KONGSBERG

Kongsberg Digital EmPower Wind

Eirik Skare

VP Sales & Marketing
Renewables & Utilities
Kongsberg Digital

Kongsberg active partner in Nowitech

- Kongsberg introduction
- Kongsberg EmPower
- Kongsberg as an active partner in Nowitech

203 years
of technology innovation

FROM DEEP SEA TO OUTER SPACE

Kongsberg
business areas

KONGSBERG MARITIME

Global market leader within offshore, merchant marine and subsea applications

KONGSBERG DEFENCE SYSTEMS

Modern product portfolio in growing defence and aerospace niches

KONGSBERG PROTECH SYSTEMS

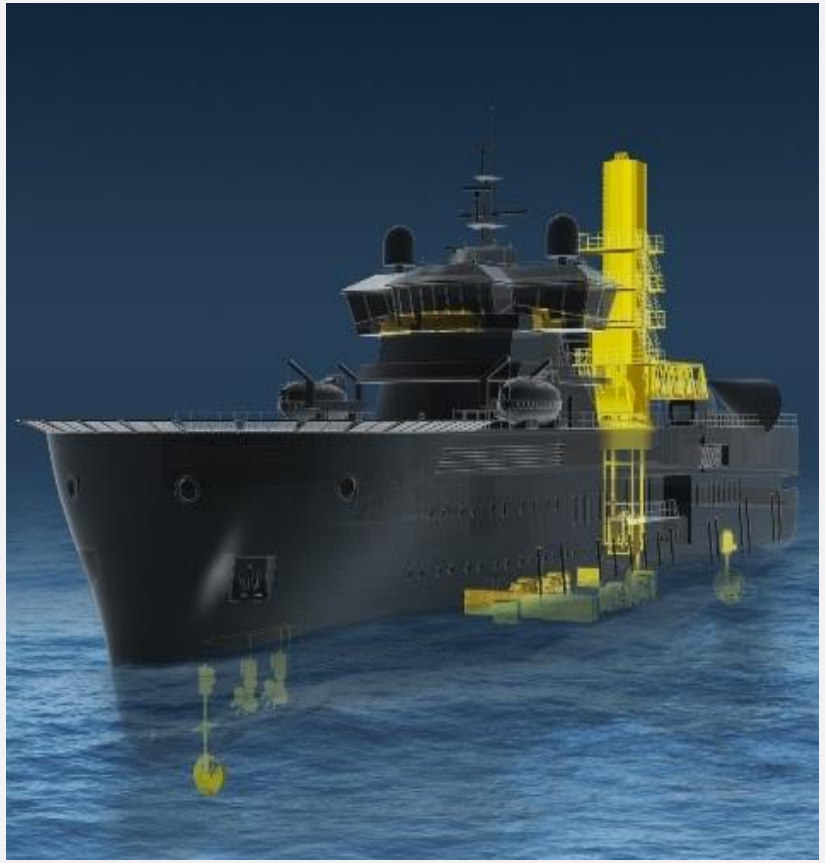
Global market leader in remote weapon stations

