



29TH JUNE 2023

MKE Expert Day

Powertrain Condition Monitoring -The Journey from Reactive to Proactive Maintenance

Michael Roebuck: Digital Lead - Motion

Industry

Production Lines & Infrastructure



Whole Life Cost

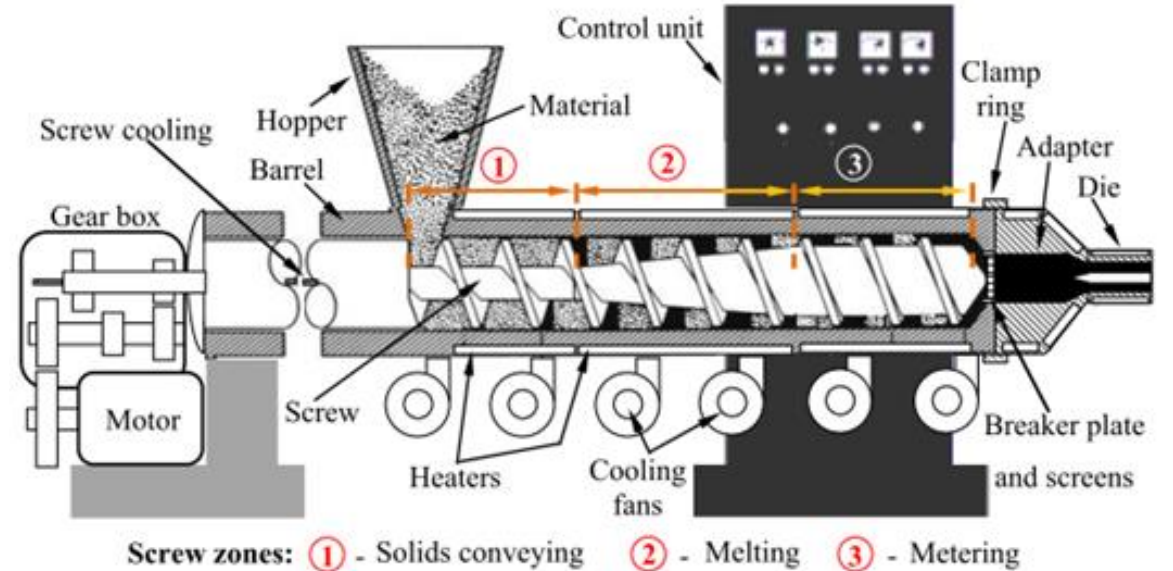


Extrusion

What happens if an extruder drive or motor fails?

Cost of not running

- Waste material
- Replacements parts
- Labour
- Crack the barrel?
- Clean up
- Effect on the next stage of the process
- Logistics disruption
- Penalty clauses?
- Process restart costs



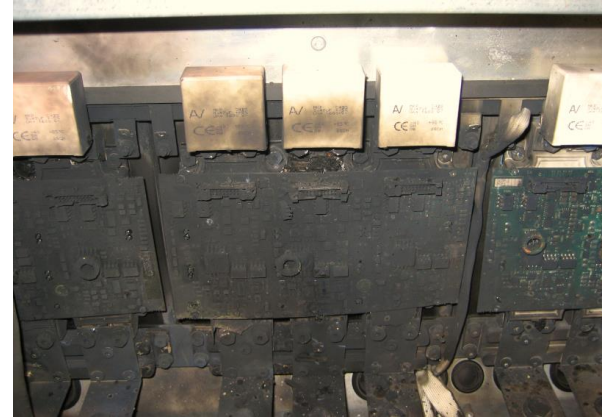
Reliability

What makes drives and motors fail?

