Examples of Faults Detected

Suezmax M/E, Turbine fouling

April - May 2020 :

EHC® detected low performance of turbine #2

- (Warning: wheel or nozzle ring damage or fouling)

June 2020:

Inspection found deposits and blocked nozzle ring.

- T/C was overhauled.

→ Engine Hyper Cube® helps with diagnostics and troubleshooting, leading to retaining engine performance

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Conclusions-1

Propulsion Analytics

Euronav FAST platform (Fleet Automatic Statistics & Tracking) :

- Starting 2020, now 80% of fleet connected

➢ Improvement in fleet performance, economic gains

➢ Centralized platform vessels/ office, improvements in safety

➢ Improvements in fuel efficiency, emissions performance

➢ Benefits in sustainability

❖ Reduction in use of FUEL

~1% -> 6 mio USD, 30k tons CO_2 per year for fleet

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Conclusions-2

Digitalization- Digital transformation

Propulsion Analytics

- Complex project
- Incomplete spec at start
- Time, budget, resource limitations
- Many stakeholders within company: ownership & accountability issues
- Inhouse vs outsourcing dilemma
- Legacy hardware onboard issue
- Delays!

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Conclusions-3

Propulsion Analytics

Digitalization- Digital transformation

Decision support systems & Applications for fleet operation

- Complexity of specialist apps & difficulty in evaluation by shipco.
- Quality of data must be ensured. (+Migration of legacy data)
- Different interacting applications require “integrator”

End-user involvement

- Initial opposition: Reluctance to change way of working
- Benefits from new apps *slow* to materialize
- Shipco internal capacity issues in day-to-day usage of platform and follow-up actions
- Measure of **success**: users to embrace, see value, suggest improvements!

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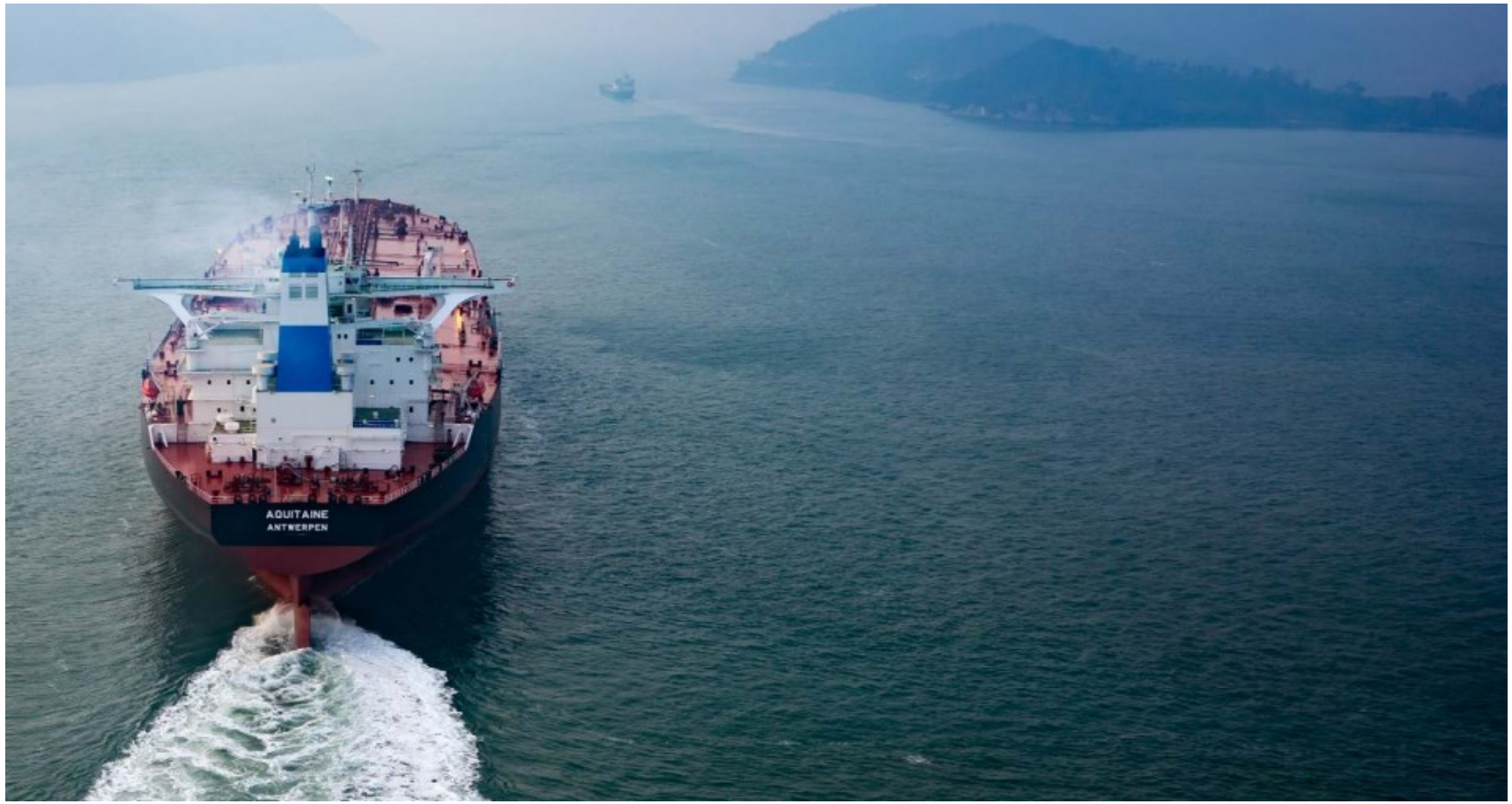
Propulsion Analytics

End of presentation, Thank you!



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