WÄRTSILÄ

ISLA June 15th 2021

LEVERAGING AI TO MAKE EQUIPMENT EXPERTS MORE PROACTIVE

Content

- Wärtsilä
- Service Activities
- Asset Management
- Paradigm Shift
- Leveraging Expertise
- Working Principle
- Falling 3 paradox
- A few examples
- Future outlook

WÄRTSILÄ

CLEAN ENVIRONMENT
A future without emissions or pollution

ENERGY INTELLIGENCE
An optimized way of producing and using energy

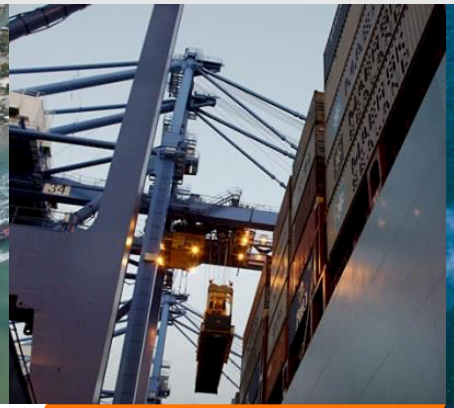
MARKET SHAPING & INNOVATION
A union of new technology and business models

WÄRTSILÄ'S PURPOSE

is to enable sustainable societies with smart technology

WÄRTSILÄ

Our offering covers all market segments


OIL & GAS	MERCHANT	CRUISE & FERRY	NAVY	SPECIAL VESSELS

LEADER IN: EFFICIENCY • GAS AND DUAL-FUEL SOLUTIONS • ENVIRONMENTAL SOLUTIONS

THROUGH OFFERING:

- **Lifecycle solutions** for ship owners and operators
- **Integrated solutions** for the shipbuilding industry, owners and operators
- The **best customer value and customer experience** in the marine industry

ENERGY SOLUTIONS THE LEADING ENERGY SYSTEM INTEGRATOR

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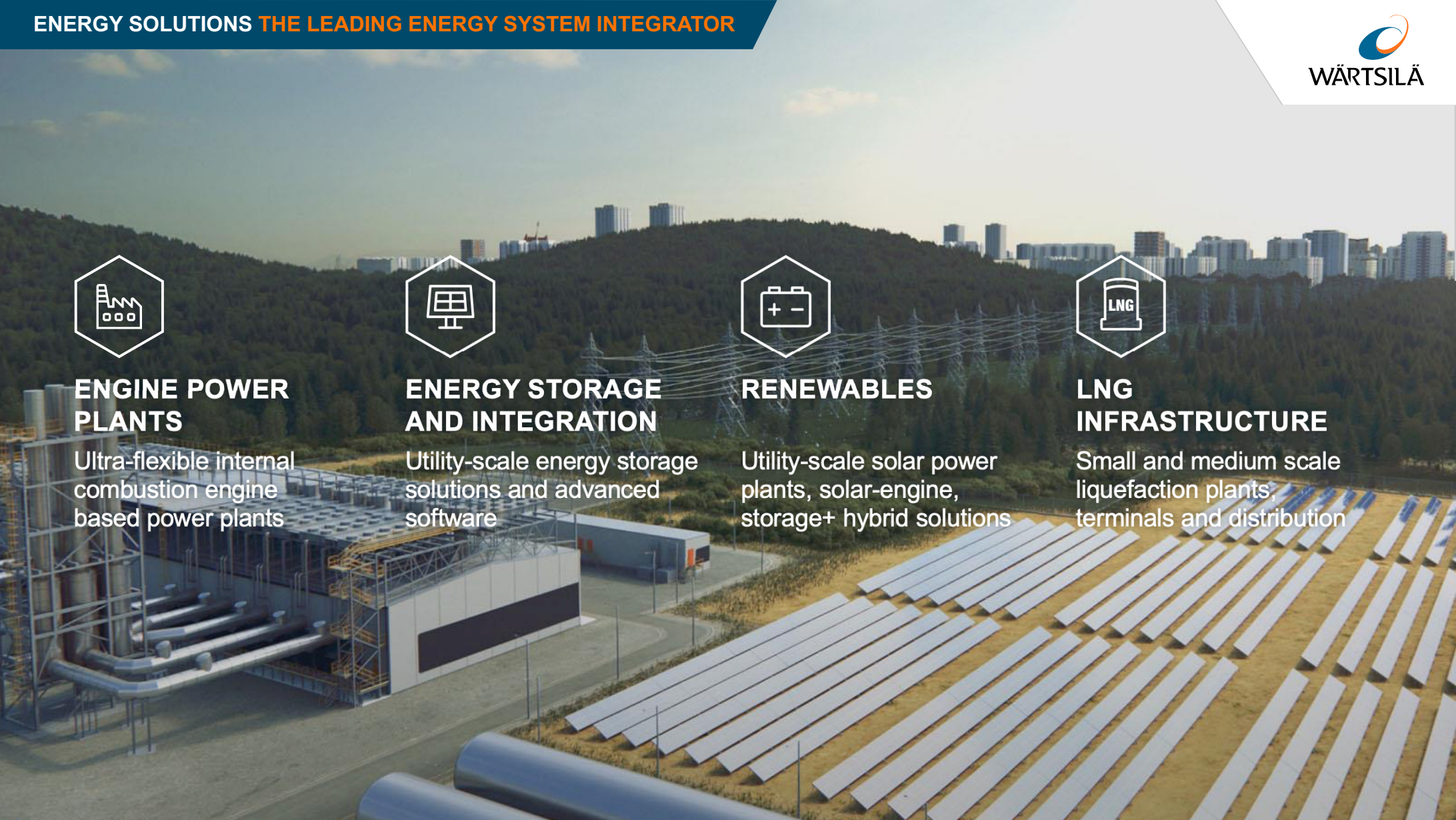