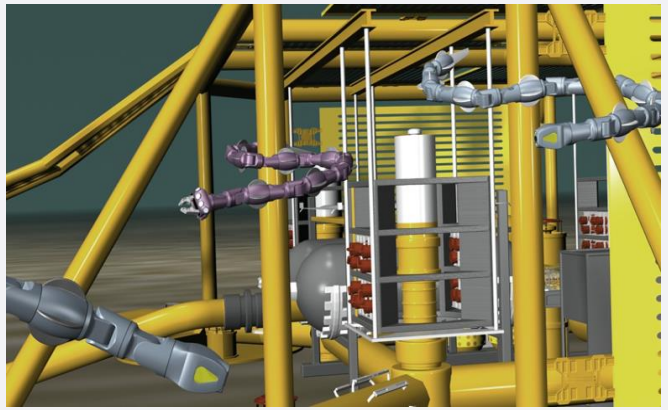
KONGSBERG DIGITAL

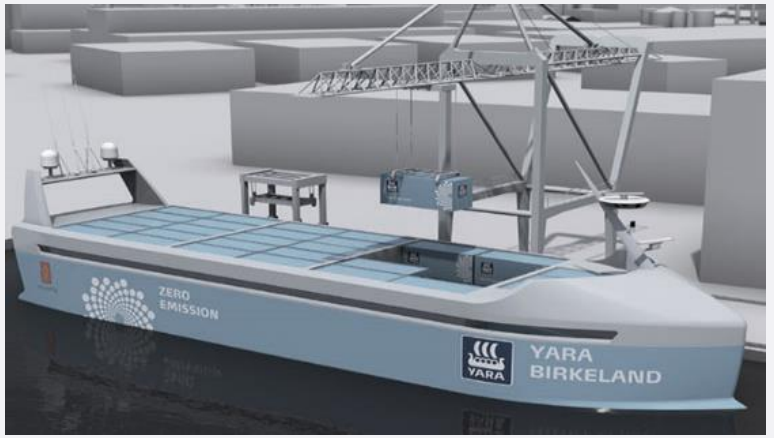
Developing the next generation of digitalized products and services

innovation
driving new opportunities

KONGSBERG







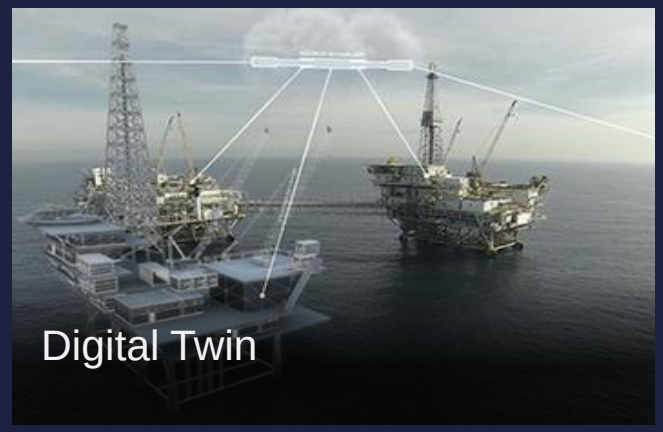
kognif ai

KONGSBERG DIGITAL
KEY FOCUS AREAS

maritime | oil & gas | renewables | utilities

kognif ai open digital platform ecosystem

KONGSBERG DIGITAL APPLICATION AREAS



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Technology
Kongsberg EmPower

Kongsberg EmPower

Condition Monitoring

Condition based maintenance
Detection of early degradation
Minimize unscheduled service and down time

Production Forecasting

Prediction and decision support for trading in the intraday and day ahead market

Performance Monitoring

Performance overview at portfolio, farm and turbine level. Identifying under performing turbines and lost production

Wind Farm Control

Control for grid code compliance. Site specific control. Control for increased energy yield and load reduction. Wake control

