Onboard Data Collection System for Energy Efficiency Monitoring Ships

INTERTANKO -WONG KAI CHEONG

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Tripartite 2023

Tokyo, Japan

LEADING THE WAY,
MAKING A DIFFERENCE

INTERTANKO

- Introduction and Background
- Why Onboard data collection
- Challenges / Issues

INTERTANKO 2023

- **FORUM** for Members to meet and share information and best practice with each other and the wider industry
- **ADVISOR** for Members providing guidance on issues affecting their operations and interests
- **CHAMPION** that speaks on behalf of and acts for independent tanker owners

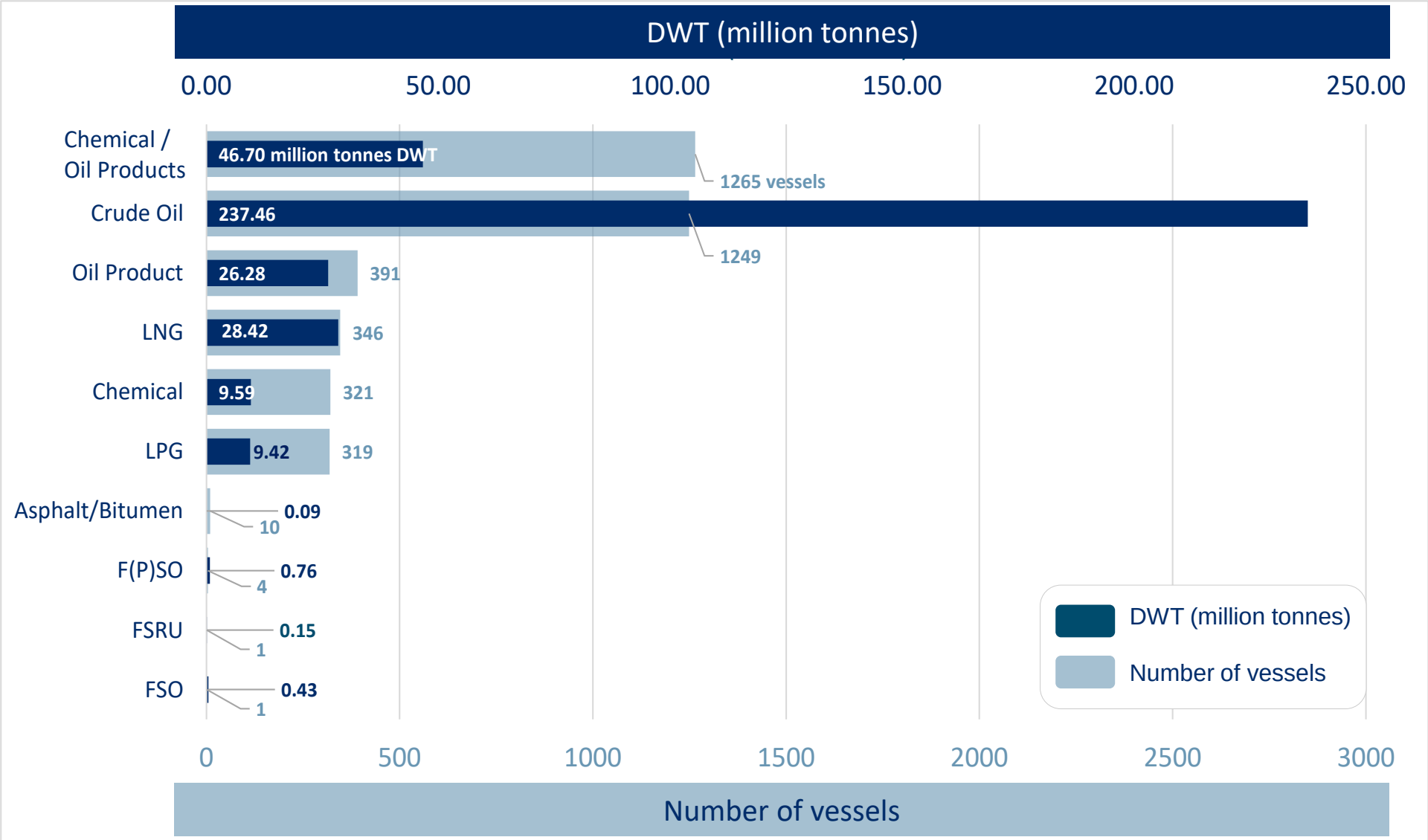
INTERTANKO MEMBERS
Lead the continuous improvement of the tanker industry's performance and strive to achieve the goals of:

ZERO fatalities, **ZERO** pollution and **ZERO** detentions

Deliver the highest quality services to meet their stakeholders' expectations

Promote the availability and use of personnel with the best marine skills and competencies