ENGINE POWER PLANTS

Ultra-flexible internal combustion engine based power plants

ENERGY STORAGE AND INTEGRATION

Utility-scale energy storage solutions and advanced software

RENEWABLES

Utility-scale solar power plants, solar-engine, storage+ hybrid solutions

LNG INFRASTRUCTURE

Small and medium scale liquefaction plants, terminals and distribution

CUSTOMER BASE

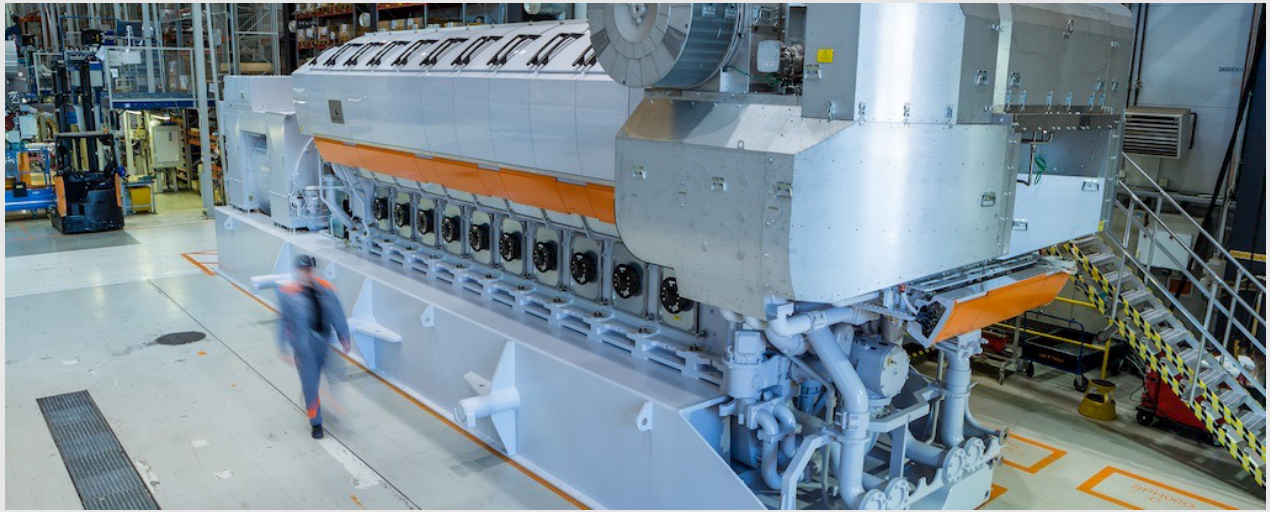
- 182,000 MW
- > 800 installations covered by lifecycle solution agreements
- 2,600 customers manage their 22,500 installations through Online Services

