**Hartelijk welkom bij het
Koninklijk Instituut Van Ingenieurs.**

Webinar: Using ESA as Condition Monitoring Tool

Start Webinar is om 16.25 uur.

Programma 18 maart 2021

Using ESA as Condition Monitoring Tool

16.00 tot 16.25	Inloop deelnemers webinar
16.25 tot 16.30	Introductie door KIVI (Kees Jan Grin)
16.30 tot 17.30	Webinar door Samotics (Derek Benner)
17.30 tot 18.00	Digitale borrel en napraten

Opmerkingen:

Using ESA as Condition Monitoring Tool

- Zet s.v.p. je microfoon uit tijdens het webinar
- Vragen stellen kan maar graag via de chat
- De meeste vragen worden behandeld tijdens webinar
- Vragen die niet beantwoord kunnen worden, zullen schriftelijk worden beantwoord door Samotics
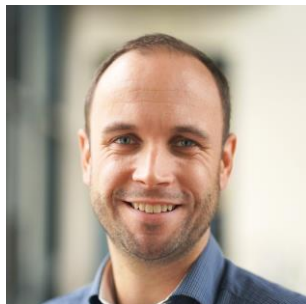- Na het webinar is er nog ruimte om met elkaar verder te praten.

Samotics

Using ESA as Condition Monitoring Tool

KIVI Engineering Society

MAIN DECK

18 March 2021

What's my connection with Condition Monitoring?

Maintenance Engineer
SPIE Nederland
Aug 2016 – Mar 2018 · 1 yr 8 mos
Amsterdam Area, Netherlands

Client: Heineken Brewery Zoeterwoude:
I worked on a project where I reviewed all equipment bill of materials for the complete brewery of Heineken Zoeterwoude. In this project I analyzed the state of bill of materials, proposed improvements, and interacted with suppliers to create a common vision on the way for ...see more

10

8

Samotics
3 yrs

Maintenance Consultant
Mar 2021 – Present · 1 mo
Leiden, South Holland, Netherlands

Helping companies eliminate unplanned downtime on rotating equipment.

Vrije Universiteit Amsterdam
Master of Science (MSc), Business Administration
2013 – 2017

Msc Thesis: How to adapt operations organizations due to Industry 4.0

Maintenance Consultant
Apr 2019 – Mar 2021 · 2 yrs
Leiden, Netherland

Eliminate Unplanned Downtime of Rotating Equipment.

Consultant Maintenance Engineer
Total
Nov 2013 – Aug 2016 · 2 yrs 10 mos
Den Haag

SAM4's algorithms turn data into real-time insights into the health, performance, and energy consumption of assets, to provide insights that help you optimise asset reliability whilst ...see more

Maintenance Engineer
Vector Maintenance Management B.V.
Apr 2013 – Aug 2016 · 3 yrs 5 mos
Total HQ Den Haag

Maintenance Engineer / Business Developer
Apr 2018 – Mar 2021 · 3 yrs
Leiden

Client: Total Exploration & Production Netherlands:
As the team leader of the methods department at Total Exploration & Production Netherlands I performed research on improvement of maintenance strategies on offshore installation processes through reliability research in maintenance. The data for the research was obtained from ...see more

SAM4 is Semiotic Labs' Smart Condition Monitoring solution for AC induction motors and rotating equipment. Unlike traditional tools that use vibration sensors, SAM4 measures electrical waveforms from inside the Motor Control Cabinet, creating a reliable, accurate, and easy to use condition monitoring solution

Hogeschool INHOLLAND
Bachelor of Science (BSc), Mechanical Engineering
2003 – 2008

Van Oord
4 yrs 8 mos

5

Technical Superintendent
Dec 2010 – Dec 2012 · 2 yrs 1 mo

In the role of technical superintendent, at the Van Oord yard in Port Harcourt in Nigeria, I was responsible for the scheduling of dockings, general maintenance and maintaining class for multiple class dredgers and auxiliary equipment. In addition to the technical aspect, I acted as maintenance team leader for the Nigerian local staff on site at the Van Oord yard.   ...see more

0

Junior Technical Superintendent
May 2009 – Nov 2010 · 1 yr 7 mos

During an eight-week period I worked as a superintendent at a dredging project in Santiago de Cuba, Cuba. In this role I was responsible for the daily operational activity of a dredging project including crew transfers, flight arrangements, daily dredging reporting and communication towards the client.   ...see more

13

Trainee Program
May 2008 – Apr 2009 · 1 yr

Agenda

01

Part I
The ways we do maintenance

02

Part II
ROI, business case, and created value

03

Part III
Introduction to ESA

04

Part IV
Use Cases

05

Closing
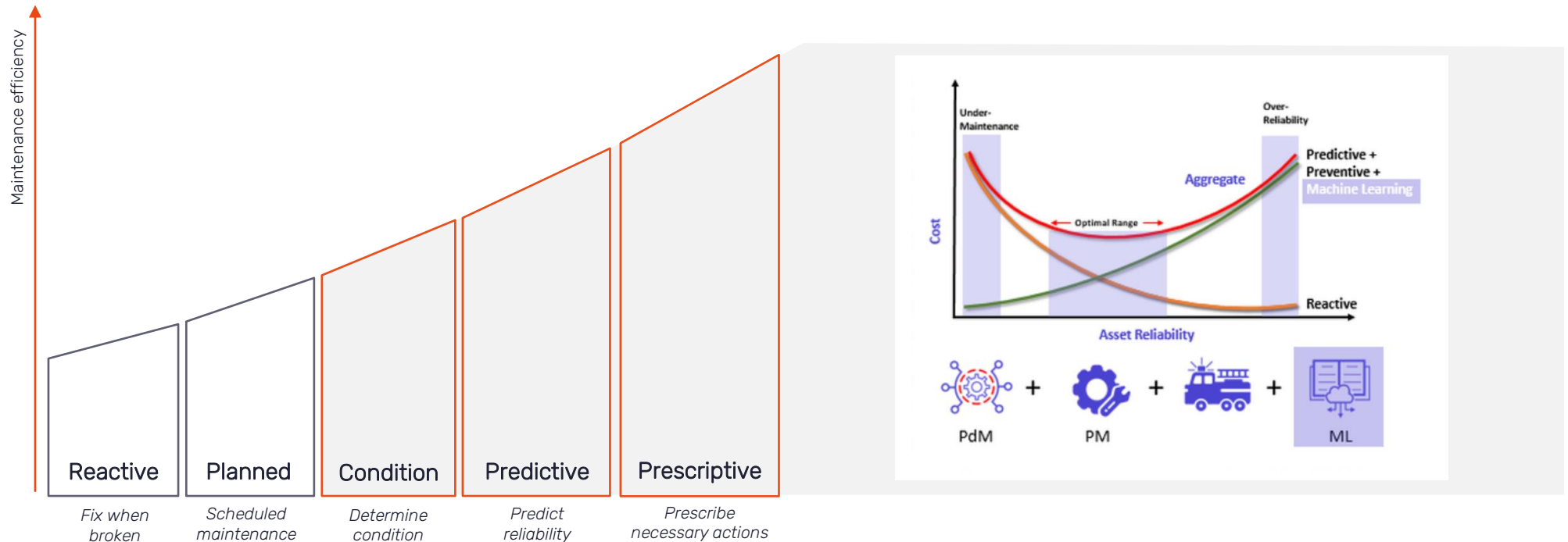Challenges for Condition Monitoring in Maintenance

The ways we do Maintenance
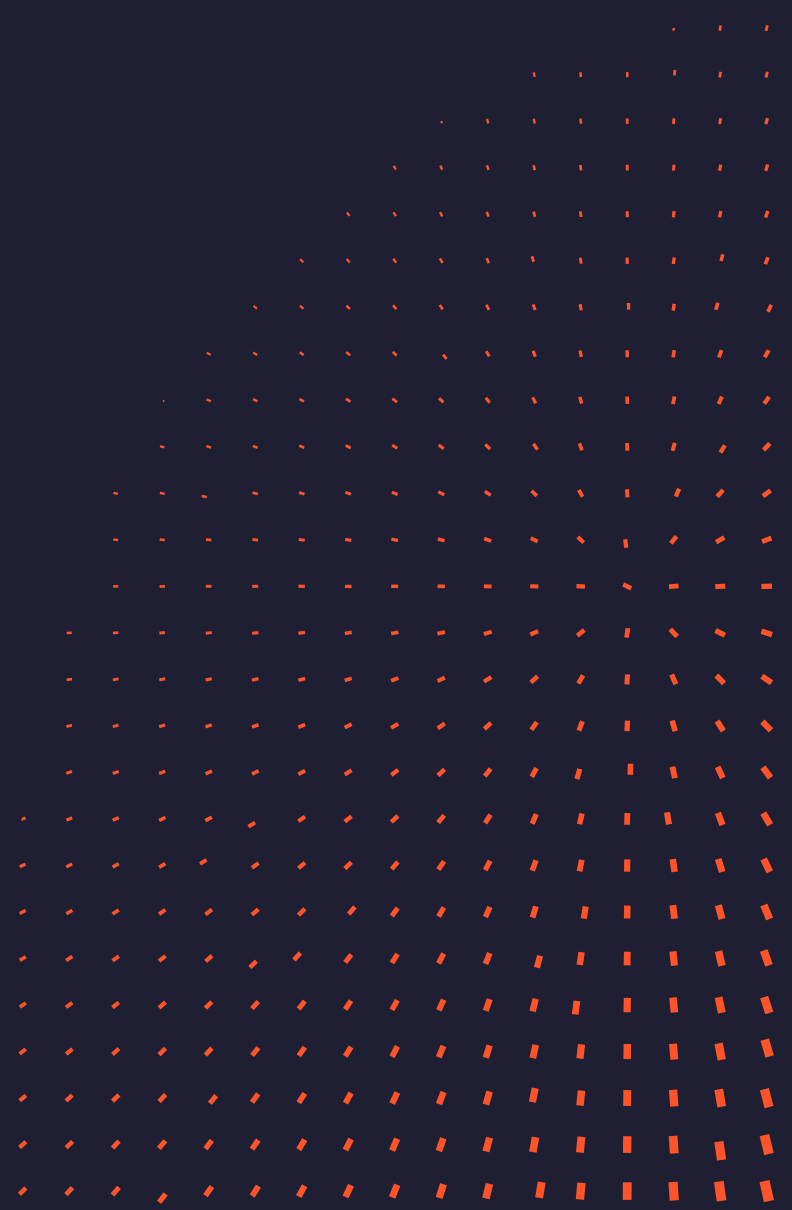
The way we do maintenance is changing