The majority of failures are fundamentally due to Temperature / Environment

- Blocked filters
- Cooling fan failures (Cabinet Fans or VSD internal Fans)
- Contamination (dust / dirt / chemical)
- Moisture / Condensation
- Motor / Cable faults
- Greasing

Simple, regular visual inspection will help identify some of the above



Aging and Maintenance

Operating Conditions



T
thermal



E
electrical

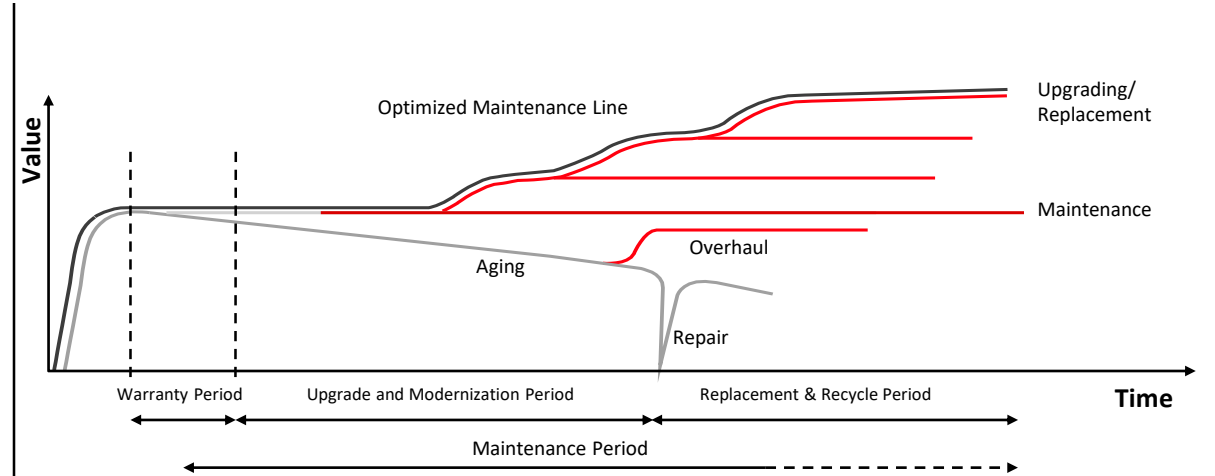


A
ambient



M
mechanical

Lifetime



Reactive maintenance
Corrective actions taken upon
failure or abnormal operation

Unpredictable stops
High downtime cost from unplanned stops

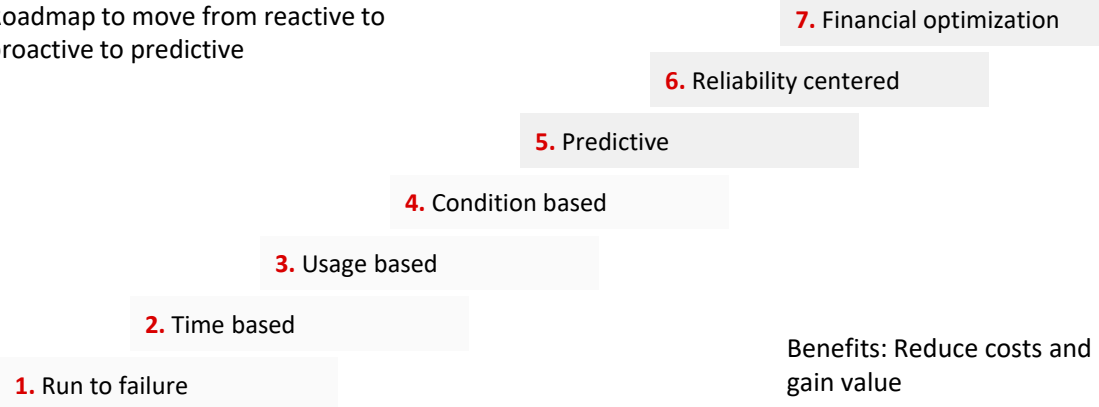
Scheduled maintenance (preventive)
Maintenance actions
schedule based on experience

Planned stops
Predefined spare parts

Condition based maintenance (predictive)
Maintenance actions **as consequence of the measurements activities**
that check the status of components