REACH AND EXPERTISE

- 11,000 service professionals
- Certified and extensive OEM experience
- Comprehensive digital approach for optimising operations and enabling growth

Asset Management

- Asset Management
- Preventive Maintenance
- Predictive Maintenance
- CM and CBM



A new Wärtsilä Engine

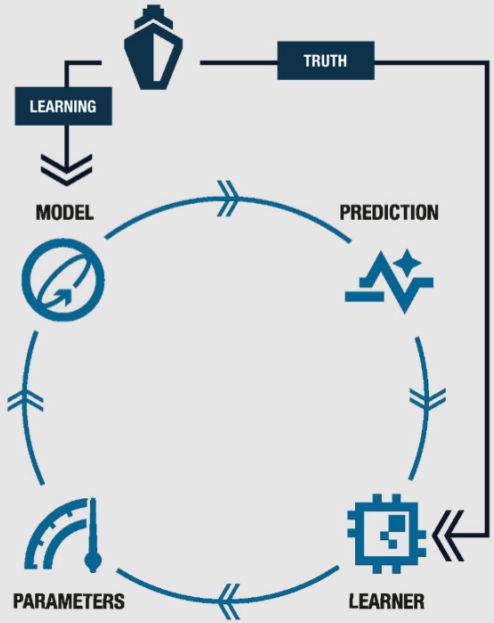
Paradigm Shift

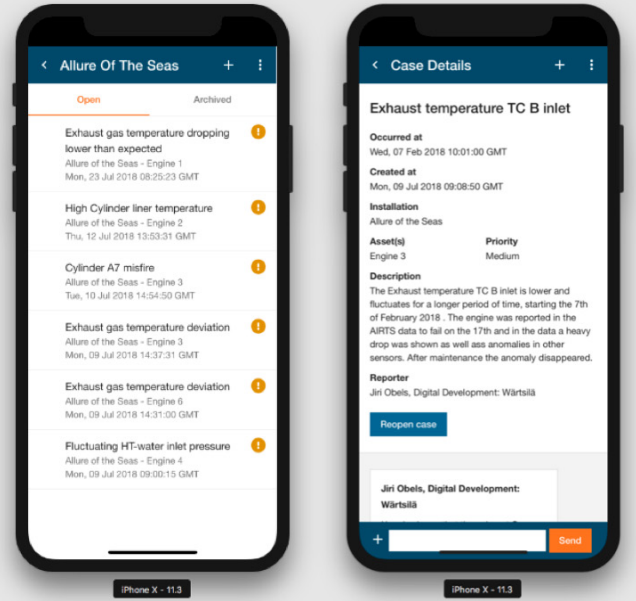
Paradigm shift in predictive maintenance enabled by new technologies

From	To
engineering rules	self-learning ML algorithms
point solutions	holistic solutions
experts crunching data	experts supporting customers
periodic reports	real-time collaboration
reactive troubleshooting	proactive support and optimisation

Leveraging Expertise

- Artificial Intelligence techniques are used to **predict operational parameters** at any given time.
- Deviations between actual and predicted values are used to **generate anomalies**.



