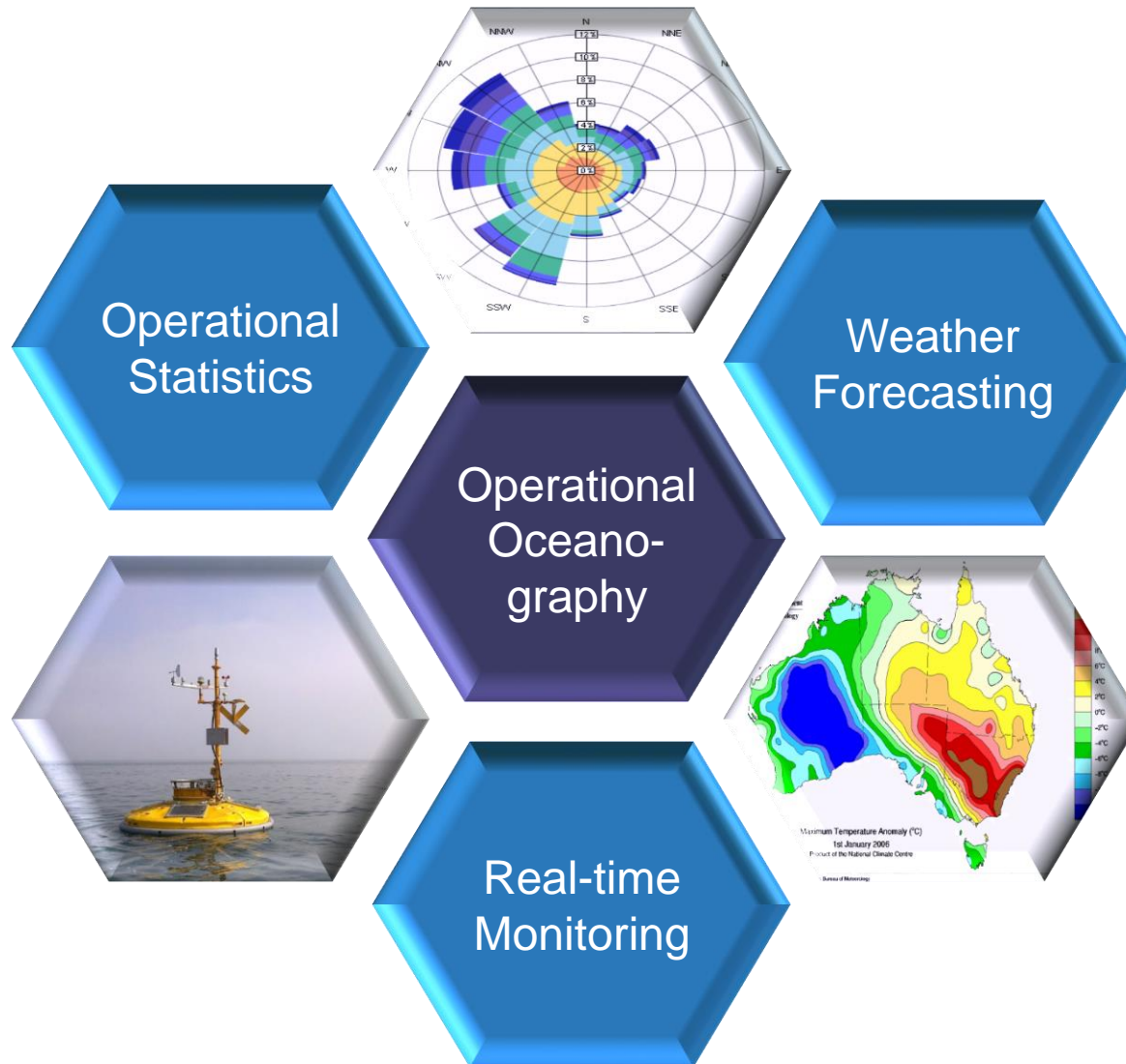# The Emergence of Data-Driven Technologies for Operational Oceanographic Applications
Simon Foster / Rizwan Sheikh