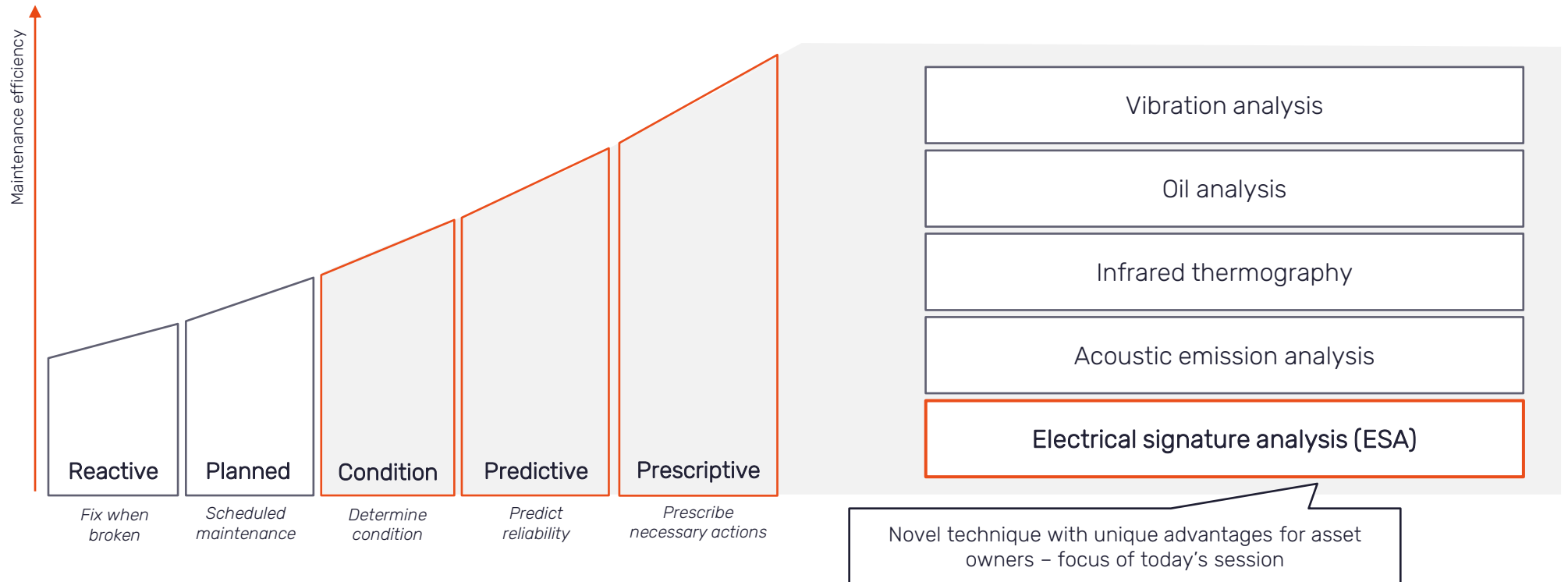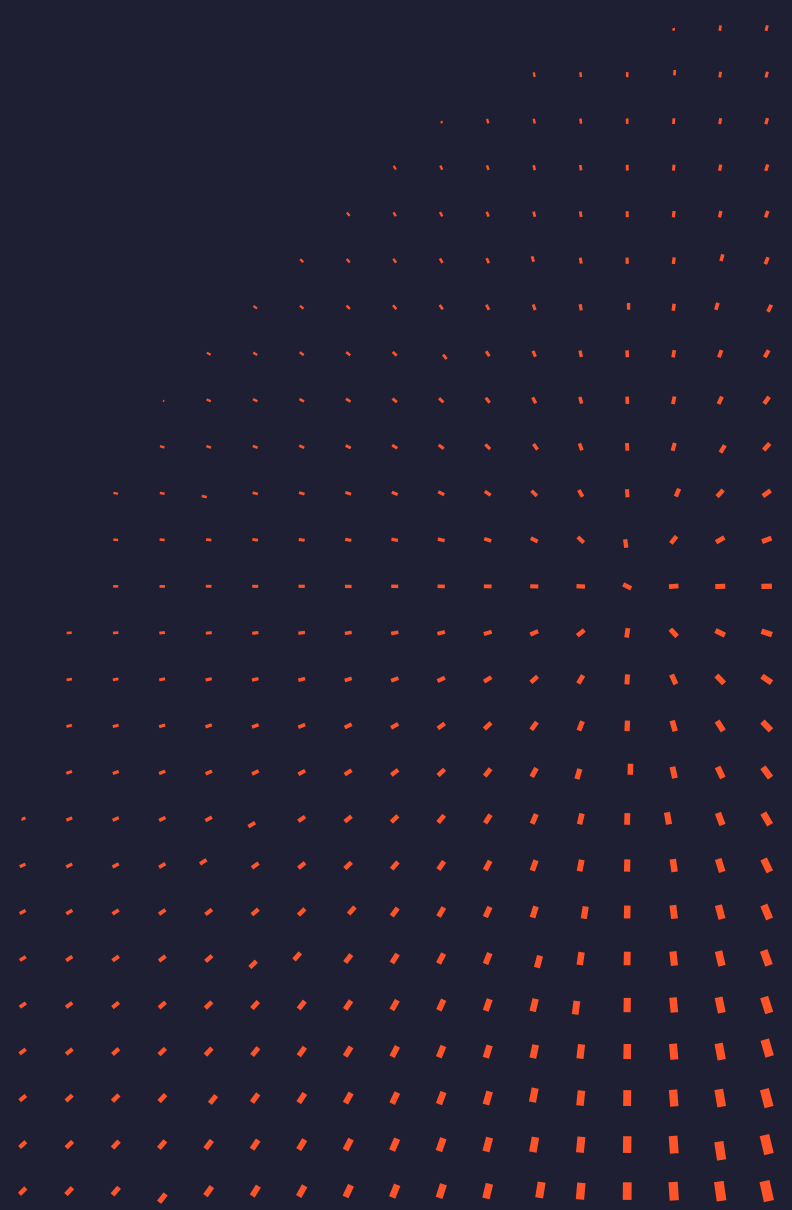Asset maintenance is shifting towards predictive and prescriptive strategies

Maintenance efficiency

Reactive	Planned	Condition	Predictive	Prescriptive
Fix when broken	Scheduled maintenance	Determine condition	Predict reliability	Prescribe necessary actions

Note: https://medium.com/@presenso/the-economics-of-the-smart-factory-how-does-machine-learning-lower-the-cost-of-asset-maintenance-fce016dd370

The way we do maintenance is changing

Asset maintenance is shifting towards predictive and prescriptive strategies

There are five main condition monitoring "systems" – each with their own properties

Maintenance efficiency

Reactive	Planned	Condition	Predictive	Prescriptive
Fix when broken	*Scheduled maintenance*	*Determine condition*	*Predict reliability*	*Prescribe necessary actions*

Vibration analysis

Oil analysis

Infrared thermography

Acoustic emission analysis

Electrical signature analysis (ESA)

Novel technique with unique advantages for asset owners – focus of today's session

ROI, business cases and created value

Example: Business case calculation output

Eliminate unplanned downtime

- **Improve uptime**, revenue and thus **profit margin generated**

  > €25k additional profit
  > - **2** prevented unplanned standstills per year
  > - x **8** hours per incident
  > - x **€35,000** of hourly production value
  > - x **~5%** profit margin
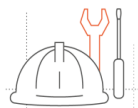
Reduce maintenance and electricity costs

- Reduce need to open machines for **visual inspection**

  > €25k in reduced inspections
  > - **4 hours** of inspection
  > - x **26 times** per year (every 2 weeks)
  > - x **4** maintenance engineers
  > - x **€65** wages per hour

- **Eliminate need for corrective maintenance** after unplanned failures

  > €20k in reduced corrective maintenance
  > - **€10k** average electric motor replacement cost
  > - x **4** prevented failures per year (SAM4 >90% accurate)
  > - x **50%** cost to repair before failure vs replacing entire motor

- Use insights into energy usage to run at optimal performance point and **reduce electricity bill**

  > €5k saved on electricity bill
  > - **2x10** electric motors
  > - x **15, 30 and 75 kW**
  > - x **~7,000** production hours per year
  > - x **€0.05** / kWh electricity cost
  > - x **3-4%** energy use reduction with SAM4

Improve condition insights

- **Avoid quality concerns** from metal-metal friction of rotating equipment

  > Maximum ~€1m of recalled product if friction damage detected
  > - **~200 production hours** between visual inspections
  > - x **5 tons** of product produced per hour
  > - x **€1,000 / ton** product price

The Business case of Condition Monitoring

€ 600.000

Chart values (bottom to top):
- 115.000 (yellow)
- 35.000
- 25.000
- 180.000
- 40.000
- 90.000
- 65.000
- 50.000