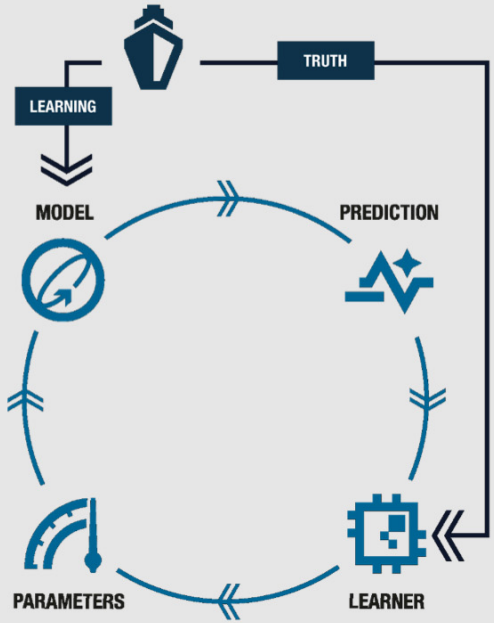


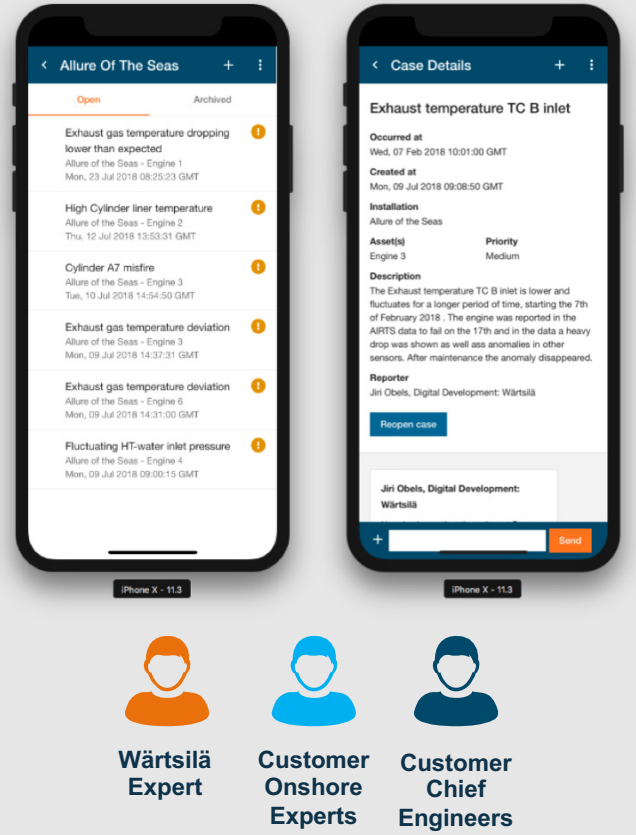
Wärtsilä Expert | **Customer Onshore Experts** | **Customer Chief Engineers**

Leveraging Expertise

- Equipment **experts review the anomalies and provide a diagnosis** and recommendation in a collaboration application.

- Application allows **easy collaboration between experts and operators** enabling better asset management decisions