Stopover based on findings from condition
monitoring
Minimized downtime

Roadmap to move from reactive to
proactive to predictive



Predictive vs Preventative vs Corrective Maintenance

Predictive

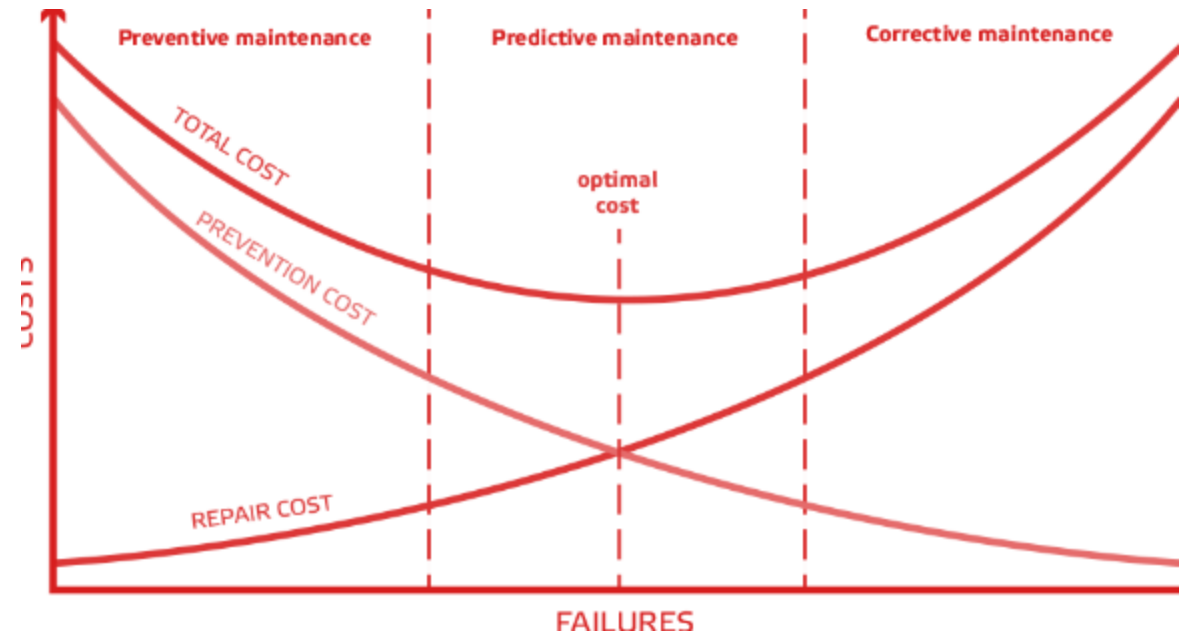
- An attempt to determine when best to perform preventative maintenance activities
- ‘Closed Loop’ – i.e. feedback from the system helps the determination of when it should be done
- Lowest overall cost, potentially higher risk

Preventative

- Done in order to prevent potential breakdown
- ‘Open Loop’ – i.e. using manufacturers recommendations
- Lower risk, potentially higher cost (unnecessary cost?)

Corrective

- Fix on failure
- High cost (more potential for consequential costs), high risk





The Data

Mechanical Assets



ABB Ability™ Condition Monitoring

How does it work?

- The ABB Ability™ Smart Sensor transmits data from the motors and pumps via a smartphone or gateway to a secure cloud service.
- Algorithms analyze the data and convert it into meaningful information, which is sent to the user's smartphone and customer portal.
- The ability to gather and analyze the data can reveal information on the status and condition of the equipment, to intelligently maintain and manage the performance of the powertrain.