Y-axis: 0, 100, 200, 300, 400, 500, 600, 700

3 Reduce maintenance costs
- Reduce parts replacements
- Reduce periodic inspections
- Avoid corrective maintenance

2 Improve operational efficiency
- Energy savings
- Reduce defects
- Extend asset lifetime

1 Eliminate unplanned downtime
- Increase revenue & margin
- Reduce product discarding

Introduction to ESA
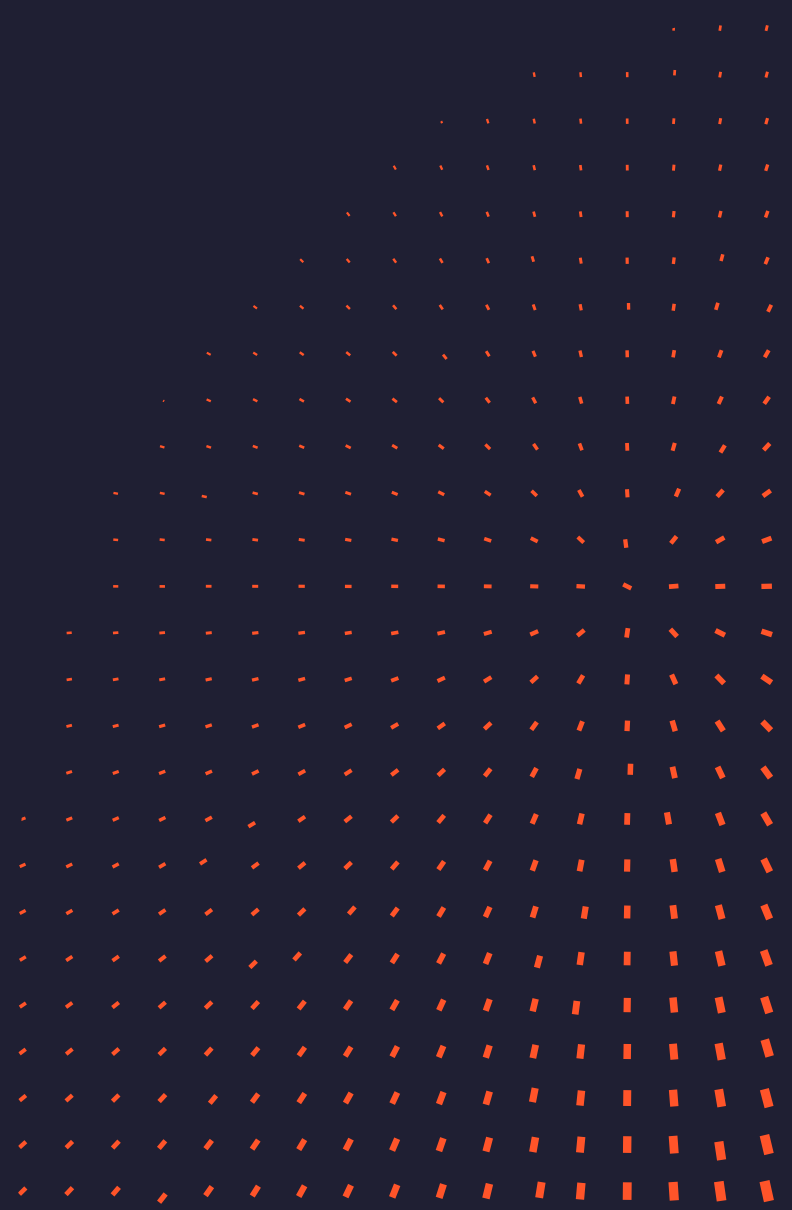
Electrical Signature Analysis (ESA)

"Electrical Signature Analysis (ESA) is the general term for asset monitoring techniques that analyse current and voltage sinewaves to provide insights into the condition, performance and energy consumption of electric motors and rotating equipment"

How to collect the required data for analyse?

Motor

- Source of the data is the asset monitored
- *Data owner: client*
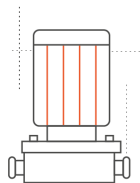
Sensor

- Data is collected by Samotics' sensors
- *Data owner: client*

Gateway

- Data is transferred via Samotics' gateway
- *Data owner: client*

Cloud

- Final destination of the data is the cloud
- *Data owner: client*

ESA works on a wide variety of applications including the following common asset types
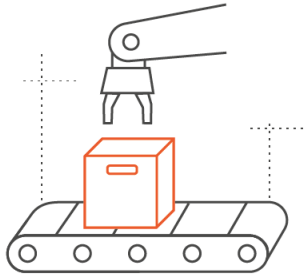
Conveyors
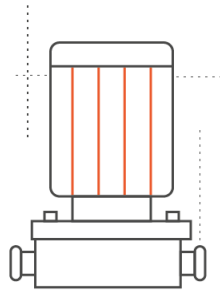
Pumps
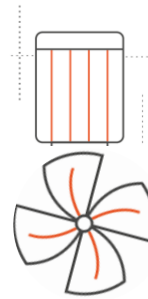
Mixers
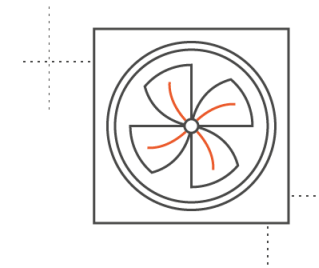
Blowers & Fans

SAM4 also covers a wide variety of other assets and applications including cranes, churners, redlers, filling stations and mills

ESA systems generate high frequency measurements from inside MCC

Monitoring in motor
control cabinet (MCC)
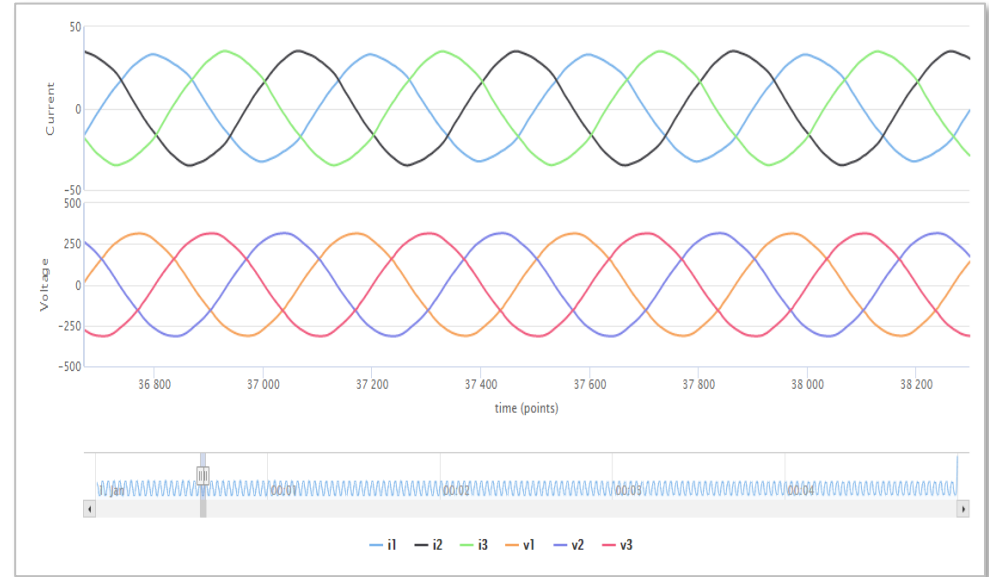
High frequency
measurements