Member composition by Vessel Type



Last updated: 02/03/2023

Working Committees

INTERTANKO

Strategic Workplan 2023-25

1.SAFETY AND TECHNICAL

1.1 Tanker design & construction

1.1.1 Application of CSR
1.1.2 Classification standards
1.1.3 Safety Criteria for EEDI compliant tanker designs

1.2 Machinery & equipment

1.2.1 Lifesaving appliances
1.2.2 Classification standards
1.2.3 Anchoring and mooring systems

1.3 Cargo

1.3.1 Properties
1.3.2 Safe entry into enclosed spaces
1.3.3 Inert gas

2. HUMAN ELEMENT

2.1 Fair treatment

2.1.1 Criminalisation
2.1.2 Shore access & visas
2.1.3 Medical treatment

2.2 Crew competence

2.2.1 Training requirements
2.2.2 Competence Management
2.2.3 Officer matrix

2.3 Seafarer welfare

2.3.1 Cadet berthing
2.3.2 Health and wellness

2.4 Maritime Security

2.4.1 Security
2.4.2 Piracy
2.4.3 Refugees
2.4.4 Cyber risk management

3. ENVIRONMENT

3.1 Air Emissions

3.1.1 Greenhouse gas emissions reduction
3.1.2 Energy efficiency
3.1.3 Onshore Power Supply
3.1.4 MARPOL Annex VI (SOX, NOX, VOC)
3.1.5 Alternative Fuels