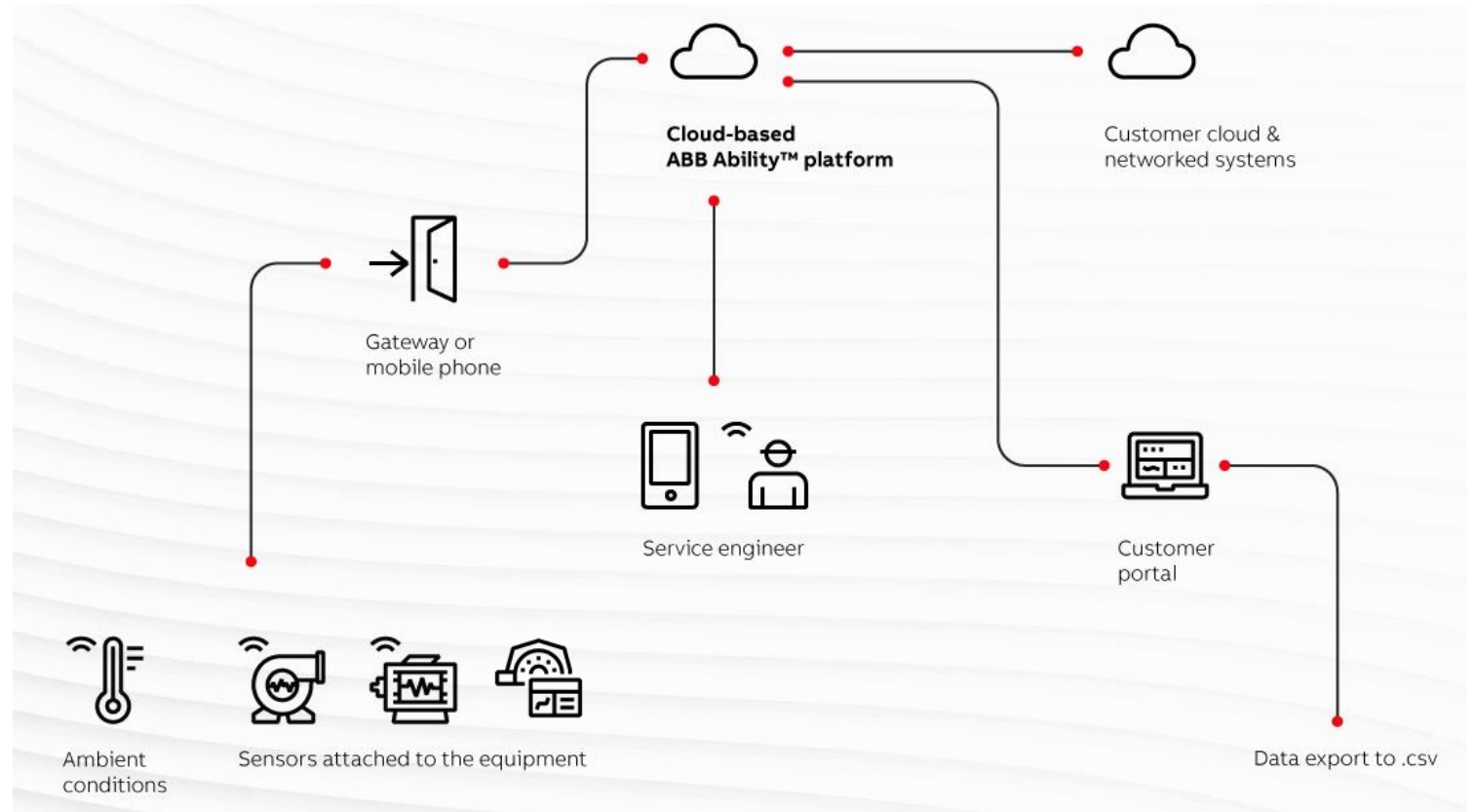


ABB Ability™ Smart Sensor for motors

Monitored parameters

Health parameters

- Overall condition
- Overall vibration
- Bearing condition
- Misalignment
- Skin temperature

Operating parameters

- Vibrations (radial, tangential, axial)
- Speed
- Operating hours
- Number of starts
- Supply frequency
- Output power
- Regreasing count-down



ABB Ability™ Smart Sensors

Timeline of continuous development and introduction of innovations



WiMon 100

2012



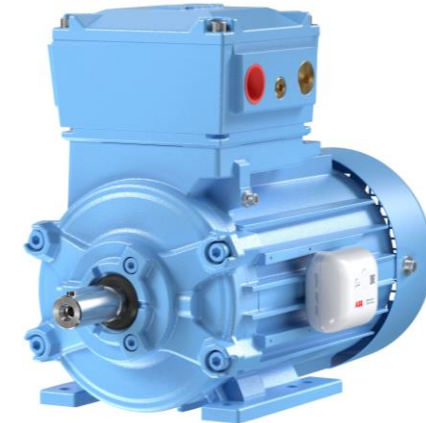
Smart Sensor for motors

2016



Smart Sensor for pumps

2018



Smart Sensor for hazardous areas

2020

Easy-to-use, wireless sensor to monitor the health and performance of industrial assets