- Metocean Measurement

- Metocean Consultancy

- Environmental Services

- Weather Forecasting

- Integrated Offshore Monitoring Systems

- Structural Monitoring

Operational Statistics

Weather Forecasting

Operational Oceano-graphy

Real-time Monitoring

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Image courtesy of HHI

PAST

- Measurements
- Hindcast

Operational Criteria
- Operability
- Weather windows
- OLS

PRESENT

- Real-time Systems

Monitoring
- Metocean
- Helideck
- Structural Integrity

FUTURE

- Forecasts

Weather
- Tow route
- Installation
- Site specific
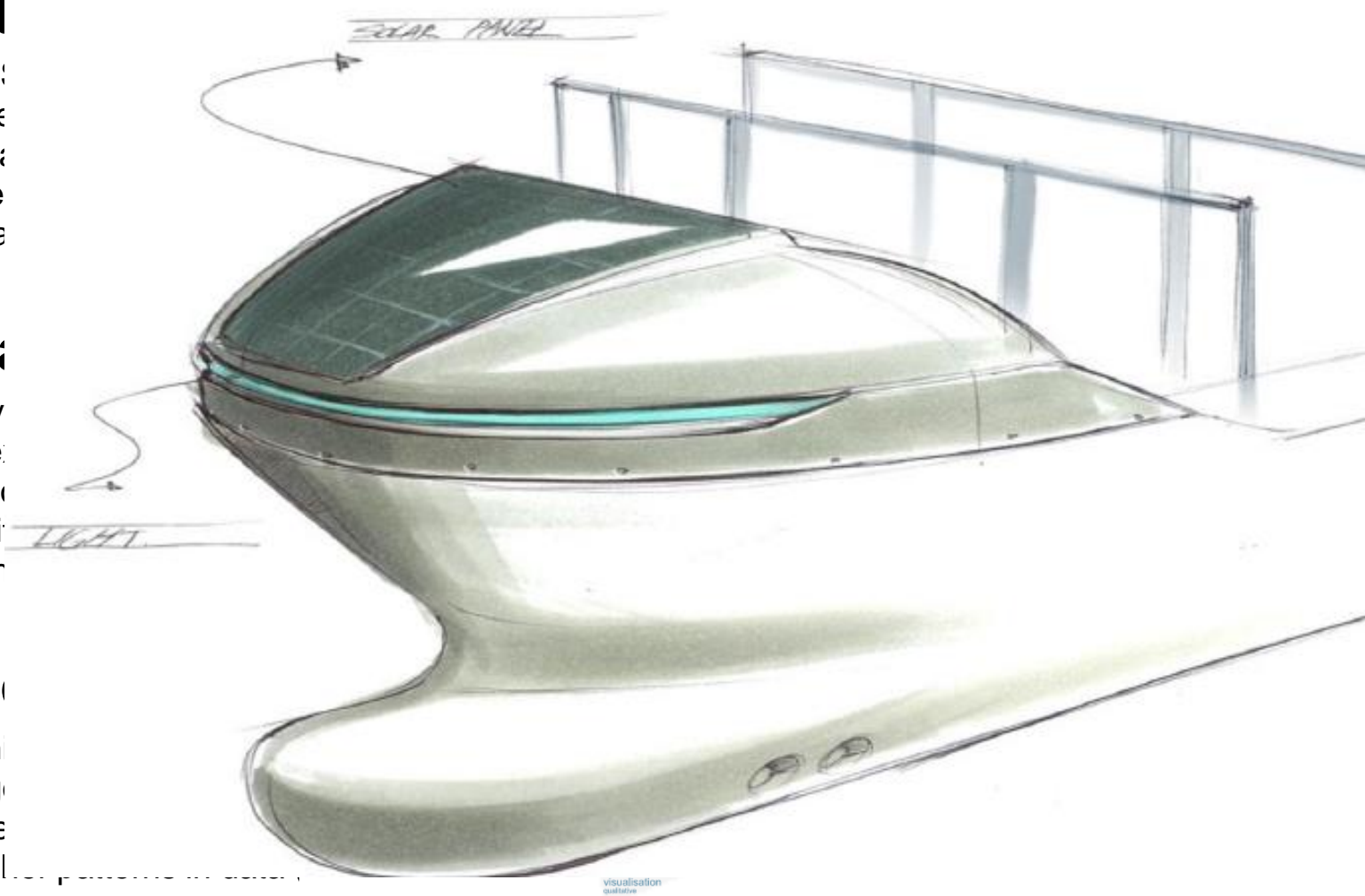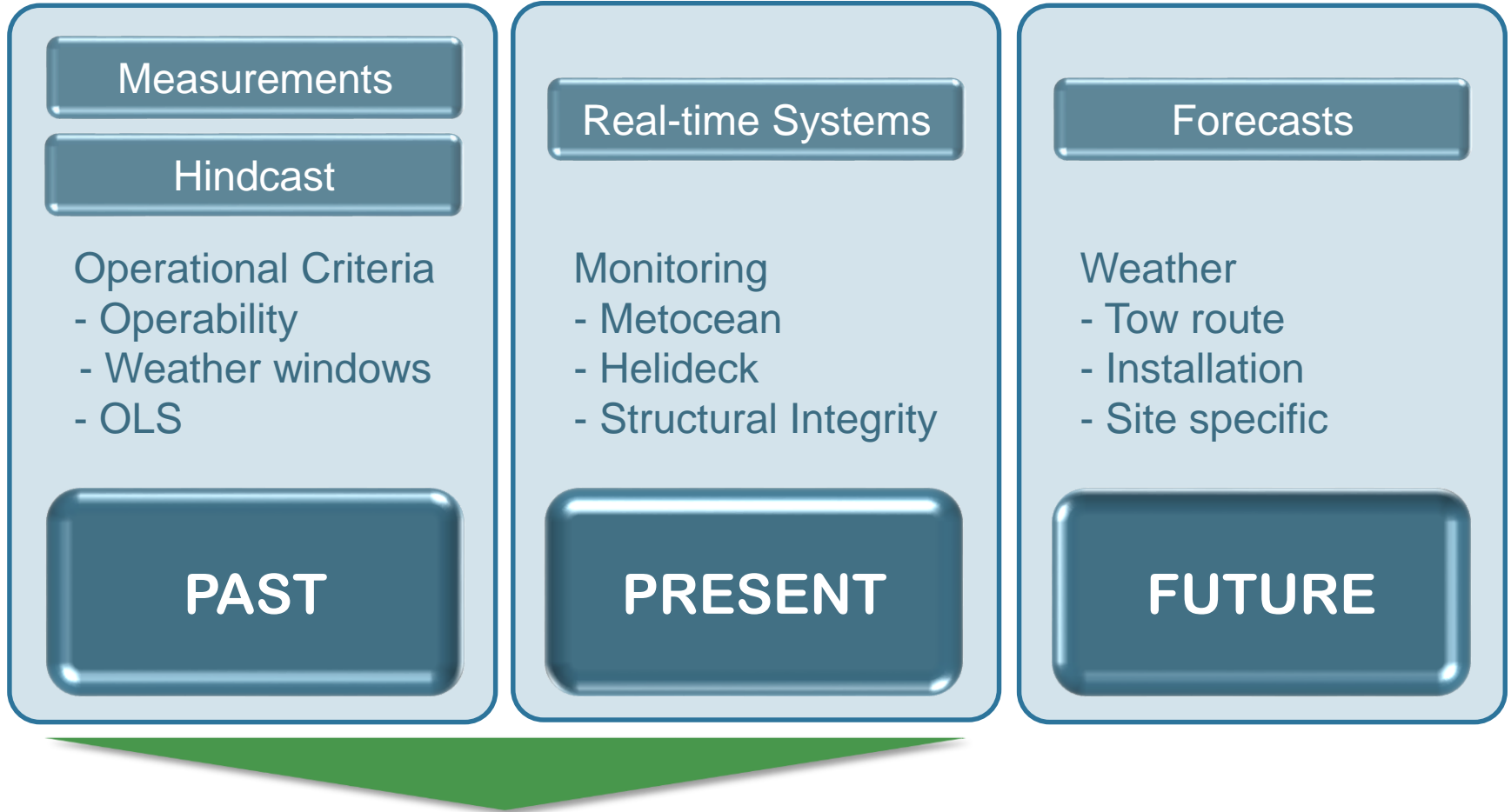
Example:
Smart Mooring Integrity Monitoring

Motivation:

Numerous mooring line failures worldwide, many initially undetected.