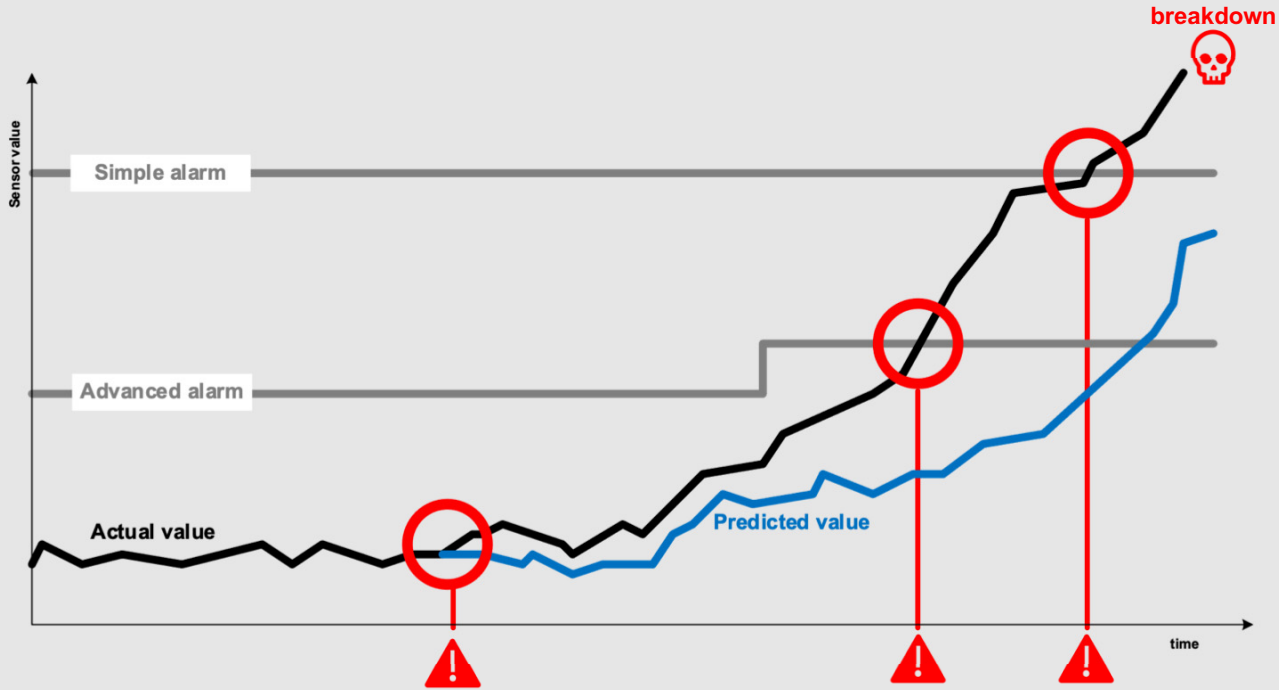


Wärtsilä Expert

Customer Onshore Experts

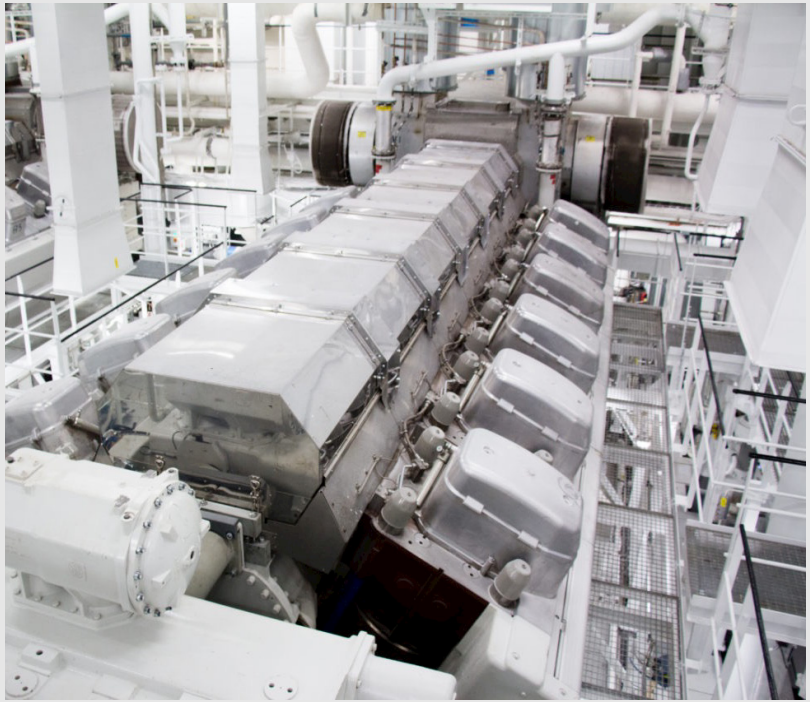
Customer Chief Engineers

Early Detection



Results Proof-Of-Principle