3.2 Ballast water management

3.3 Biofouling and hull management

3.4 Ship Recycling

3.5 Waste Management

3.5.1 On board waste management
3.5.2 Shore waste reception facilities

3.6 Places of Refuge

3.7 Underwater noise

4. QUALITY OPERATIONS

4.1 Vetting and Risk Management

4.2 Port State Control

4.3 Ports and Terminals

4.4 Offshore operations

4.5 Safe navigation

4.5.1 eNavigation
4.5.2 Pilotage

4.6 Chemical tanker ops

4.7 Gas tanker ops

4.8 Fuel

4.8.1 Quality
4.8.2 Sampling
4.8.3 Switching operations

5. COMMERCIAL SUSTAINABILITY

5.1 Chartering

5.1.1 Worldscale
5.1.2 Charter party terms & documentation
5.1.3 Freight Demurrage
5.1.4 Payment Performance

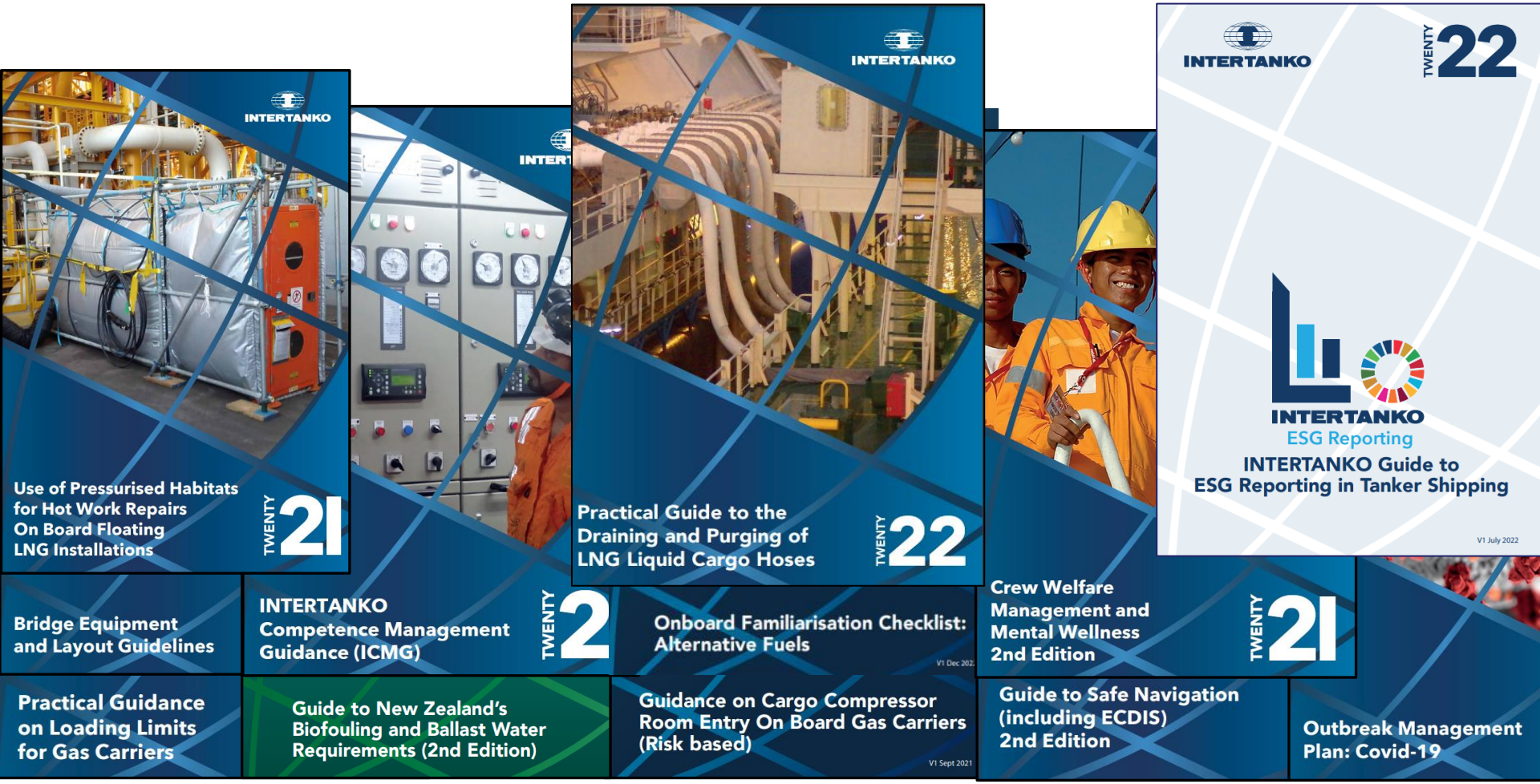
5.2 Insurance & Liability

5.2.1 Marine Insurance
5.2.2 Liability and Compensation regimes
5.2.3 Sanctions

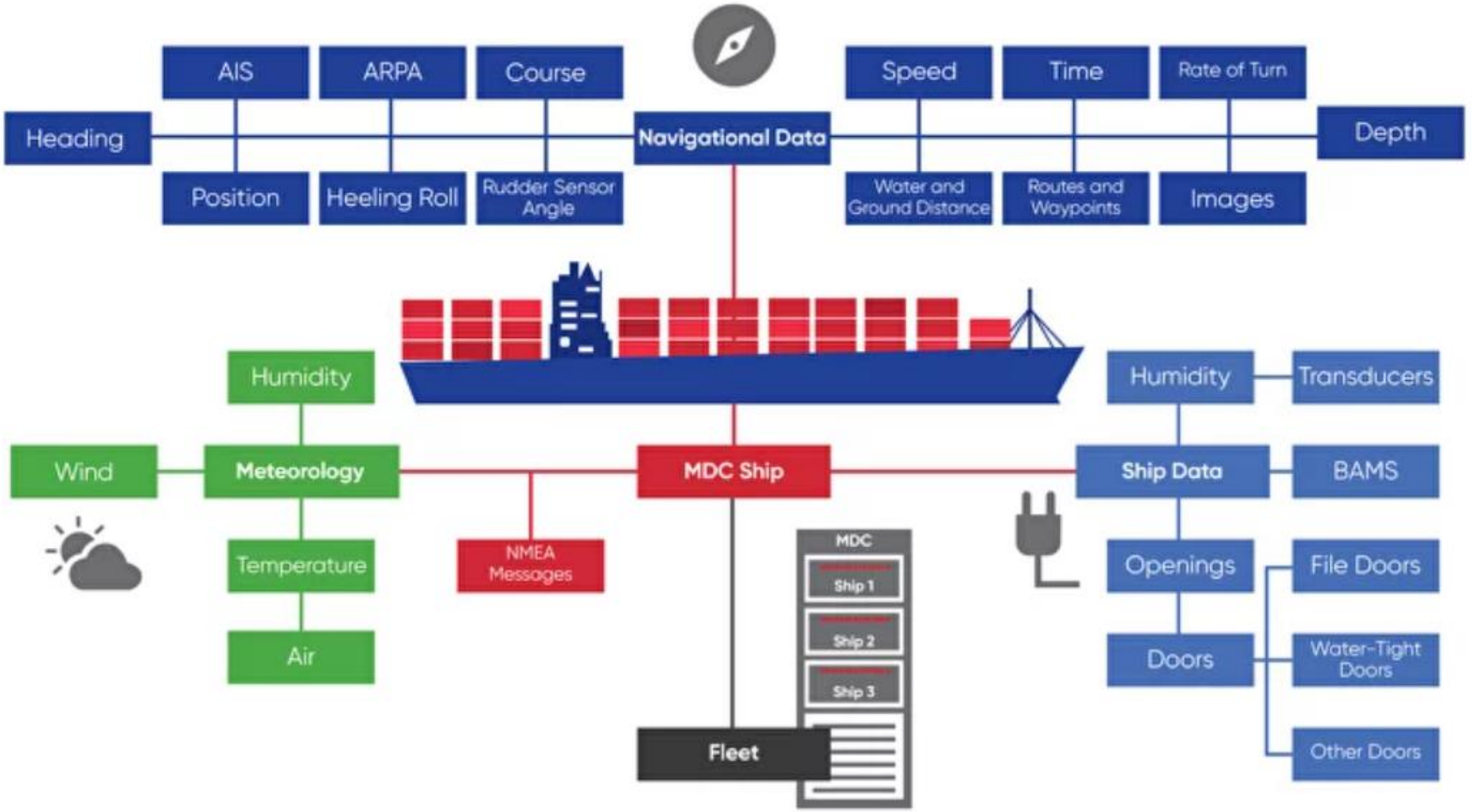
5.3 Anti-corruption

5.4 ESG Reporting

Advisories & Best Practices



“Data Flood” onboard Ships



Source: Marine-Digital

Objectives for Data Collection onboard ships

Role	Function	Example of Application
Ship Operator, Crew & Charterer	Operator	Energy saving operations Connecting the Dots & feedback loops
	Fleet Planning	Fleet & commercial allocation Route planning Transparency & Accountability
Ship Owner	New building	Design optimisation
	Technical Management	Maintenance Act Quickly Compliance - Achieving CII Targets

Need for Onboard Data Collection to use CII correction factors

$$\frac{\sum_j C_{Fj} \cdot \left\{FC_j - \left(FC_{voyage,j} + TF_j + (0.75 - 0.03y_i) \cdot \left(FC_{electrical,j} + FC_{boiler,j} + FC_{others,j}\right)\right)\right\}}{f_i \cdot f_m \cdot f_c \cdot f_{ivse} \cdot Capacity \cdot (D_t - D_x)}$$

Fuel consumed in the following cases may be deducted from the calculation of CII.

- $FC_{electrical,j}$ **for corrections relating to electrical power**
  - for electrically-driven cargo discharge pumps on tankers & electrical-powered cargo cooling/reliquefication systems on gas carriers.