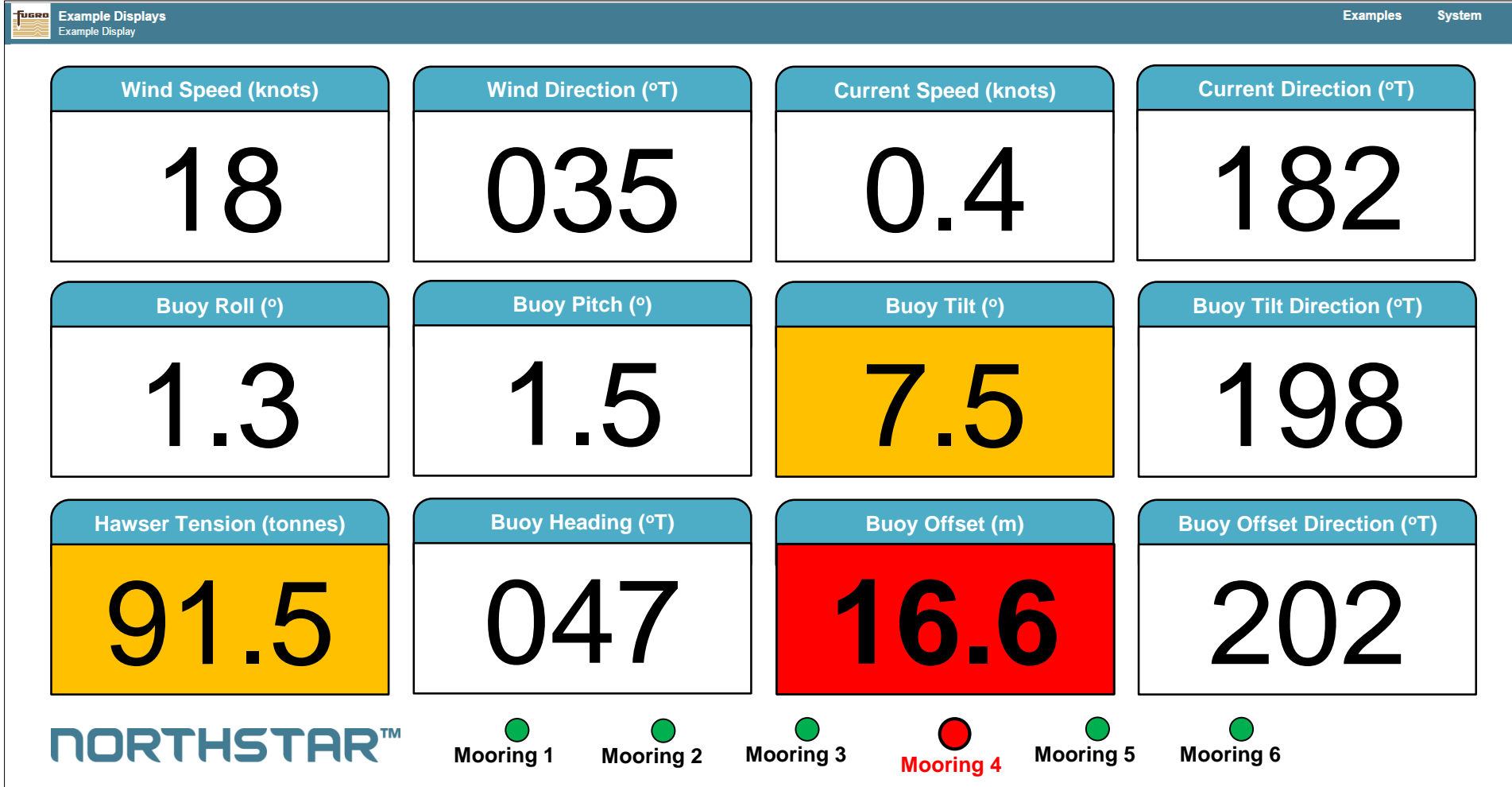Existing hardwired monitoring systems are expensive and often unreliable.