On two cruise vessels with in total 10 W46 engines



W46 on a cruise vessel

30

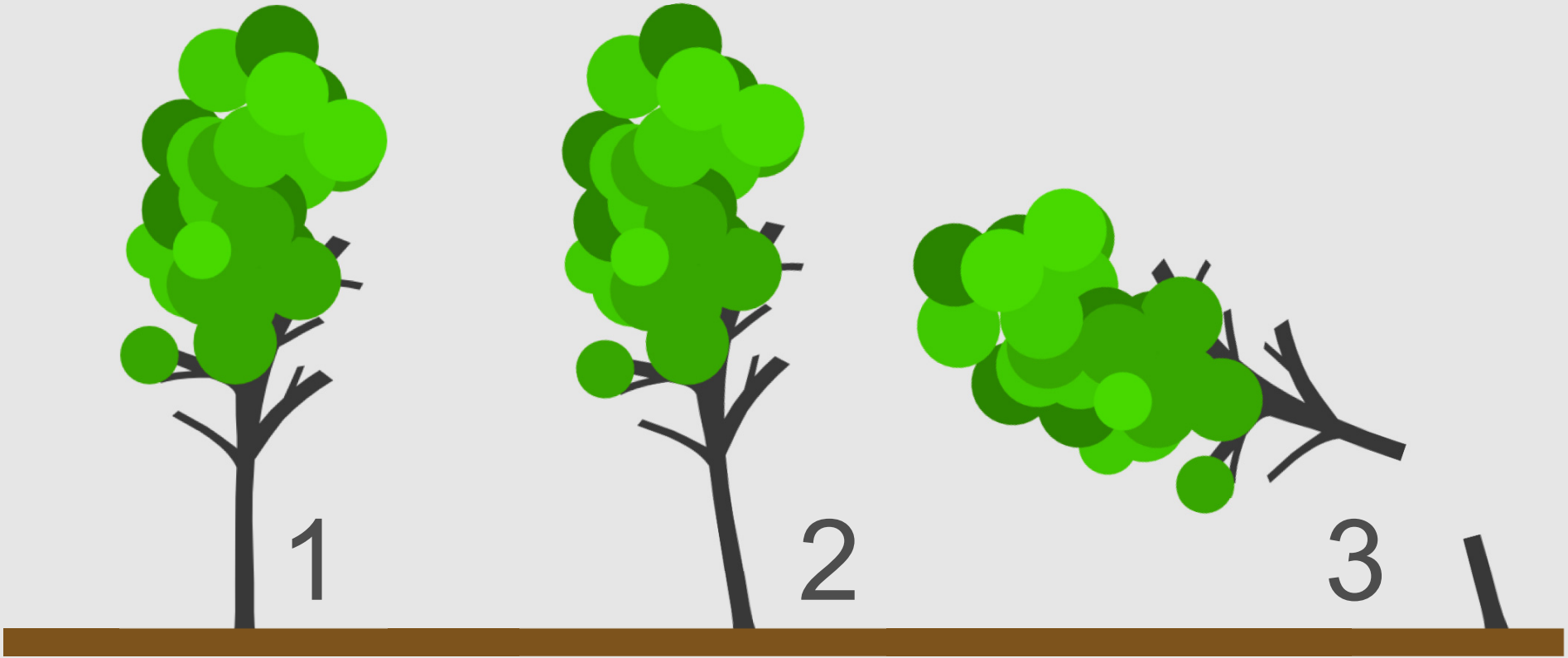
Whilst receiving live data in 8 weeks with 180 comments