- $FC_{\text{Boiler},j}$ **for corrections relating to boiler fuel consumption**
  - for boiler doing cargo heating and cargo discharge

- $FC_{\text{others},j}$ **for corrections relating to other fuel consumption devices**
  - for standalone engine-driven cargo pumps during discharge operations on tankers

Need for Onboard Data Collection to use CII correction factors

$$\frac{\sum_j C_{Fj} \cdot \left\{FC_j - \left(FC_{voyage,j} + TF_j + (0.75 - 0.03y_i) \cdot \left(FC_{electrical,j} + FC_{boiler,j} + FC_{others,j}\right)\right)\right\}}{f_i \cdot f_m \cdot f_c \cdot f_{iVSE} \cdot Capacity \cdot (D_t - D_x)}$$

- $FC_{electrical,j}$ **for corrections relating to electrical power**
  - Use of kWh meters to measure electric power used when electrically-driven cargo discharge pumps on tankers & electrical-powered cargo cooling/reliquefication systems on gas carriers are used.
  - Use of estimated SFOC to derive fuel consumed to generate required electric power
  - derivation of fuel consumption or kWh from ***auto-logged data*** may be used subject to approval by the Administration.

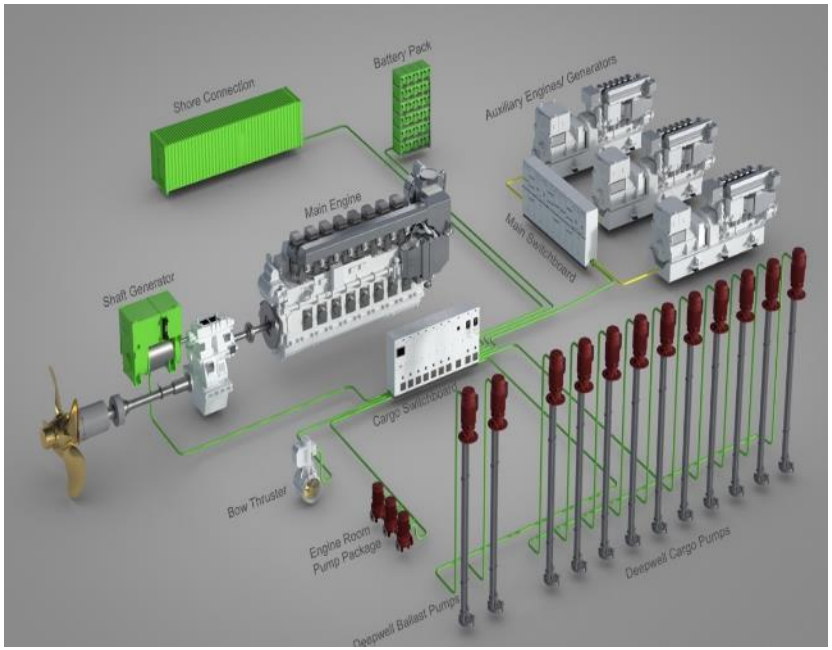
- $FC_{\text{Boiler},j}$ **for corrections relating to boiler fuel consumption**
  - Measure fuel consumed by boiler doing cargo heating and cargo discharge by steam-driven cargo pumps
  - Same boilers could be used for other purposes, e.g. calorifiers, deck machinery, galley, etc.

- $FC_{\text{others},j}$ **for corrections relating to other fuel consumption devices**
  - measurement of fuel portions to drive engine-driven cargo pumps during discharge operations on tankers?

Need for Onboard Data Collection to use CII correction factors

Fuel consumption for tanker fitted with electric cargo pumps

- During idling operation, the tanker will be operating only with one generator which will be adequate to supply the electrical power to the tanker
- However, additional generator(s) will be started to supply the electrical power to the cargo pump during cargo discharge operations.
- Collection of the total running hours and fuel oil consumed by the additional generator(s)



Source:Svanehøj

Need for Onboard Data Collection to Review CII regulations

Review of CII to be concluded by 1 January 2026:

- Review adequacy of all CII Guidelines
- Consider reduction factors for 2027-2030
- Strengthened corrective actions if appropriate
- Check the need for enhancement of the enforcement mechanism

Review of CII – Possible Outcomes:

1. **Broadly unchanged, but new reduction rates for 2027-2030**

2. **Improve coverage of correction factors – new, existing applied to more ship types, adjustment of existing (opposition to proliferation of correction factors though)**

3. **Re-consider the metric to be more suitable & reduce the need for correction factors (consideration to use actual transport work falls under this option) - CII having 'distance' in the denominator is not correlated with absolute emissions**

4. **Remove CII as a compliance mechanism and use it for benchmarking comparison only. Develop SEEMP to drive improvements that are ship and operational profile specific.**

Need for Onboard Data Collection to Review CII regulations

Some E rated ships emit less CO_2 than their peers and are inefficient according to the metric -> limited distance travelled & likely greater proportion of time not underway. Here is the main list of reasons why ships may be rated E

1. Ship is operated at a higher speed than its peers
2. Ship is operated poorly (e.g. poor biofouling control)
3. The ship is poorly designed
4. The ship is designed to fulfil different requirements than its peers
5. The ship has substantial and variable non-propulsion consumption (hotel load, cargo loads) – this being a consequence of a formula based on a quotient of CO_2 and distance travelled
6. The ship has an unfavourable operating profile (share of short voyages, increased waiting time, etc)
7. The metric is unsuitable

Source: ARCSILEA

Ships rated E for reasons 1 to 3 are appropriately targeted, but ships rated E for reasons 4-7 are not.