ESA systems check validity of measurement from inside MCC
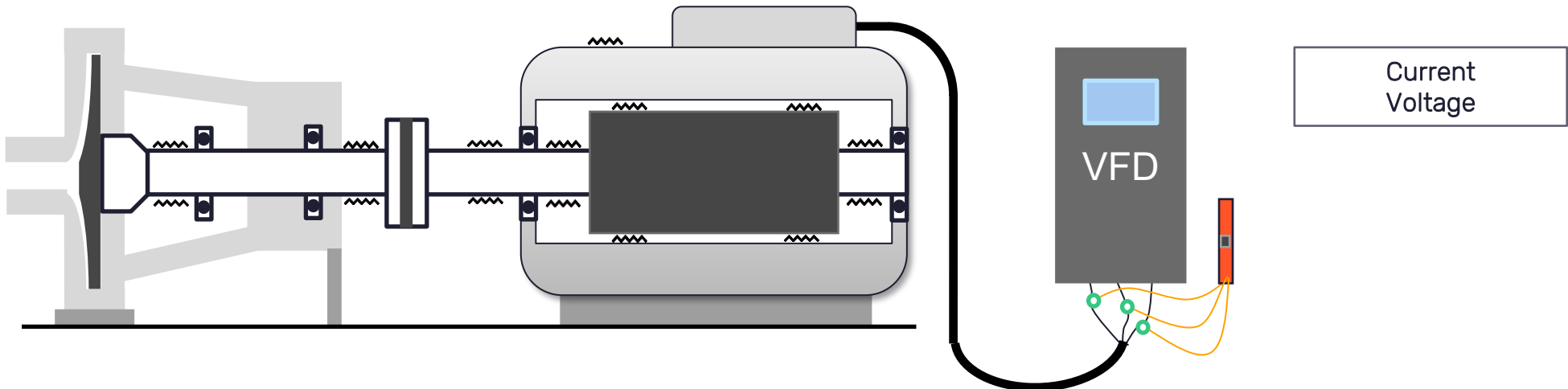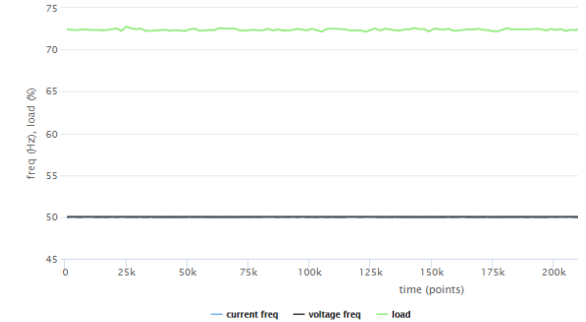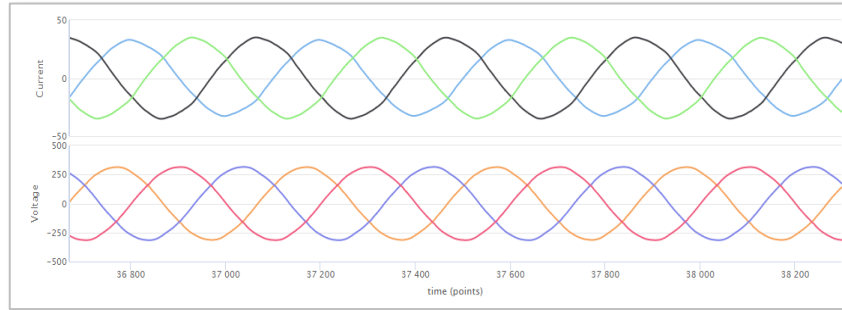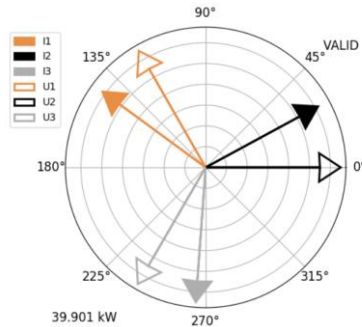
ESA systems calculate specific 'scorers' from inside MCC
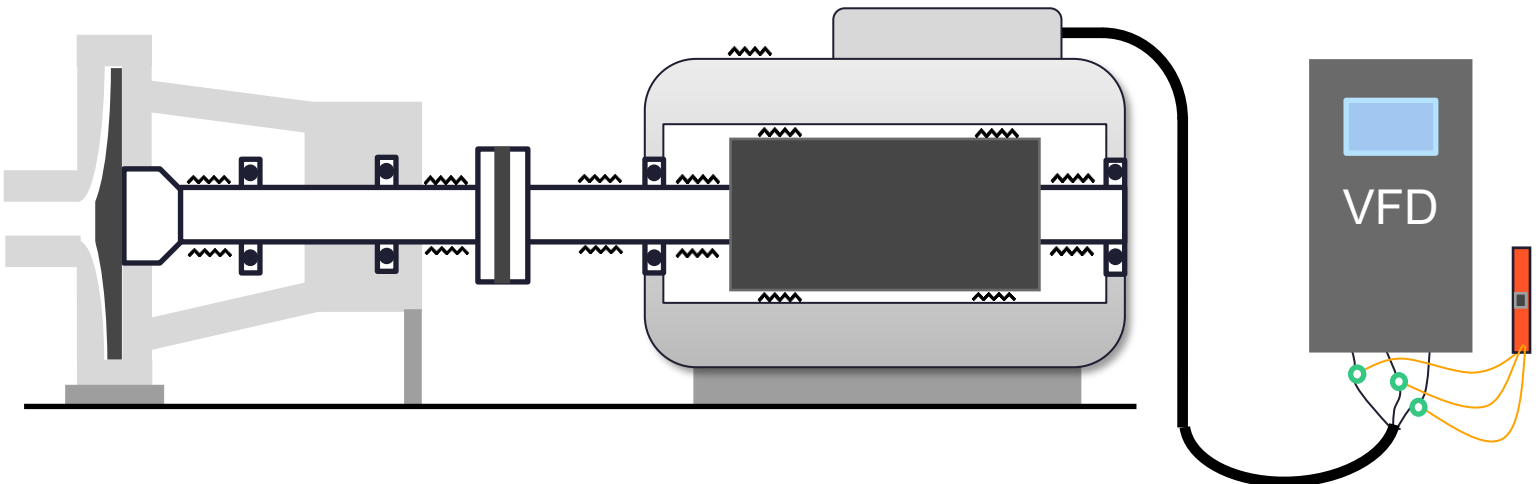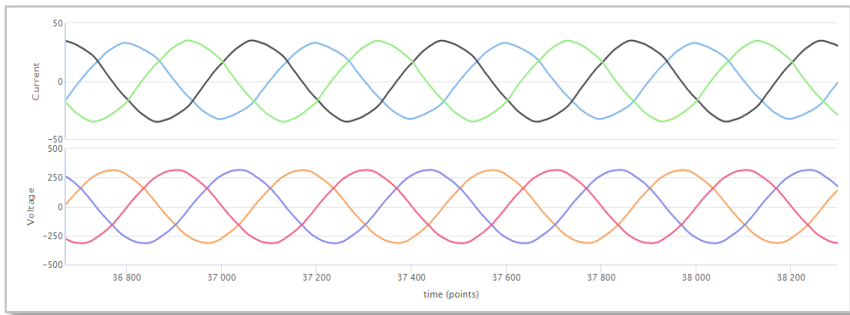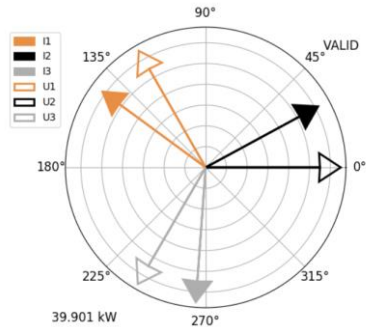
Mechanical Power (W)
Apparant Power (VA)
Reactive Power (VAR)
Active Power (W)
Torque (Nm)

RPM (magnetic field)
RPM (shaft)

Current peak value (I)
Current RMS (I)
Voltage peak value(U)
Voltage RMS (U)
Supply Frequency (Hz)
Current Unbalance
Voltage Unbalance

Current phase angle
Voltage phase angle
Power Factor / Cos phi
Phase angles (6x)

VFD

ESA system's high frequency measurements are used to determine asset condition

2

Current and voltage measurements ① are "translated" into a frequency spectrum ②

1

ESA system's high frequency measurements are used to determine asset condition

2

Current and voltage measurements ① are "translated" into a frequency spectrum ②

1
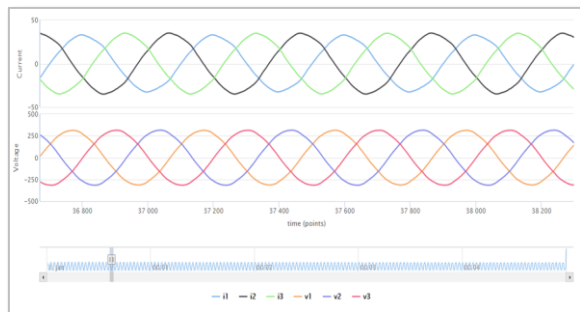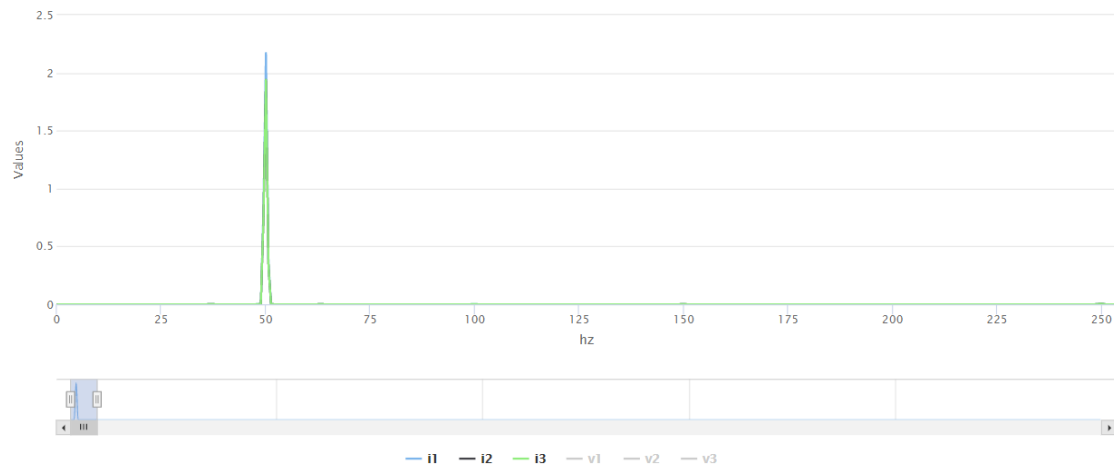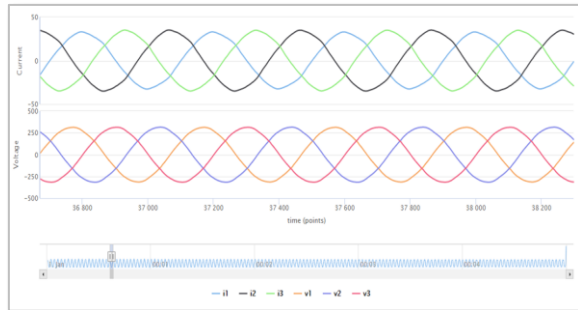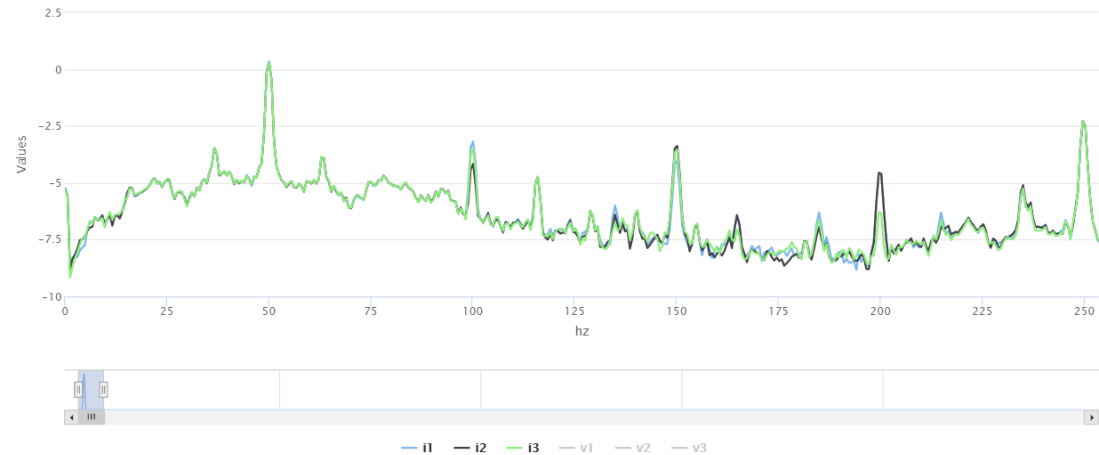
In order to detect upcoming failures, different measurements are compared. Deviation from "normal pattern" may indicate upcoming failure.