ABB Ability™ Smart Sensors

Timeline of continuous development and introduction of innovations



Smart Sensor – Standard Performance



Smart Sensor – High Performance

2022

2 Hardware options – configurable at commissioning

ABB Ability™ High Performance Smart Sensor

Features and benefits

Designed for hazardous areas

- ATEX and IECEx certified – compliant with strictest requirements for equipment operating in explosive atmospheres
- IP66/67

Pinpoint detection accuracy

Superior sensors enable detection of even slight anomalies in the equipment's condition at a very early stage



Long battery life

Up to three times longer than most competing designs

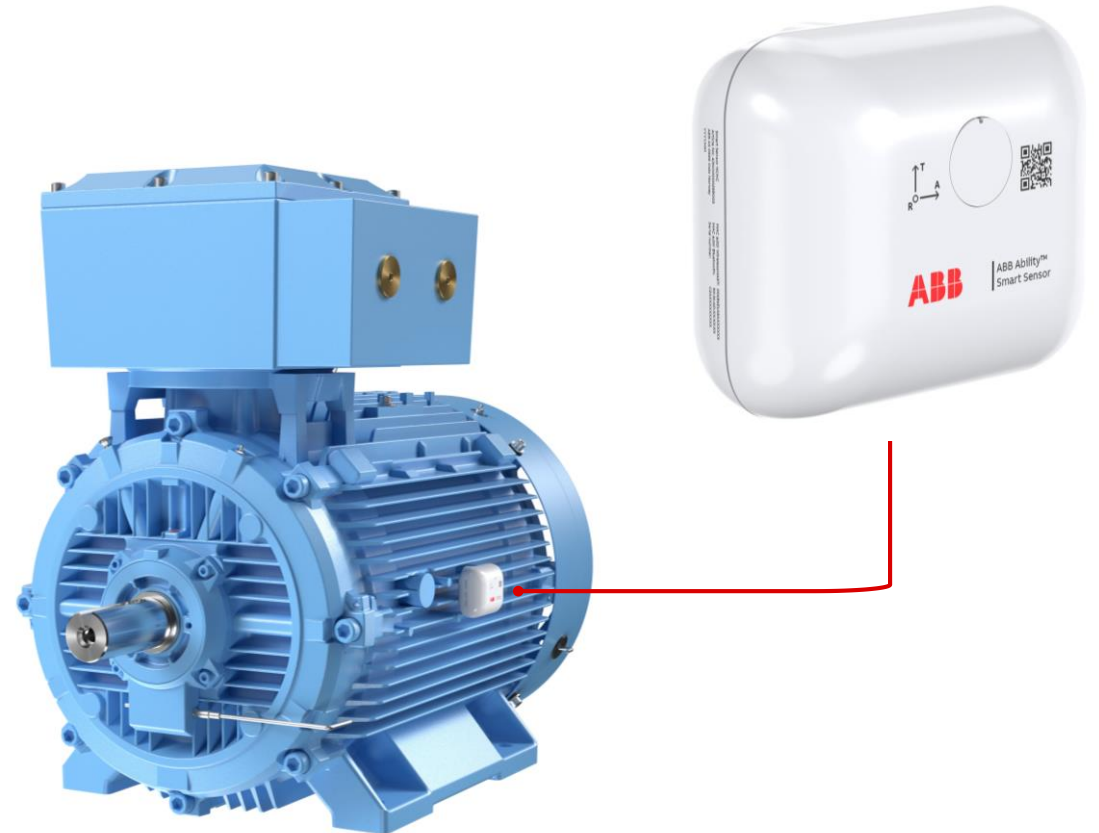
Ease of use

- Quick installation and activation for instant monitoring
- Easily reconfigured for different assets, saving time and reducing stock
- For ABB or third-party equipment