CII Review: Refine the framework for more appropriate targeting!

Existing Data Collected for CII

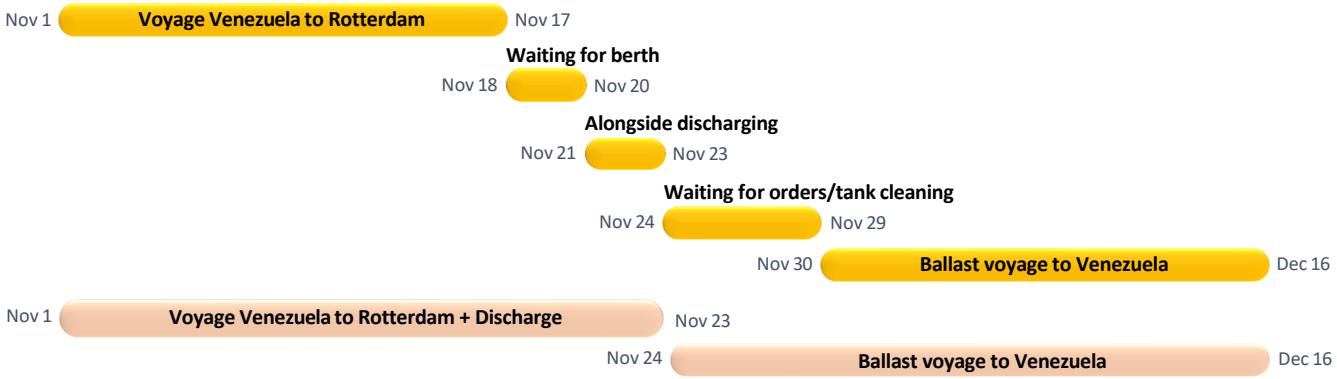
Annual aggregated data as reported to DCS:

- including fuel consumption
- DWT
- distance travelled
- hours underway
- vessel identifiers (IMO Number and ship name)
- Ice class
- Attained EEDI
- Attained EEXI
- CII
- CII rating

- Use of noon reports typically used to comply with IMO DCS, but is it sufficient to provide sufficient data to:
  - for verifiers to allocate correction factors appropriately; and
  - aid IMO's review of CII requirements?

Collection of Data for CII review

Data to be collected - Voyage



Source: ARCSILEA

Is the typical list of data currently collected sufficient? Do other rules need to be defined e.g.:

- **Report voyages separate from berth activities (otherwise derived values e.g. average speed may be misleading)**
- **Would other form of metrics be a more appropriate measure?**

Granularity of Data for CII review

Additional Data per row

- Departure port (UNLOCODE)
- Destination port (UNLOCODE)
- Unique voyage identifier
- Cargo weight (optionally cargo density, type)
- Fuel consumption by combustion unit – ME/Aux/Boiler/GCU – some others covered by current correction factors
- Operational phases:
  - Underway
  - Manoeuvring
  - Waiting
  - Ballast Voyage
  - Laden Voyage
  - Port stay, Loading
  - Port stay, discharging
  - Port stay loading + discharging
  - Port stay, tank cleaning

Source:
ARCSILEA
A Specialist Maritime Consultancy

IMO Data Collection system (DCS)

New data mandated to be reported:

- **Fuel consumption when the ship is not underway**
- **Fuel consumption for laden distance (voluntary)**
- **Total amount of onshore power supplied (in kWh)**
- **Total transport work using ton-mile**