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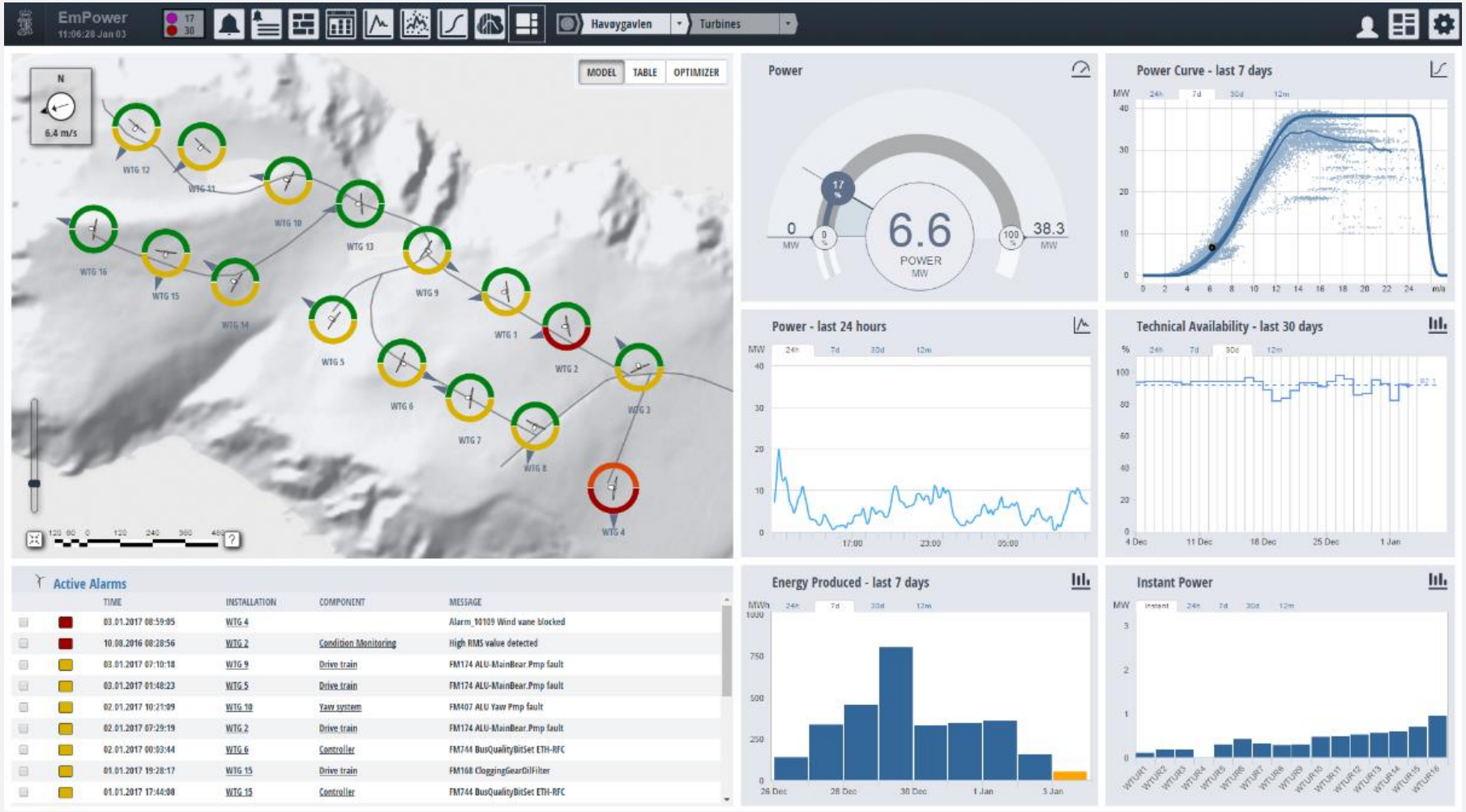