5 Cases	10 Cases	15 Cases
Potential failures detected	Excess fuel consumption detected	Other

Results proof-of-principle

Falling tree paradox

Degradation of asset until break-down

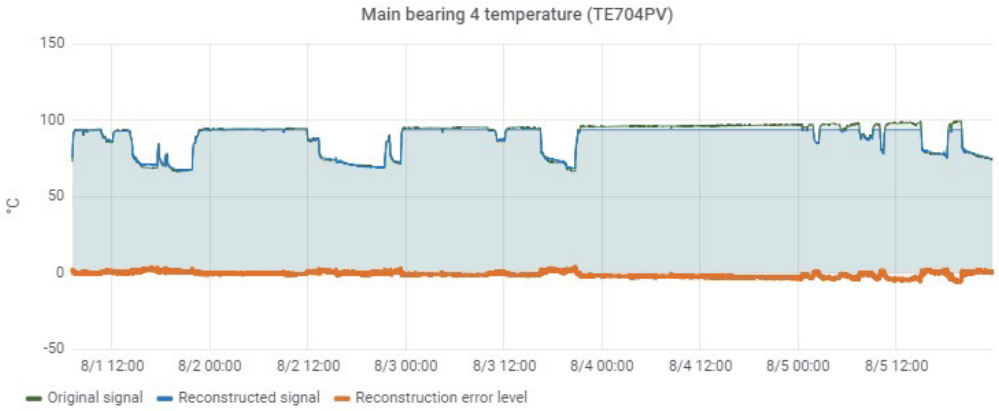


Falling tree paradox

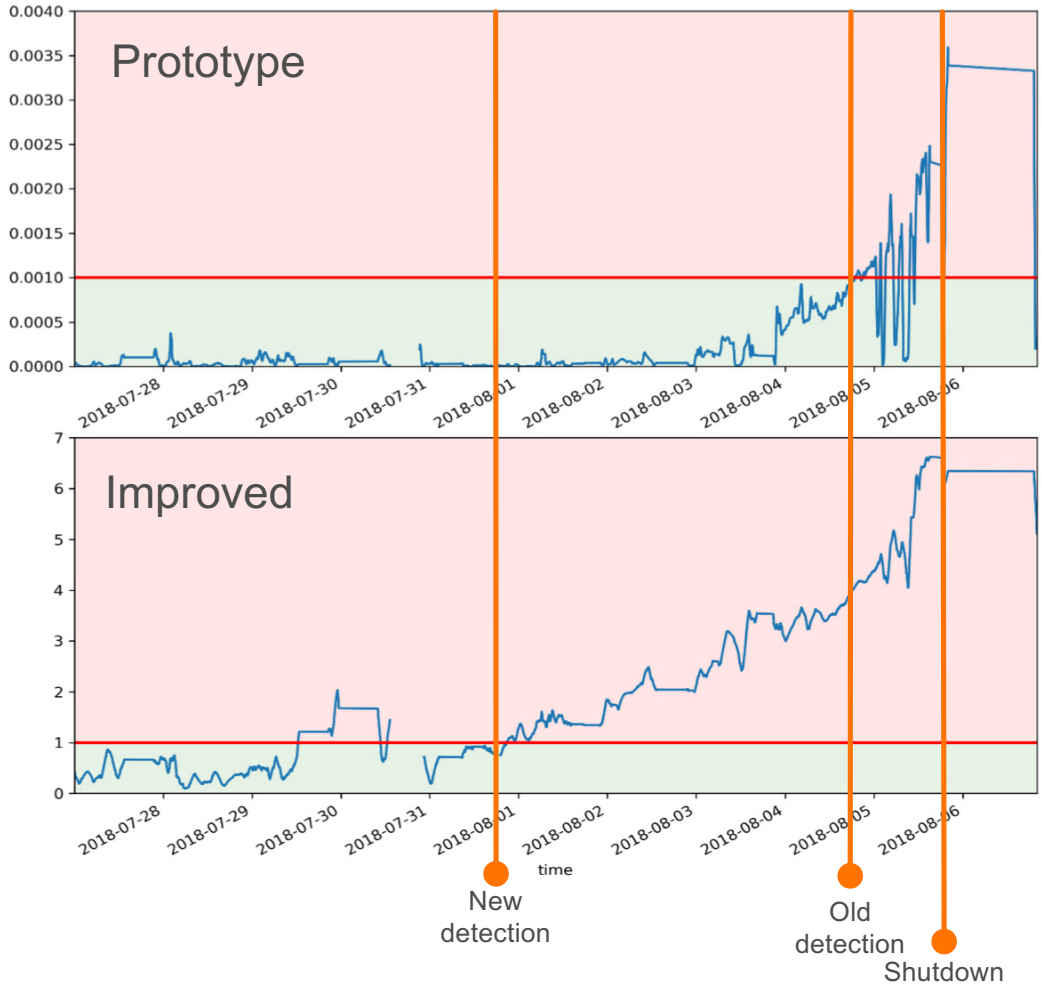
The best condition monitoring systems get the least attention