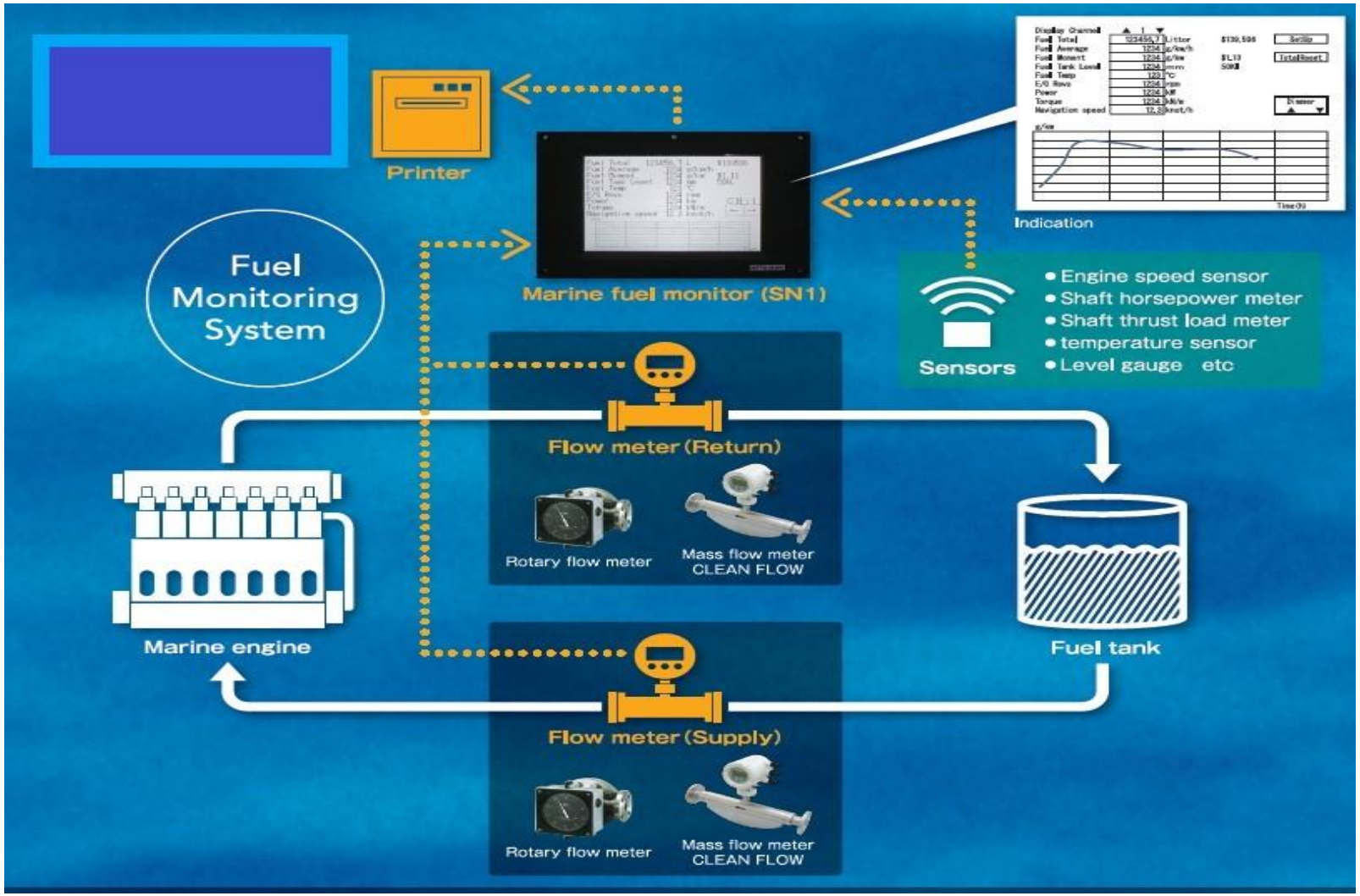
Increased mandated granularity

- **Fuel oil consumption per combustion system, by fuel oil type**

Installation of innovative technology - new definitions required in SEEMP guidelines to:

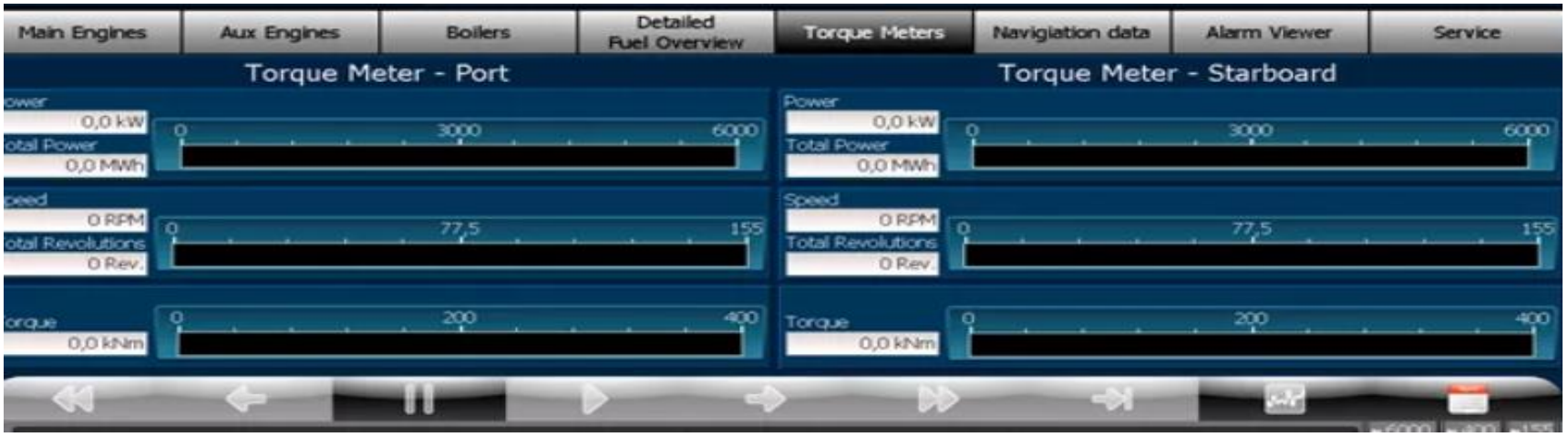
- **track uptake of zero and near zero GHG emission technologies**
- **track fuels and energy sources**
- **enhance technology tracking linked to MEPC.1 Circ.896 - *2021 Guidance on Treatment of Innovative Energy Efficiency Technologies for calculation and verification of EEDI and EEXI***