Opportunity:

Extract that hidden value from existing datasets and systems.

Reduce cost and increase reliability of mooring integrity monitoring.
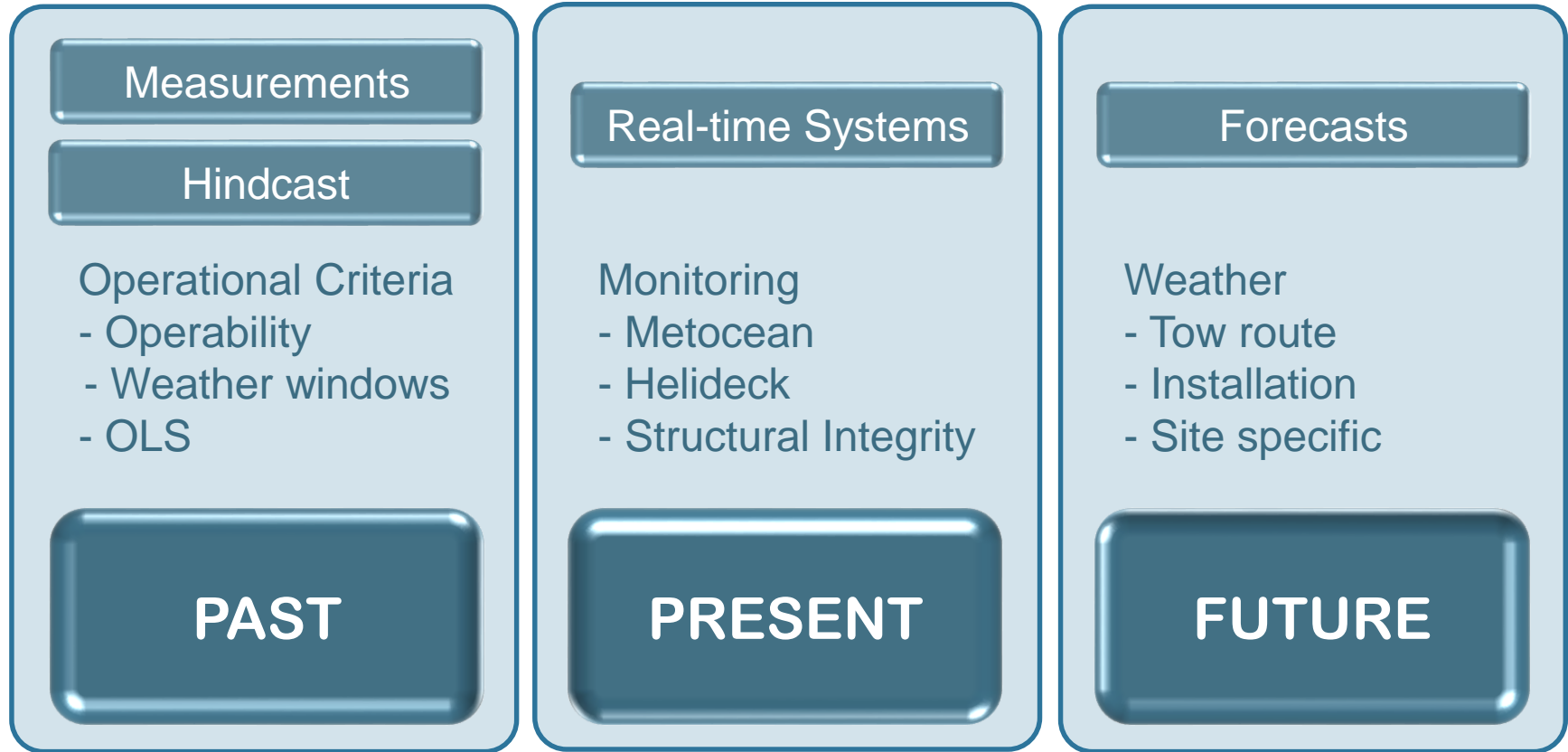
Solution:

Use Machine Learning algorithms applied to real-time measurements from sensors on the facility topside: Metocean, position, response, draft & structural.

Algorithms learn the normal intact behaviour of the system in place and are capable of detecting anomalies synonymous with line failure.
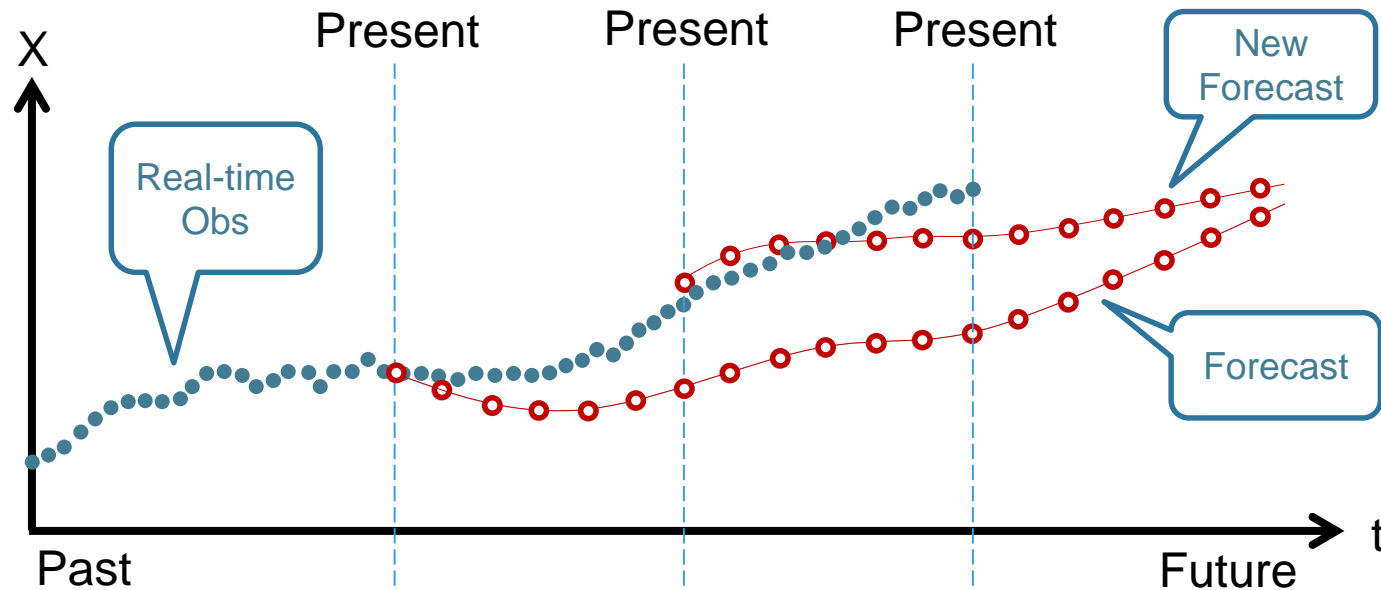
Applications:

Potentially any permanently moored vessel. System anomaly detection.