Example 1 of 3

- Cause: Fuel in lubrication oil
- Effect: Unplanned-downtime
- Early warning: From 0 day to 5 days

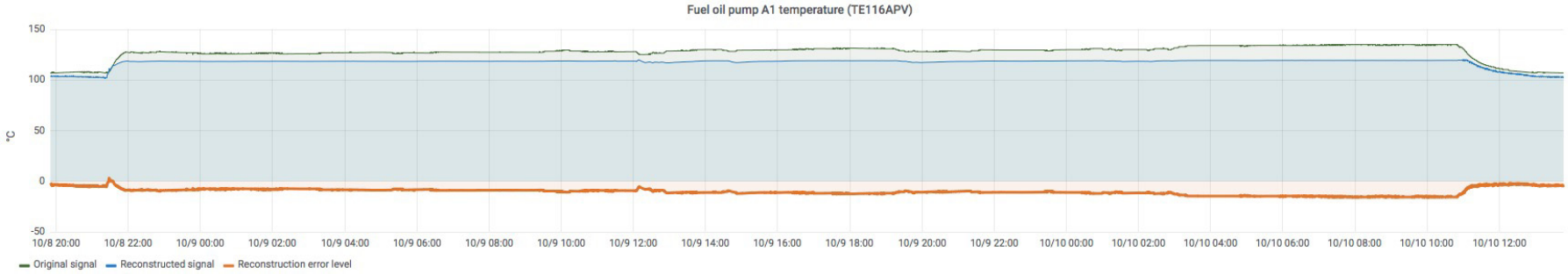


Trend of actual and predicted signal



Example 2 of 3

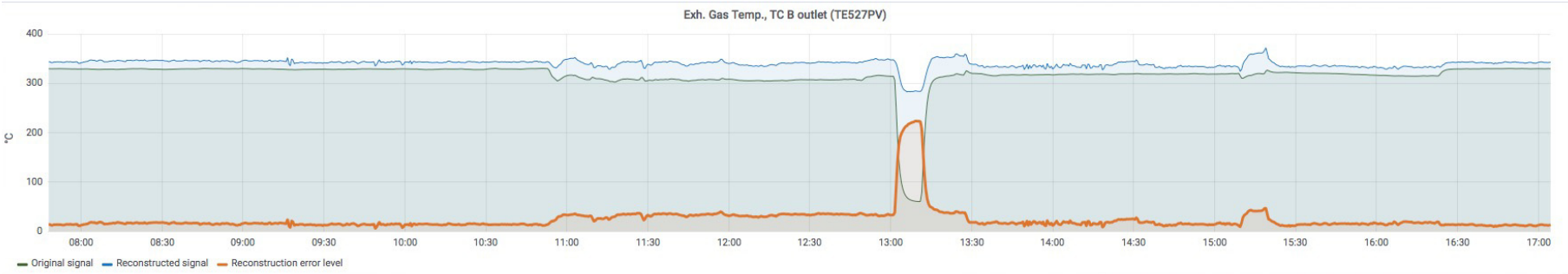
- Detected unexpected temperature increases of the fuel pump
- Actions taken by vessel crew:
  - Pump is checked and the **delivery valve spring** was found **broken** and the **steam valve** was **stuck**
- Potential consequences if not found:
  - Engine **can't run on high load** (>85%); when this higher loads are tried the engine probably will **shutdown**
  - Consequential damage: parts of the valve spring could end up in the injectors which will cause an **immediate engine shutdown**



Trend of actual and predicted signal

Example 3 of 3

- Detected **abnormal turbocharger washing**, diagnosed malfunctioning valve
- Actions taken by vessel crew:
  - Inspected washing valve and valve was fixed
- Potential consequences if not found:
  - Turbocharger will get stuck due to carbon deposits and need to be **opened up and cleaned** which is **more effort and downtime** of the engine compared to washing the turbo chargers



Trend of actual and predicted signal

Future outlook

- Integrate to maintenance strategies
- Adding additional equipment types
- Adding additional layers of intelligence