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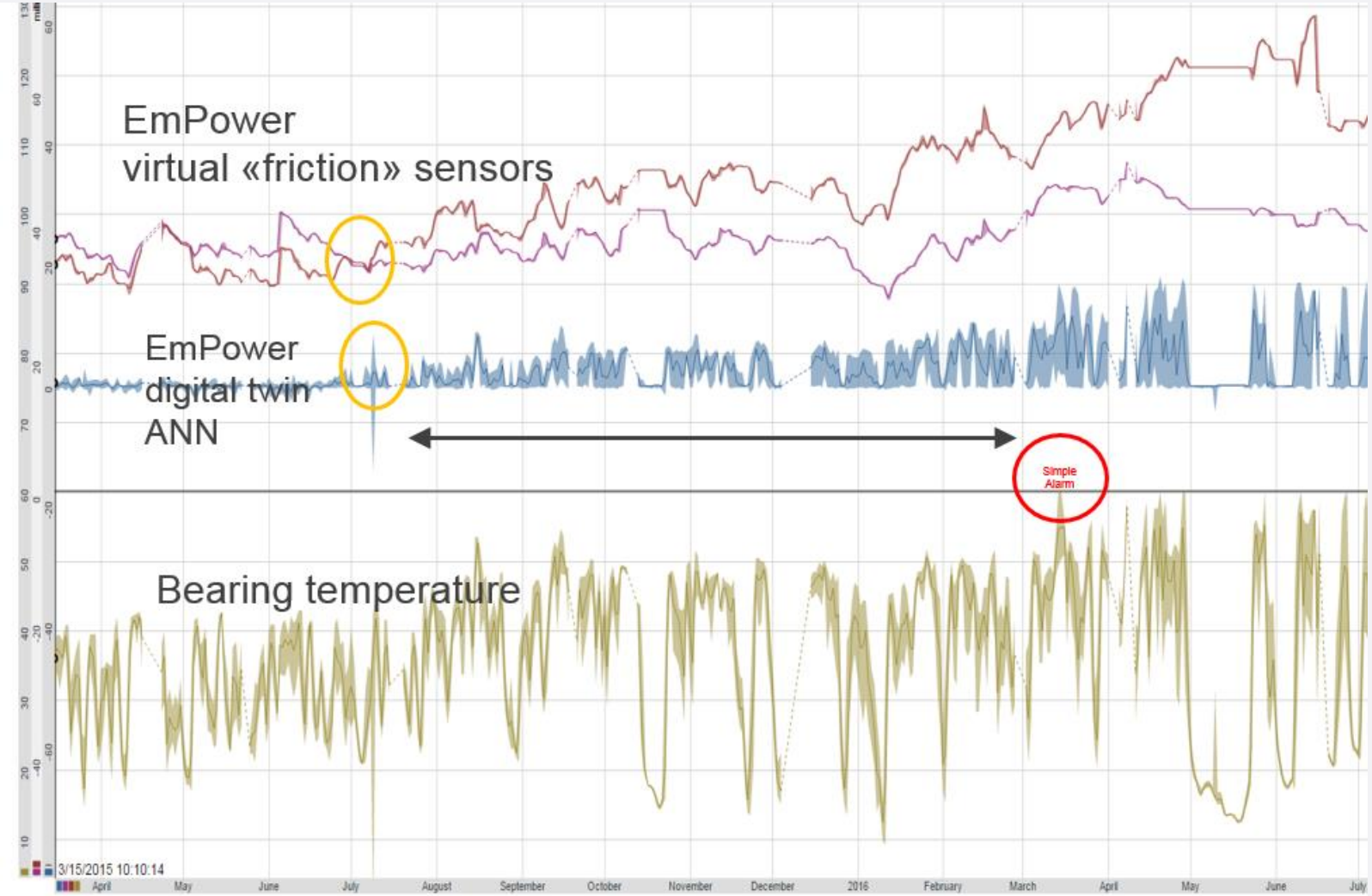
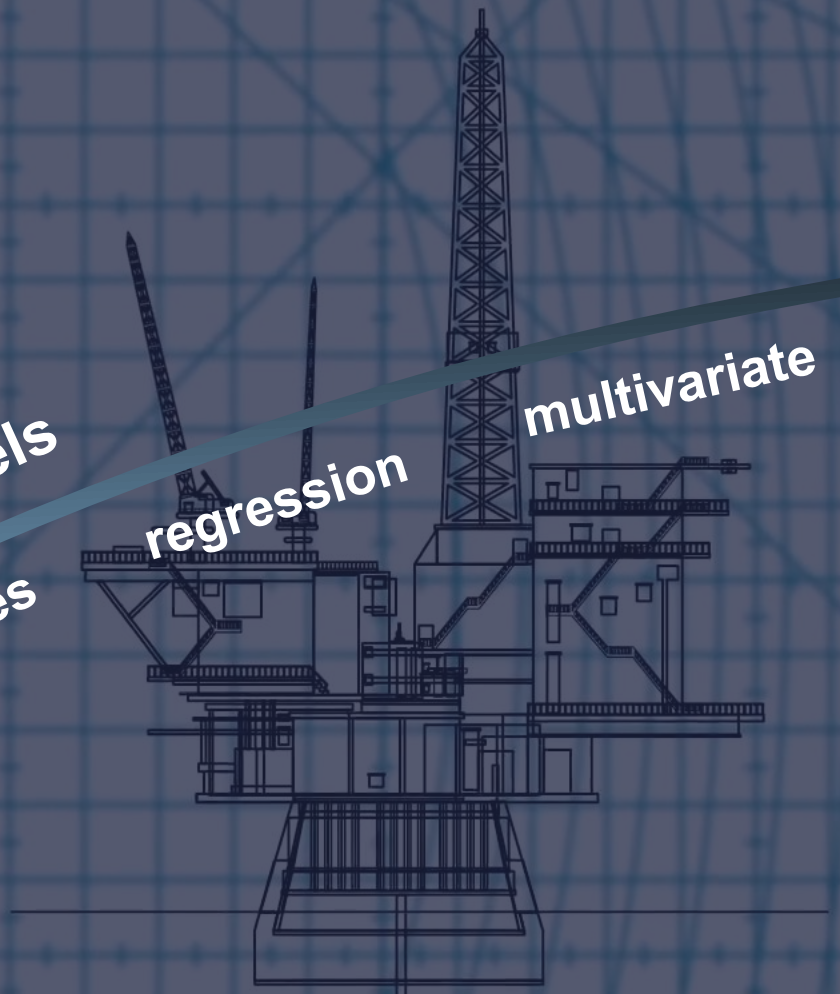