ESA can detect mechanical and electrical failures that occur throughout the drivetrain

Vibrations from the complete drivetrain influence the airgap between stator and rotor.

Stator

Rotor

Mounting Frame

VFD

Cavitation

Alignment error *Bearing damage*
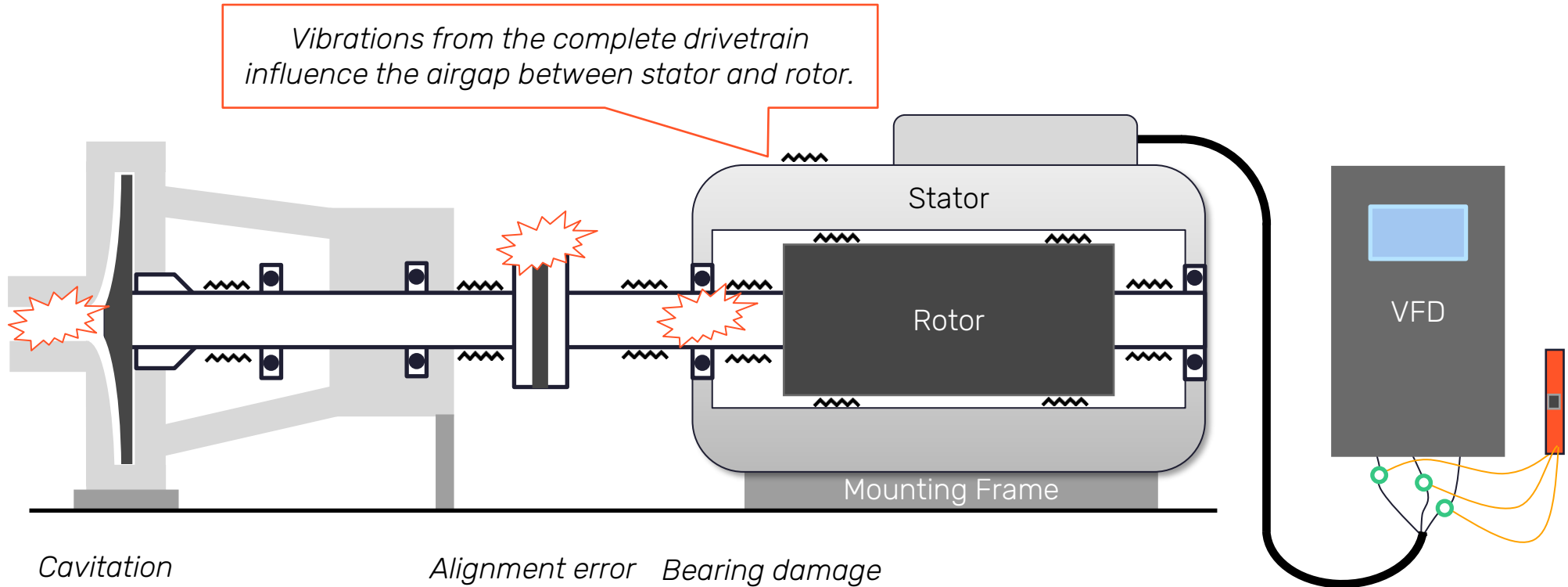
Failure mechanisms show up in their own specific way on the frequency spectrum.

ESA can visualize Applications into one Dashboard

Use Cases

ESA, the basics

A clear change is visible on 25Hz to the left and right of the supply frequency.
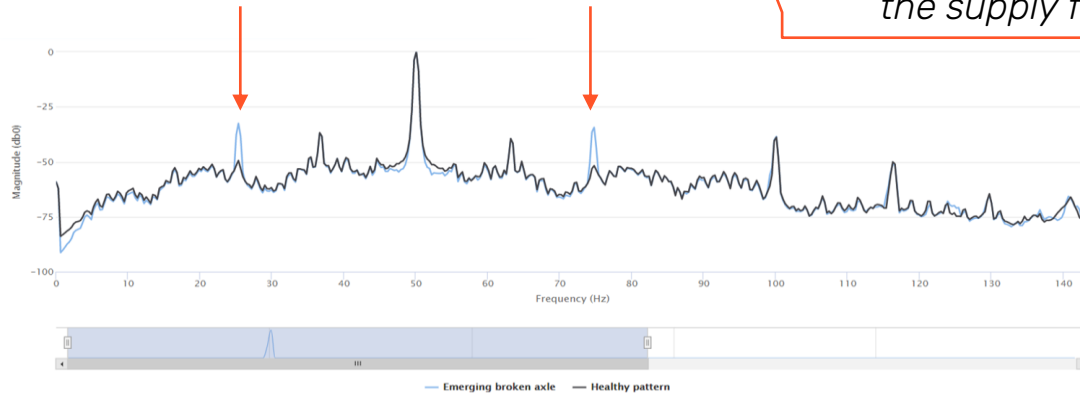
Focusing on this 25Hz component, an increase over time is visible

— Emerging broken axle — Healthy pattern

● Broken motor shaft development over time (74.46–74.77 hz)
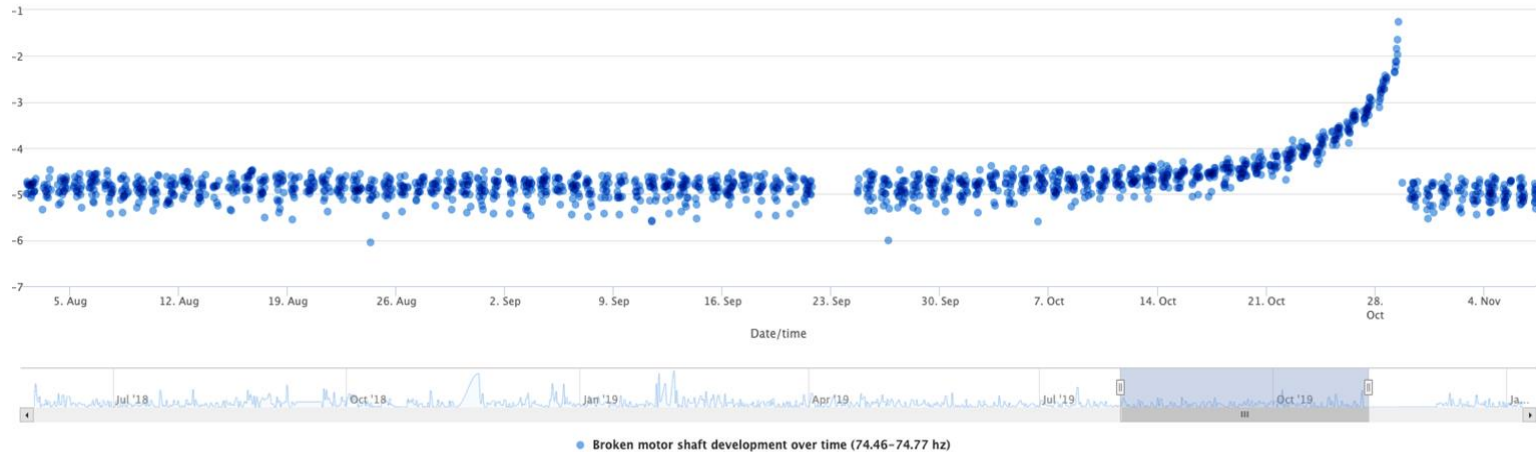
ESA, the basics

Assets shows a clear difference in current state compared to healthy state
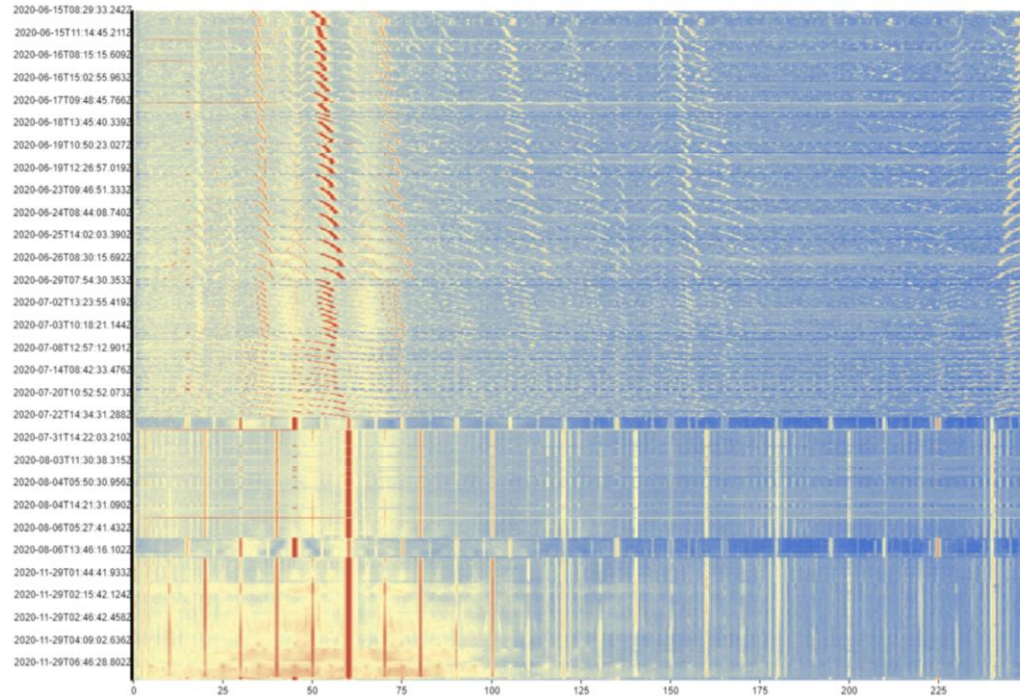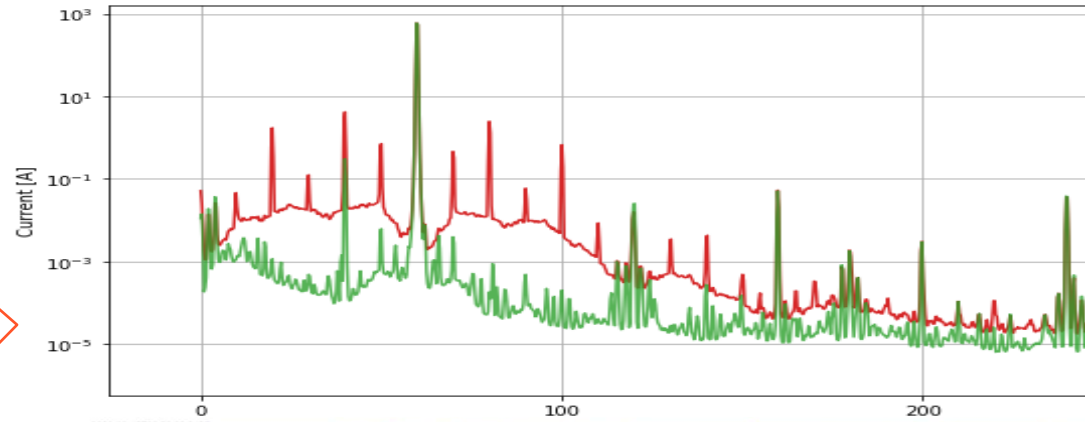
Since there are no ESA standards yet, there are no formal failure thresholds