Fuel Consumption Monitoring



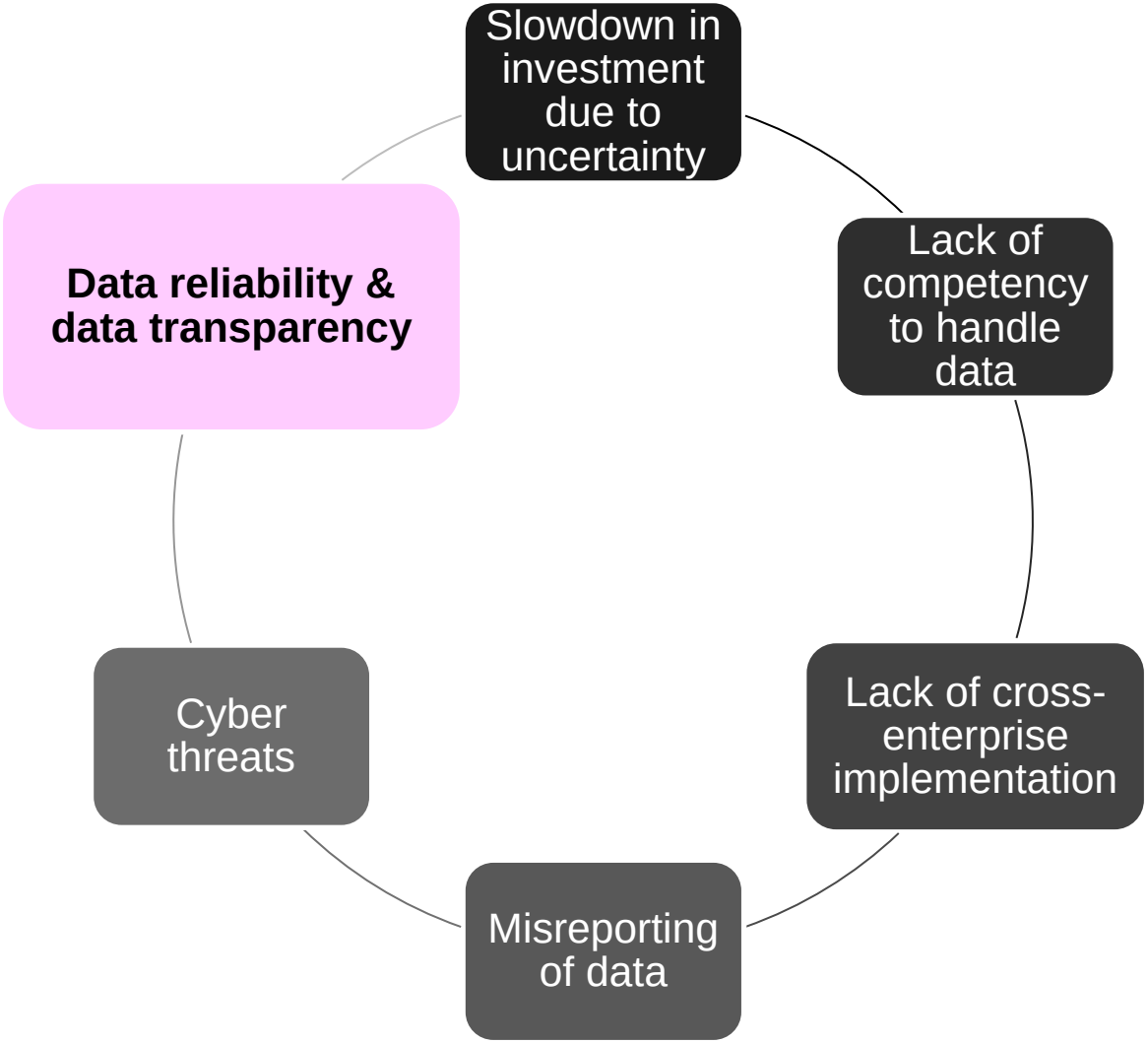
Source: Nitto Seiko

Fuel Consumption Monitoring



Source: Insatech

Challenges/Issues to adopt shipboard Data Acquisition



Challenges with Digitalisation & Automation

- Industry generally supportive of **Digitalisation**
- Leading to **Automation** to alleviate crews' burden

× Limited by questionable reliability of data for decision-making/support

× Harmonised framework for type-approval of digital components?

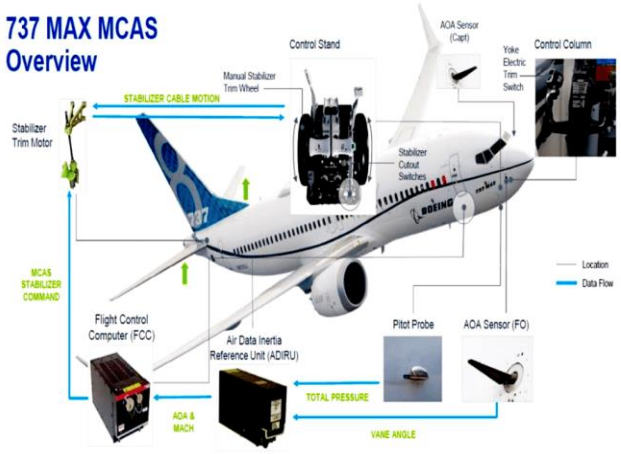
× Performance standards available? **- reproducibility, repeatability, sensitivity, durability, reliability, allowable errors, protection from corruption, failure rates, range, accuracy, resolution, repeatability, response time, interfacing performance, operating temperatures pressure, humidity, vibration limits, electromagnetic disturbance limits,, testing and commissioning, availability of diagnostic display, calibration checks**