ABB Ability™ High Performance Smart Sensor

Key parameters

- Wireless communication
 - Bluetooth® 5.0, Bluetooth® Low Energy or
 - WirelessHART (HART 7.4)
- ATEX and IECEx zone 0/20
- Long battery life
- Ingress protection: IP66/67
- Sensor activation by NFC
- Superior sensors for dramatically better measurements
- Advanced algorithms to analyze equipment data



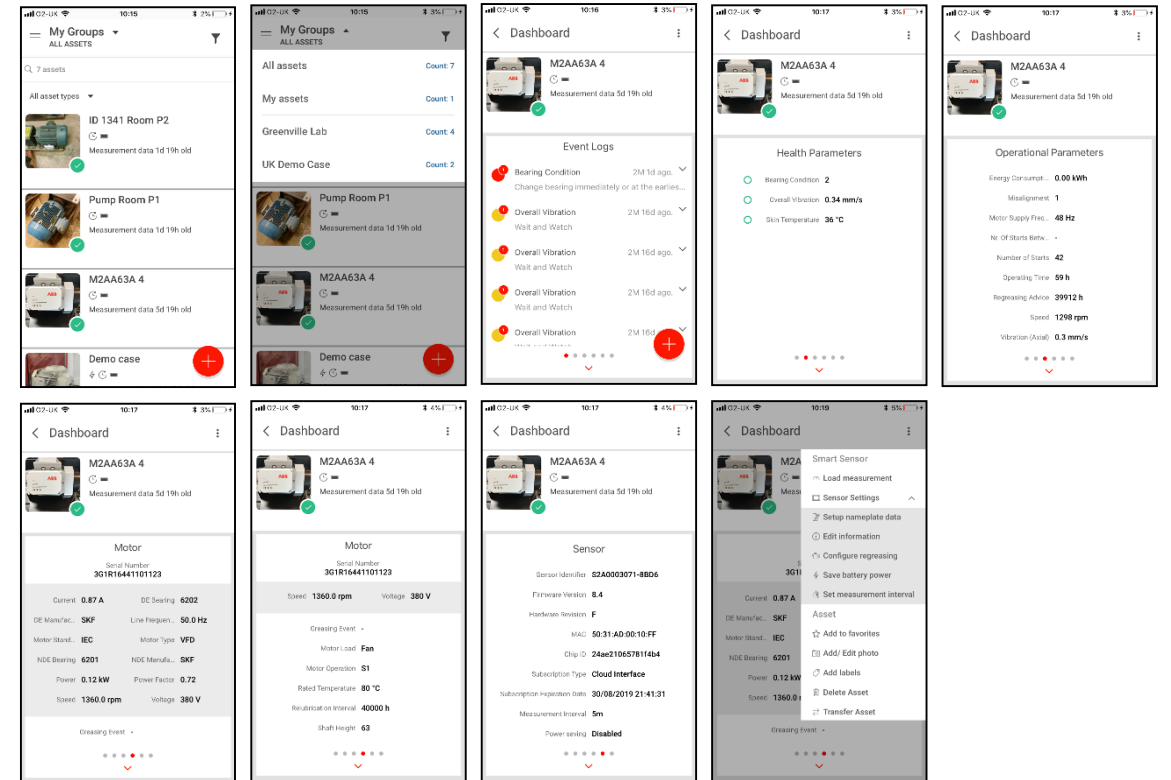
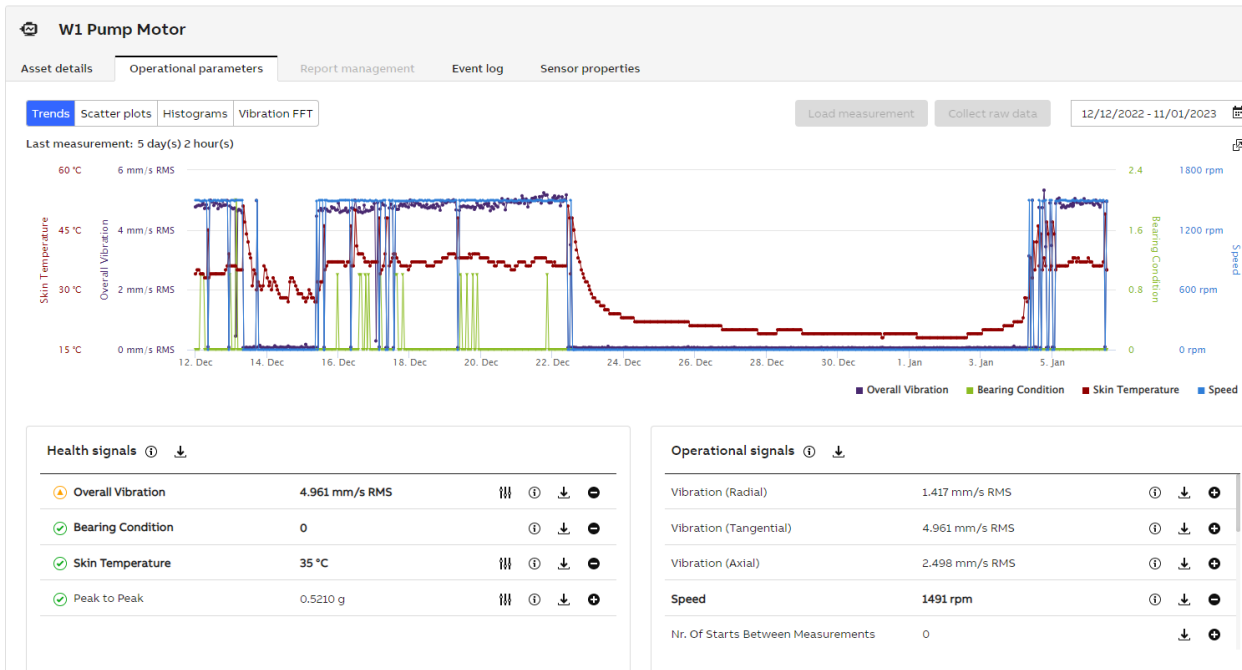
III M1 Ex ia I Ma
II 1 G Ex ia IIC T4 Ga -40°C ≤ Tamb ≤ +85°C
II 1 D Ex ia IIC T157°C Da -40°C ≤ Tamb ≤ +85°C