Measurements show how assets are operated

% Load — **Workpoints of motor A** — *Supply Frequency*

% Load — **Workpoints of motor B** — *Supply Frequency*
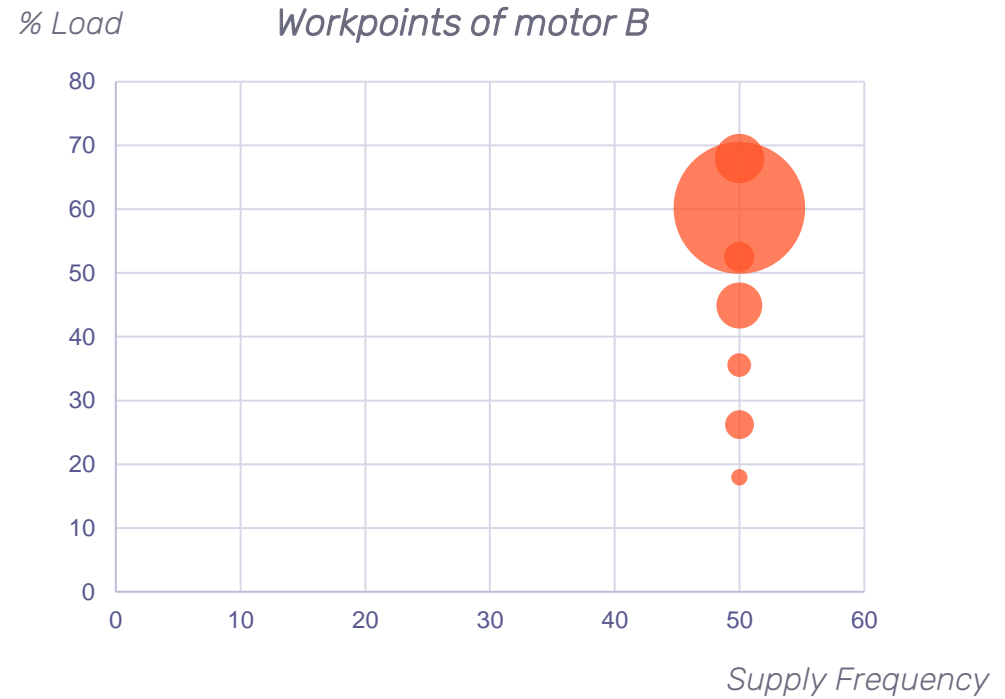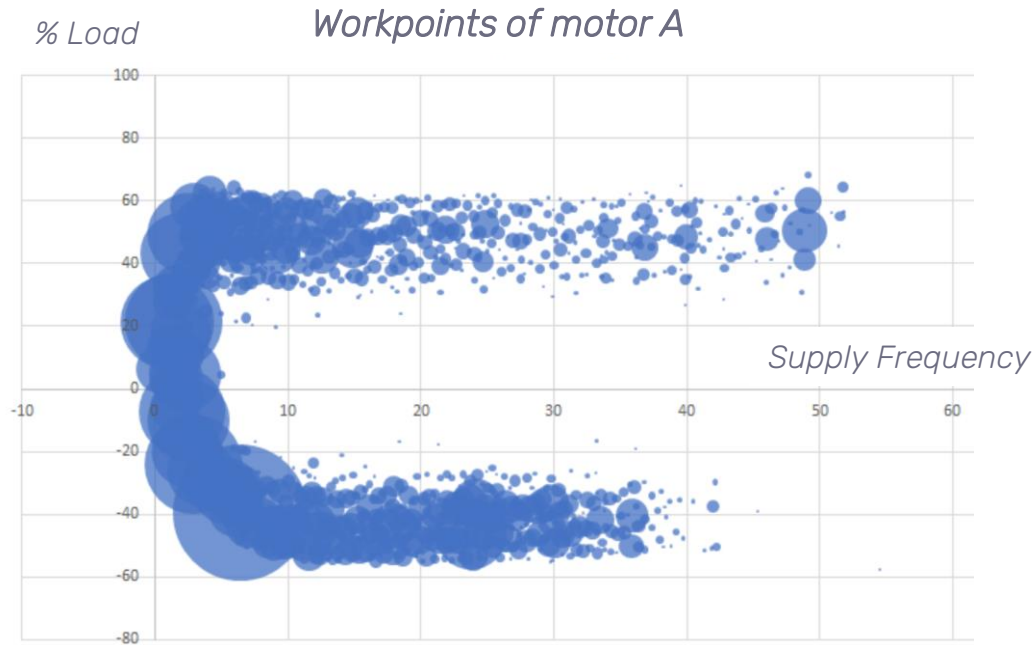