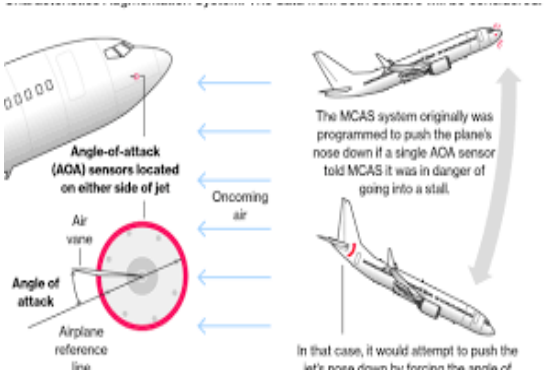
× Algorithm & logic of decision/action triggers not made known to users

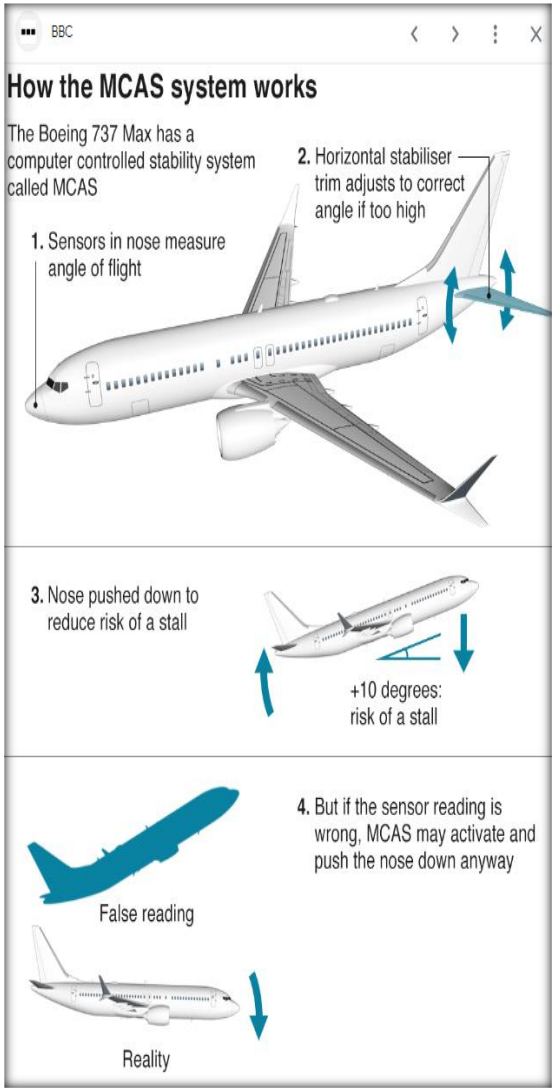
Challenges with Digitalisation & Automation

- Compatibility when new digital components are retrofitted on older ships?
- Cross-interactions and behaviors across different equipment components of different makes
- Unified standard on how equipment should be integrated and perform after integration?
- Calibration issues and needs after installation?
- Standards on failure rates or need for redundancy for components that are critical to operations e.g. stern tube temperature sensors?

Challenges with Digitalisation & Automation







- Sensor calibrated?
- Signals reliable?
- Signals accurate?
- Control algorithm & behaviour well understood by crew to appropriately react?
- Faults handling?
- Ease of manual override, in case algorithm control action outcomes are inappropriate?
- Training?

EU's Measuring Instrument Directive

Essential requirements specified in Annex I of MID (2014/32/EU)	Meaning of Essential Requirements
1 Allowable errors	Compliance of metrological characteristics to performance classes, in normal conditions and against environmental conditions (EMC, climatic, mechanical as specified in the directive) is requested For electricity meters, 3 classes are specified according to EN 50470: class A (similar to class 2), class B (similar to class 1), class C (similar to class 0,5)
2 Reproducibility	
3 Repeatability	
4 Discrimination and reproducibility	
5 Durability	Metrological characteristics shall not drift too much during operation. Time before verification is regulated by each member state.
6 Reliability	Mean Time To Failure (MTTF) shall be evaluated.
7 Suitability	Protection of metrological characteristics against fraudulent use or unintentional misuses (anti-tampering, seals, …) shall be available.
8 Protection against corruption	Protection of metrological data and software against corruption shall be available.
9 Information to be borne by and to accompany the instrument	Relevant markings, instruction sheets, documentation and technical literature shall be made available.
10 Indication of result	Metrological data shall be displayed to end-customers on a accessible display (to allow them comparison of results provided by the meter to those present on the invoice).
11 Further processing of data to conclude the trading transaction	Metrological data shall be made available to the energy provider for trading transaction (invoicing).
12 Conformity evaluation (assessment acc to schemes)	Third party body shall assess the conformity of the device according to routes specified in annex II of MID (e.g. B+F or B+D or H1 for electricity meters)

Source: Schneider Electric Tech Blog

Is the State-of-the-Art Good Enough?

- Other subsystems covering other operational aspects apart from fuel consumption that could require attention.

- Other Classification Societies' rules :
  - ABS Smart Guide, DNV D-INF notation, etc.
  - almost all are providing guidance on general principles but not the specific performance standards
  - Principles stated for these to be ***considered***:
  - failure rates, range, accuracy, resolution, repeatability, response time, interfacing performance, operating temperatures, testing and commissioning, availability of diagnostic display, calibration checks

→ How far are we from having onboard equipment type-approved to performance standards?

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INTERTANKO

INTERTANKO ESG Reporting

INTERTANKO GHG Data Project

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