Asset Integrity: Mooring Monitoring

Example Displays
Example Display

Examples   System

Wind Speed (knots)	Wind Direction (ºT)	Current Speed (knots)	Current Direction (ºT)
18	035	0.4	182

Buoy Roll (º)	Buoy Pitch (º)	Buoy Tilt (º)	Buoy Tilt Direction (ºT)
1.3	1.5	7.5	198

Hawser Tension (tonnes)	Buoy Heading (ºT)	Buoy Offset (m)	Buoy Offset Direction (ºT)
91.5	047	16.6	202

NORTHSTAR™

● Mooring 1   ● Mooring 2   ● Mooring 3   ● Mooring 4   ● Mooring 5   ● Mooring 6

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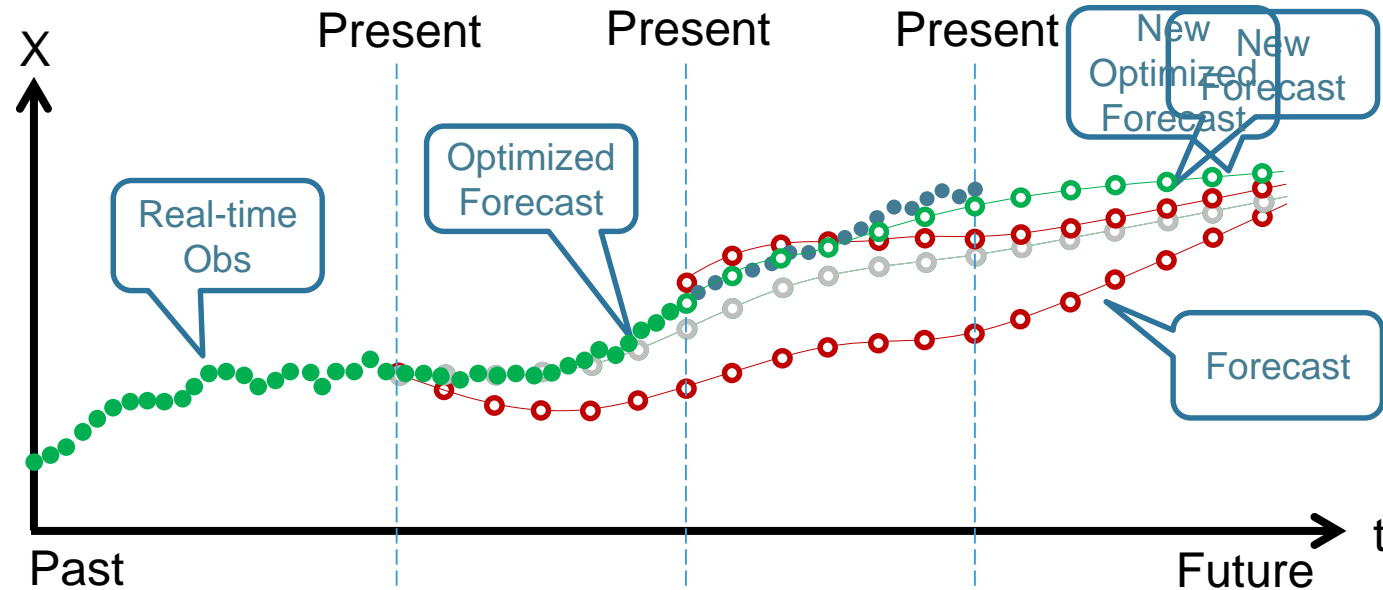- Tow route
- Installation
- Site specific
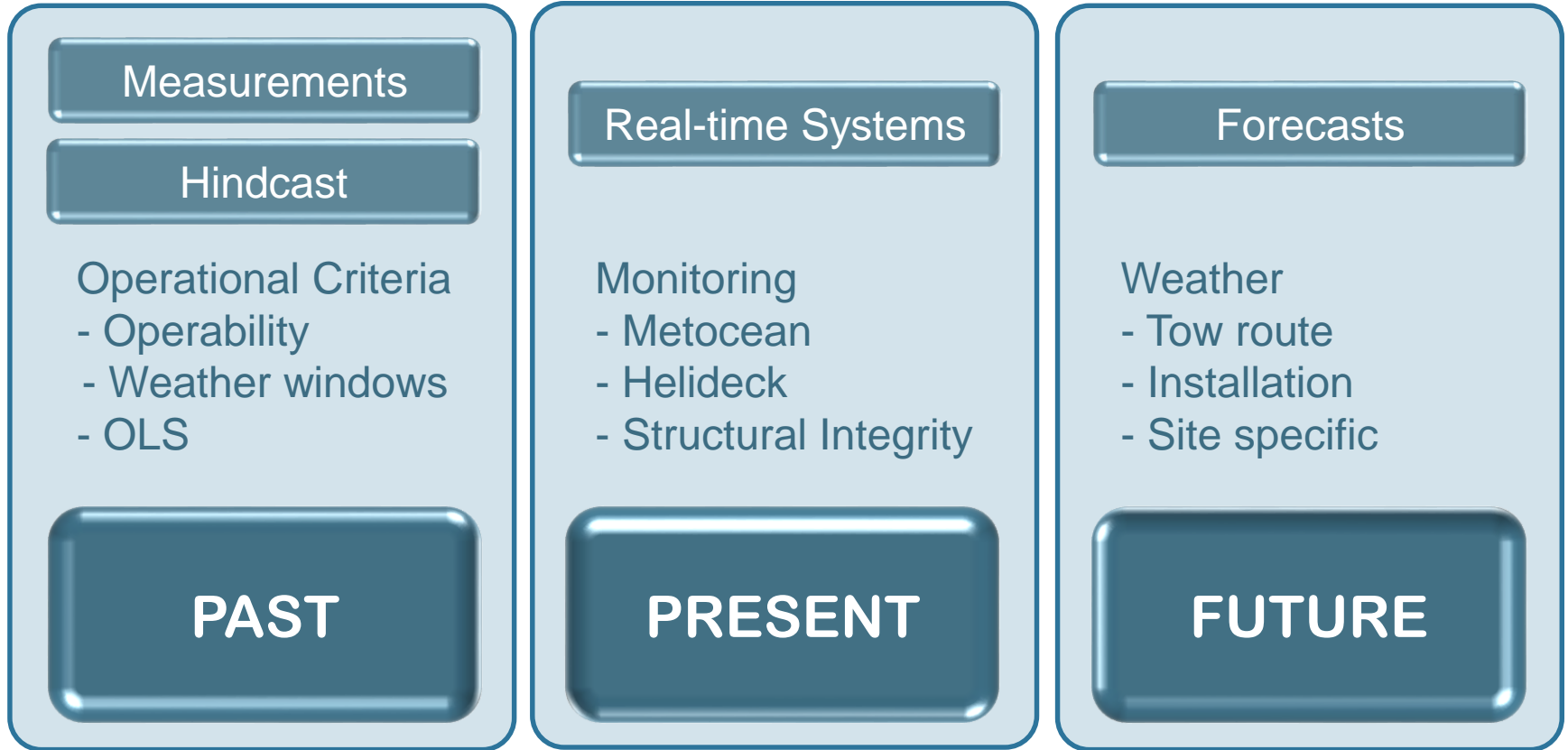
FUTURE

**Example:
Optimized Weather Forecasting**

1. Location with real-time observations of Metocean parameter, X (e.g. wave, wind)
2. Forecast bulletin issued based on output from numerical models and forecaster
3. New observations acquired – user qualitatively evaluates forecast performance
4. Prior forecast superseded by updated forecast bulletin
5. More observations acquired with forecasts updated on 6/12/24hr intervals …

1. Location with real-time observations of Metocean parameter, X (e.g. wave, wind)
2. Forecast bulletin produced based on output from numerical models (and forecaster)
3. Forecast optimized using recent observations and trained ML algorithm
4. More observations acquired
5. New forecast produced by models (and forecaster)
6. New optimized forecast produced and issued…Process continues…

Measurements

Hindcast

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FUTURE

Data integration is an enabler for data-driven Operational Oceanographic technologies.

- The renewed focus on technological innovation.

- Domain knowledge (Science & Engineering) together with Data Science (Analytics) is vitally important in developing data-driven Operational Oceanographic technologies.

- Industry forums, like the FOO and others, are among the best places for minds to meld and spark ideas.

Thank You

s.foster@fugro.com