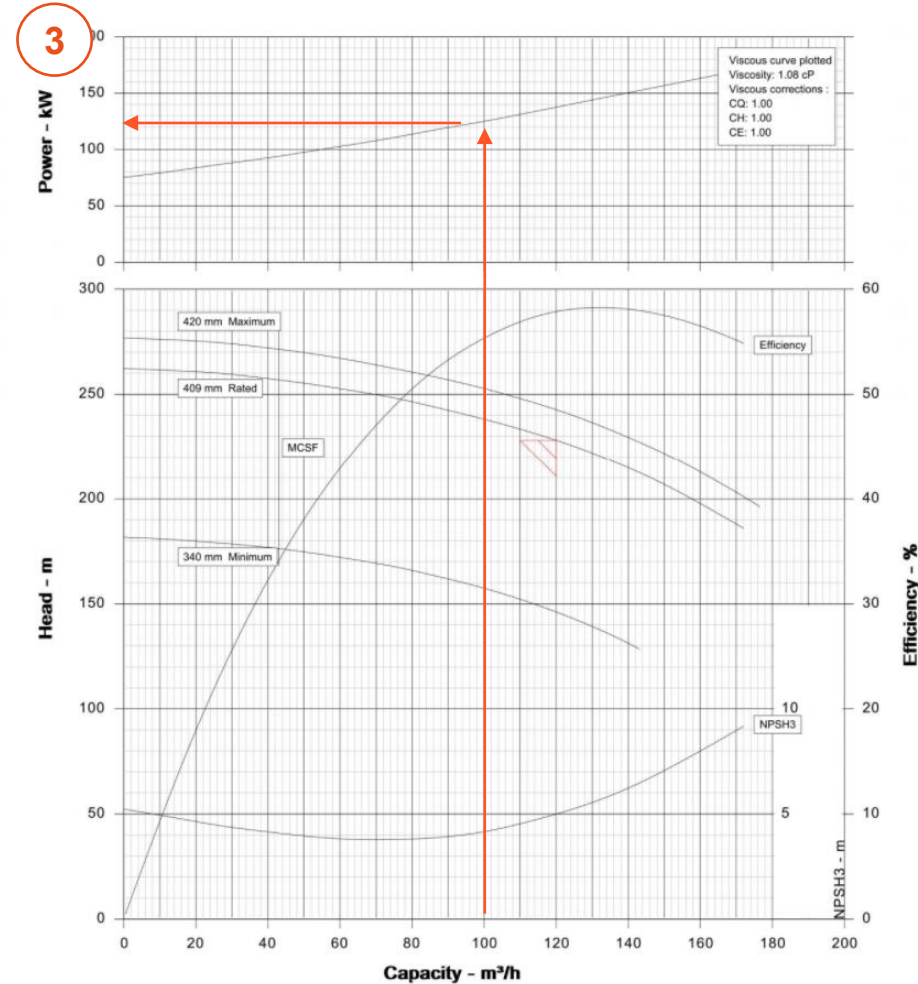
Measurements show how assets work together
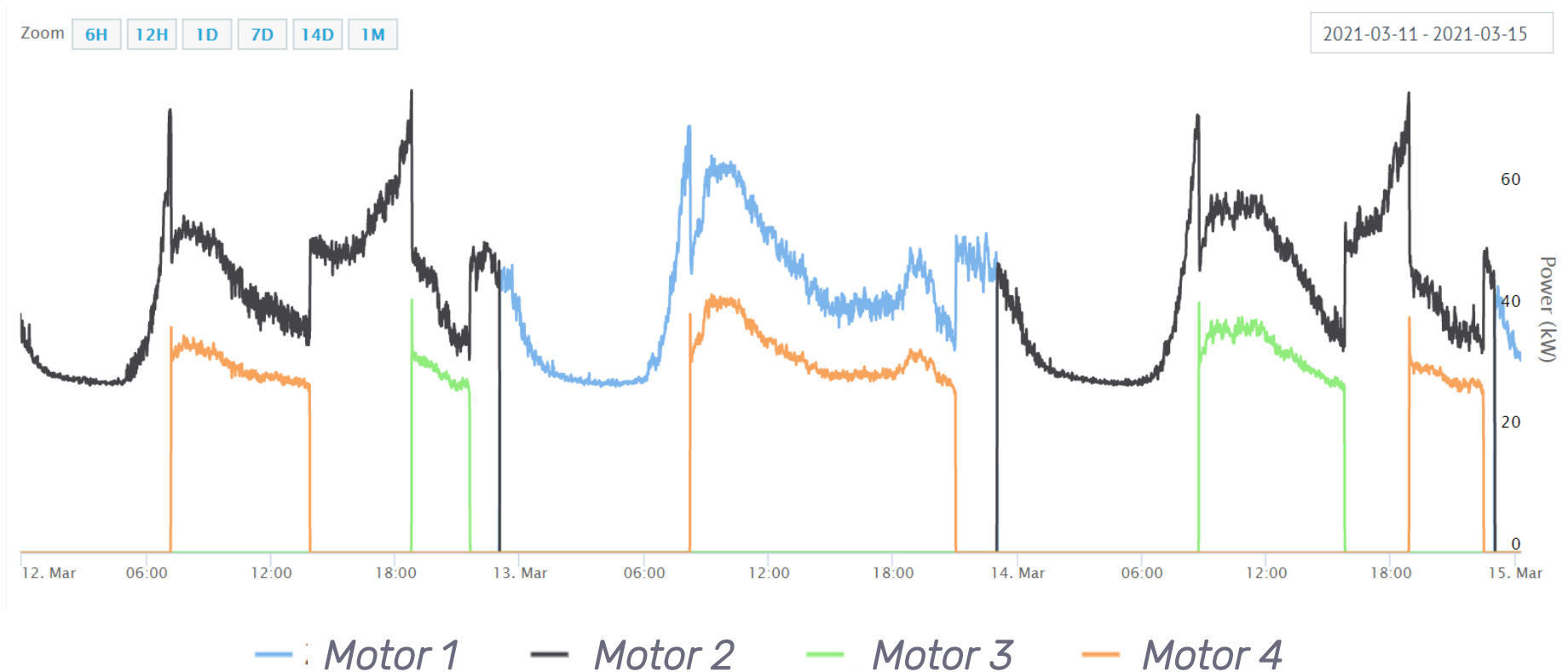
Measurements of active power tells you if motors are in sync with one another
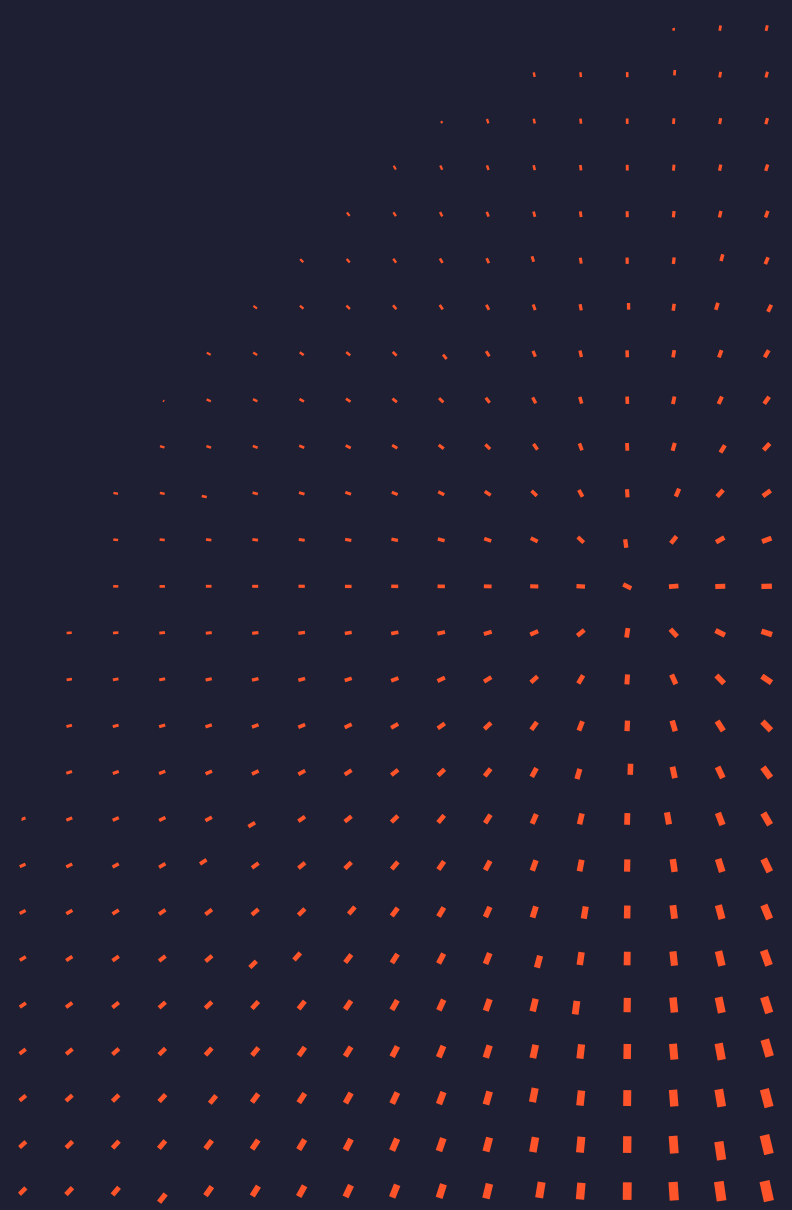