advanced analytics



data driven

artificial neural networks

multivariate

regression

physics models

first principles

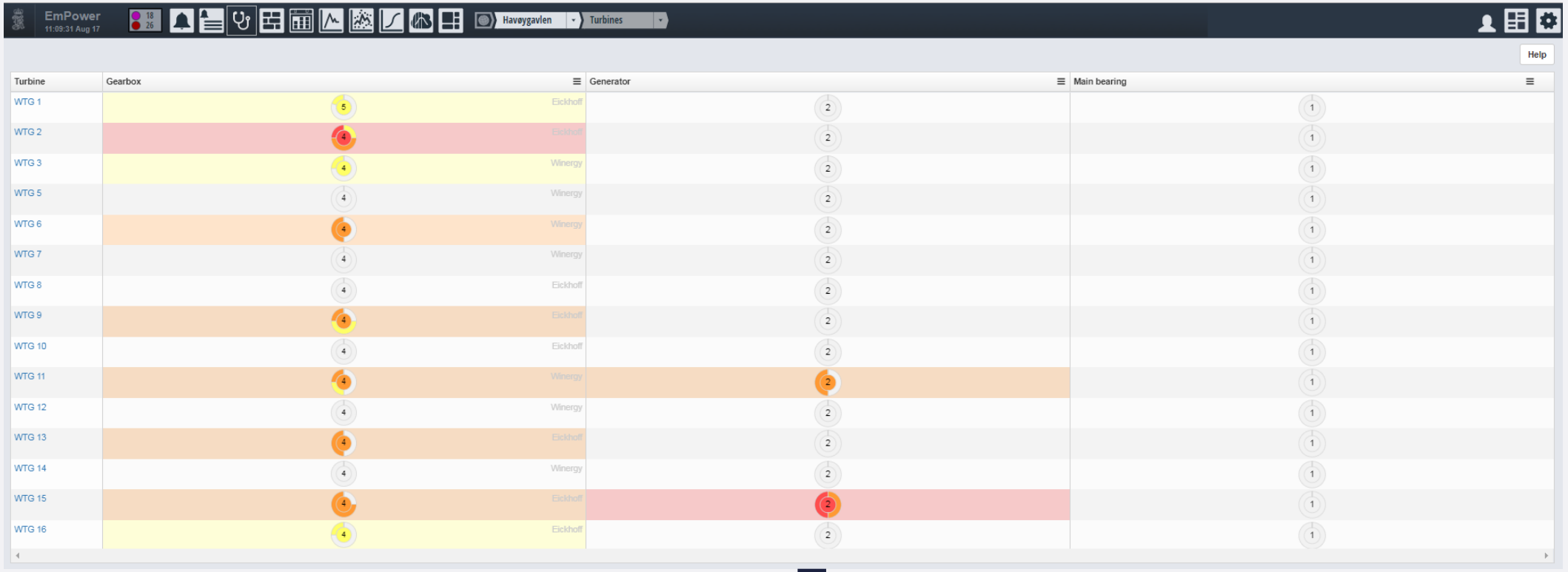
virtual sensors

structural models

machine learning tools

Condition Monitoring

RUL + CBM – online analytics



Turbine	Gearbox	Generator	Main bearing
WTG 1	5 Eickhoff	2	1
WTG 2	4 Eickhoff	2	1
WTG 3	4 Winergy	2	1
WTG 5	4 Winergy	2	1
WTG 6	4 Winergy	2	1
WTG 7	4 Winergy	2	1
WTG 8	4 Eickhoff	2	1
WTG 9	4 Eickhoff	2	1
WTG 10	4 Eickhoff	2	1
WTG 11	4 Winergy	2	1
WTG 12	4 Winergy	2	1
WTG 13	4 Eickhoff	2	1
WTG 14	4 Winergy	2	1
WTG 15	4 Eickhoff	2	1
WTG 16	4 Eickhoff	2	1

Early fault detection
Fault classification
Maintenance planning
Work order scheduling

EmPower @Hywind demo

RUL + CBM – online analytics

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Deliverables:

- RUL for Drivetrain Components
- Soft Sensor Opportunities
- CBM Strategy

Main aims are:

- Reduce Downtime to Increase Production
- Make Unscheduled Maintenance into Planned Maintenance
- Introduce RUL and level of wear estimation for maintenance planning

PO.145

Value opportunities from Operational Data Condition Monitoring and Predictive Analytics

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Statoil New Energy Solutions/ Kongsberg Digital