Assets out of sync: motors negatively influences eachother

Assets in sync: motors collaborating well
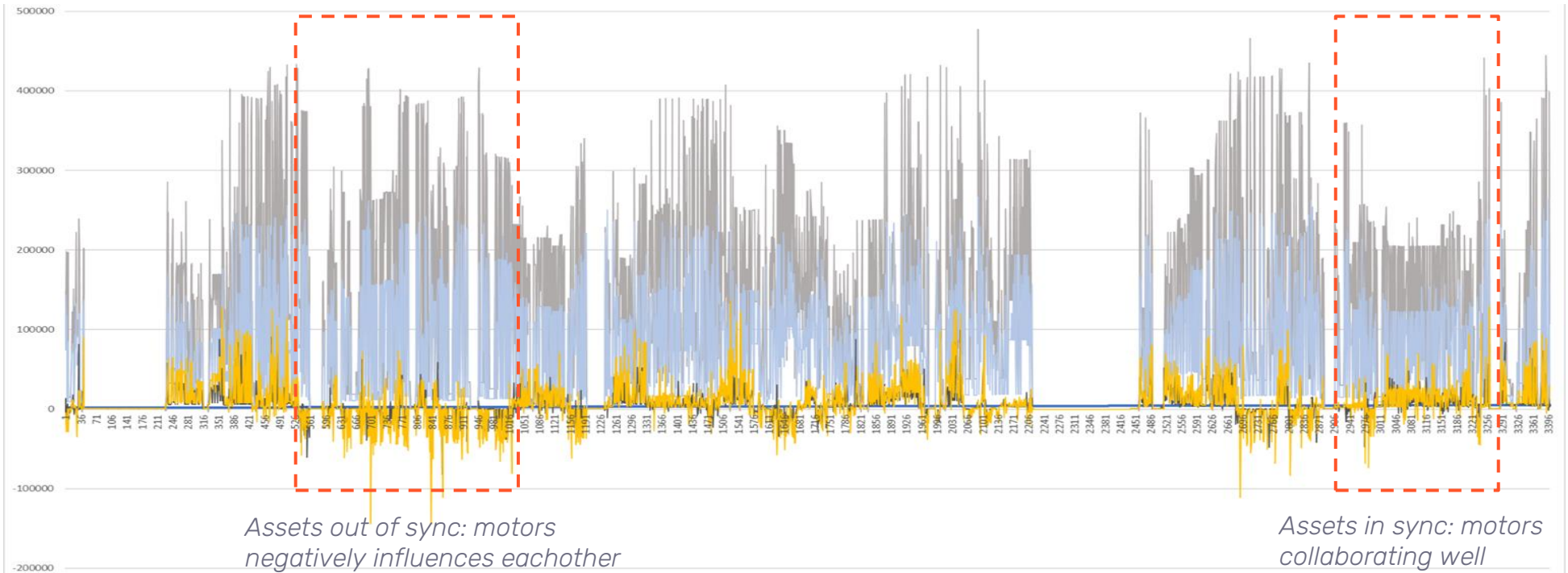
Measurements show how pumps perform in their curve
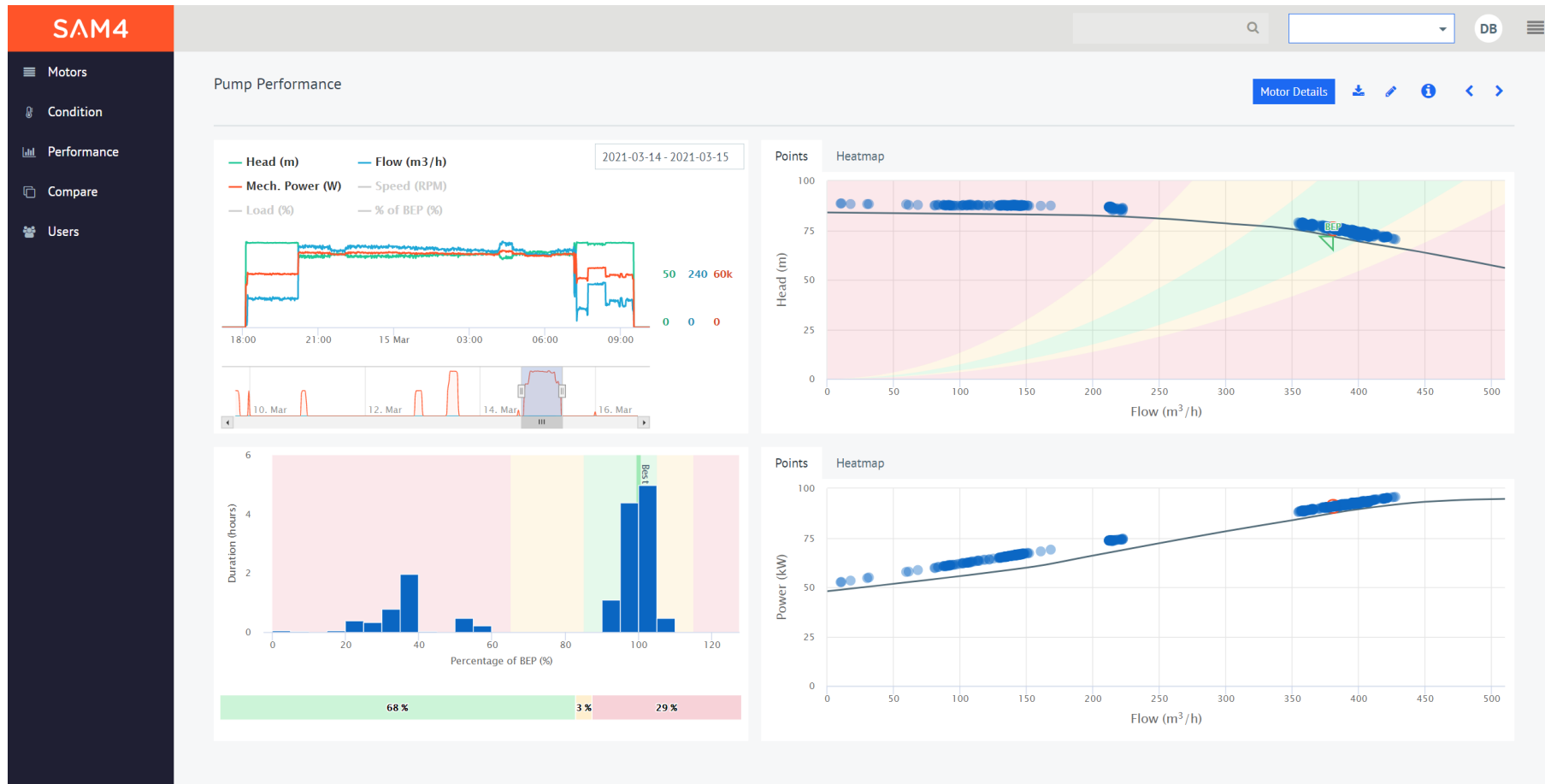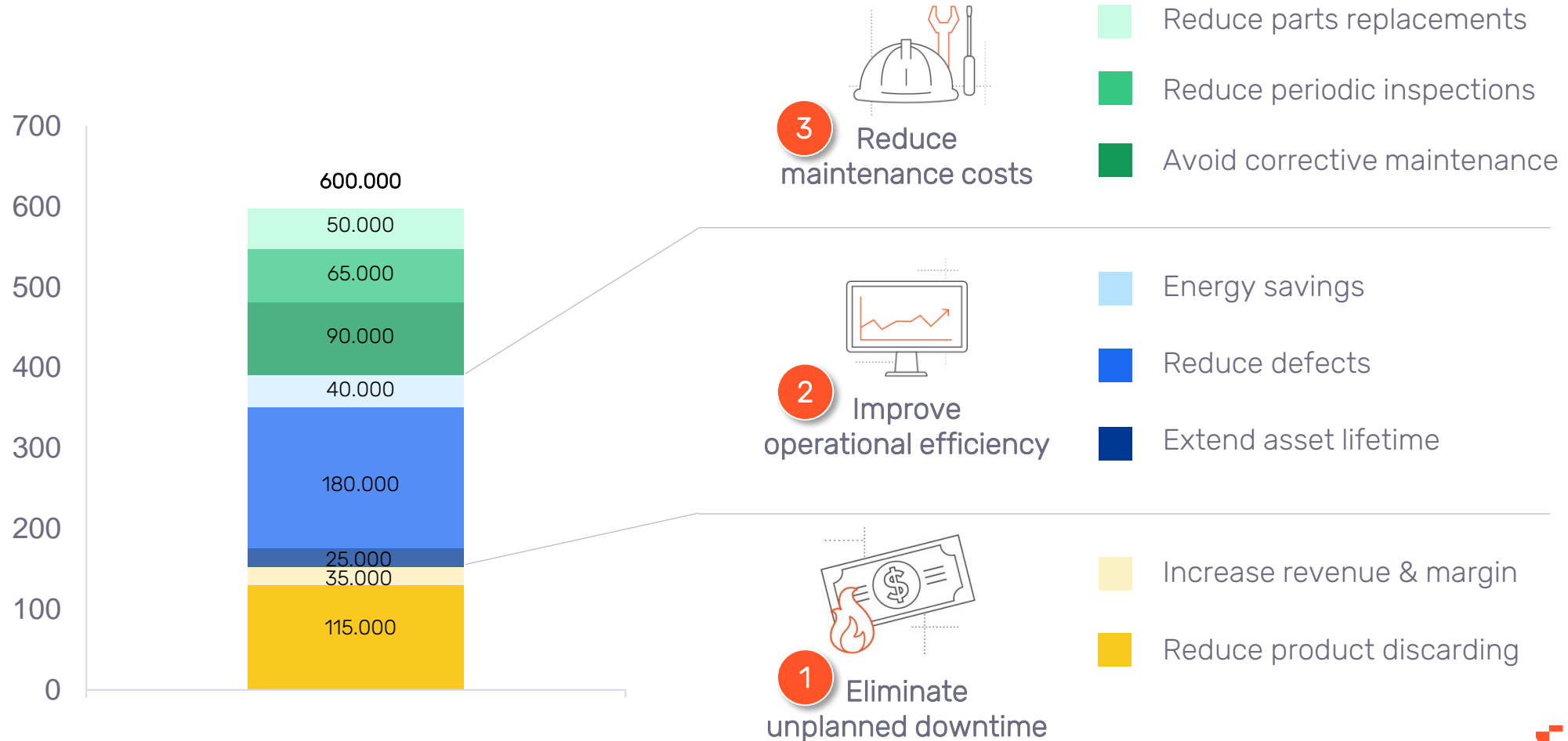
Measurements show how pumps perform in their curve
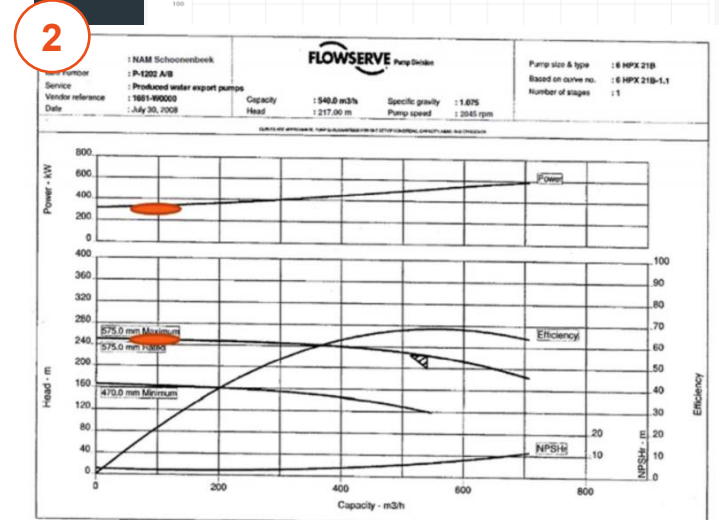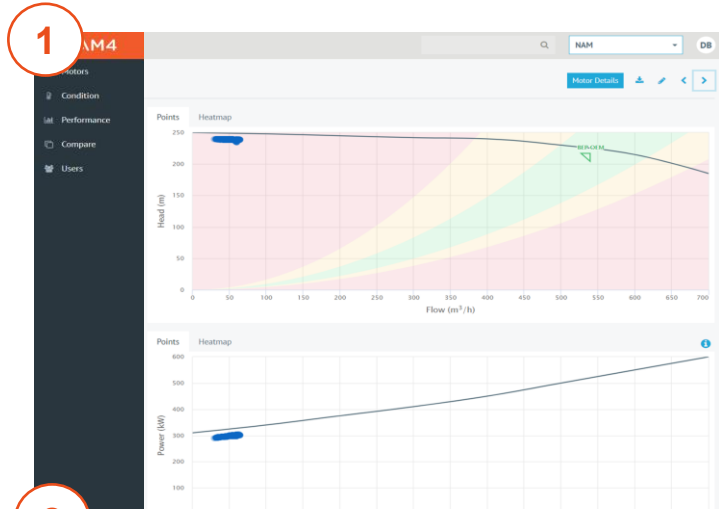
Challenges for Condition Monitoring in Maintenance

The Business case of Condition Monitoring

Get Results and prove added value, choose the right size for a pilot

Get ready for what's coming (Predictive, Prescriptive)

1. *Electrical, Mechanical, Instrumental*

2. *Maintenance-, Reliability Engineers*

3. *Data Science, Development, IT*

Thank you

derekbenner@samotics.com

Samotics

Hartelijk dank namens:

KIVI afdeling Maintenance

Samotics

Main Deck

Wij zien u graag terug op 15 april 2021 bij het webinar: Maintenance en veiligheid.

"Veiligheid van binnenuit – door Rob Kreté