Statoil

enova

Abstract

Wind industry has over the past years had limited access to operational data. However, all windfarm owners should have access to the vast amount of data from their operating assets. Some of the more active owners have taken learnings from other industries and established a standard Information Management System (IMS) for the windfarms. These systems enable storage and analysis of park performance and should open up for more predictive analytics related to turbine and balance of plant performance. The current condition monitoring systems are limited to vibration analysis and cannot be used to monitor the performance of all sub-systems. The wind industry phases a challenge when it comes to demonstrate additional value creation from operational data from the IMS or vibration monitoring system. Currently we us the data to challenge our service providers, if we do not perform maintenance in house, and to quality assure availability calculations. Statoil is active owner that is good in use of data and has proven this valuable, but we need to look for additional value opportunities to make sure that we keep sliding down the cost curve for offshore wind. We have established a demonstration project to test and develop a condition monitoring system, with the aim to predict behavior of the different sub-systems of a wind turbine.

Objectives

- Importance of systematic collection of data from the assets
- Bring the wind industry into the next phase of predictive analytics
- Create additional value from asset by reduced cost/increased production

Electricity produced by wind power is a fast growing industry. Wind farm developers and operators are facing a great competition in the market where focus is on continues decrease in the price/kWh. This results in high demands to CAPEX and OPEX. The turbine price, expected energy production, availability and installation cost is important. The OPEX cost is equally important, because it affect the Cost of Energy during the complete operating time of the wind farm. Therefore it's increasingly important to improve operation and maintenance cost.

The selection of operation and maintenance (O&M) strategy is an important step to optimize on O&M costs. For major and critical components Condition Based Maintenance and predictive maintenance is selected to be the best strategy to optimize cost especially for offshore turbines.

For offshore and remote turbines the ability to do proper maintenance planning will give advances because weather conditions can stop many operations and keep the wind turbine out of operation while waiting on service.

Therefore this project has focus on condition monitoring as an enabler for condition based maintenance and predictive maintenance

Methods

The project consists of three parts. Firstly, to develop systems and algorithms to predict failures and assess remaining useful life (RUL). Secondly, to install additional instrumentation where current signals does not prove to be effective when it comes to predicting failures. Lastly, this information will be used to affect the maintenance program. The goal is to move towards a condition based maintenance program for offshore wind turbines.

Results

The project started in March and will run until October 2017. We have installed systems and done modifications to the instrumentation on the floating wind turbine owned and operated by Statoil. First analysis have started and we have developed good analysis for specific failures and indicators.

Conclusions

The value that we can get from the IMS is underestimated and not utilized effectively. The potential to increase availability by implementing effective failure elimination strategies is large in offshore wind. The effect of unplanned outage is high for offshore wind due to the experienced lack of access to the turbines. Elimination of failures will therefore have a large impact on availability and the production. Main aims are:

- Reduce Downtime to Increase Production
- Make Unscheduled Maintenance into Planned Maintenance
- Introduce RUL and level of wear estimation for maintenance planning

With reduced failure rates the associated cost of operation will also go down if we succeed with this project.

References

1. Norwegian ENOVA have awarded the project and support it financialy. They see a great potential in the technology, both offshore floating wind turbines and condition monitoring systems to bring down operational and maintenance cost of offshore turbines.

offshore WIND ENERGY 2017

Wind EUROPE

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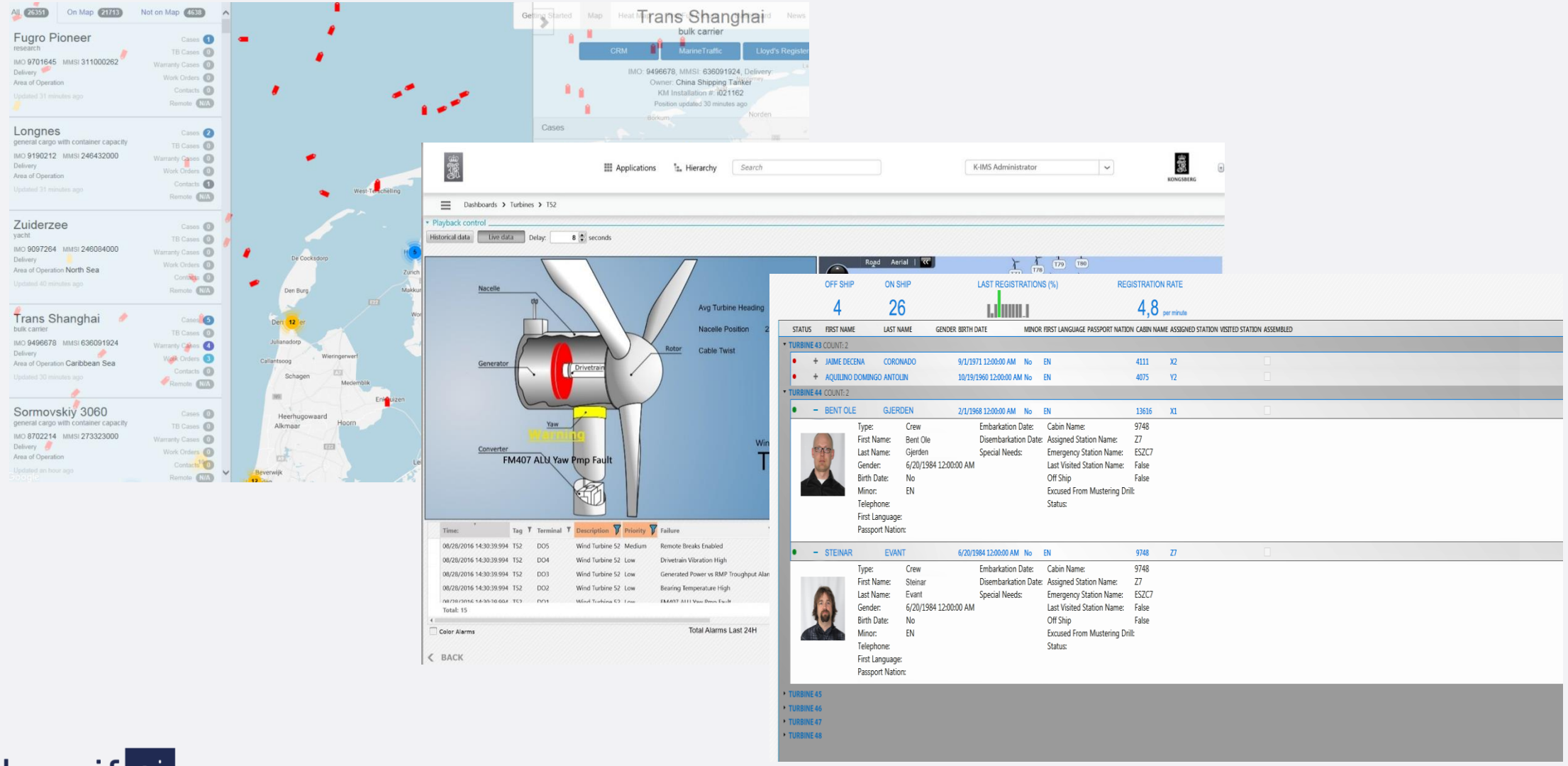
Offshore wind



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a cross industrial open eco system

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Digital Platform Ecosystem Approach

PARTNERS & CONSUMERS

kognifai

RESEARCH & ACADEMIA

AppStore
1st party
Partner
ISV

Digital Twin Fabric

INDUSTRY APPS | INDUSTRY SOLUTIONS | DIGITAL TWIN INNOVATION ARENA

Digital Platform

INDUSTRY PAAS	MICROSERVICES	API'S	OPEN SOURCE FRAMEWORK
DATA CATALOG	TECHNICAL CAPABILITIES	ADVANCED ANALYTICS	INTEGRATION FRAMEWORK

DATA | SEMANTIC | HISTORIAN

IOT GATEWAY

IT
IMS

Industry cluster

IMS
SAS
OT

kognifai

Smart apps for onshore and offshore wind

Personnel Tracking

AIS ECDIS

OEM independent SCADA

Route Planning

Automated Bridge

Condition Monitoring

Performance Monitoring

Production Forecasting

Maintenance Work Order

<...>

Customer apps and solutions

Partner's apps and solutions

Ecosystem & ISV apps

Data Scientists & AI Models

Subsea Maritime Offshore Drilling Production Renewables Utilities

Kongsberg feedback to Nowitech

- Supported industry partners in Norway to create an international business in benefit for Norway and the industry
- Better understanding of industry challenges – operations and maintenance
- Linked the Norwegian wind industry and scientist to the European collages
- Kongsberg - important input to understand industry challenges as input for development of applications for offshore wind on an international arena

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