PRESAFE 19 ATEX 14930 X
IECEx PRE 19.044X

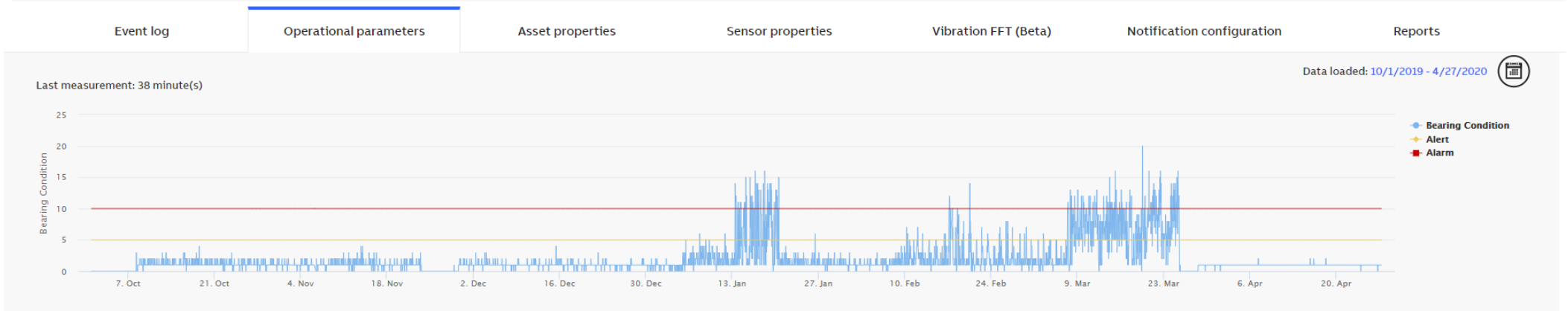
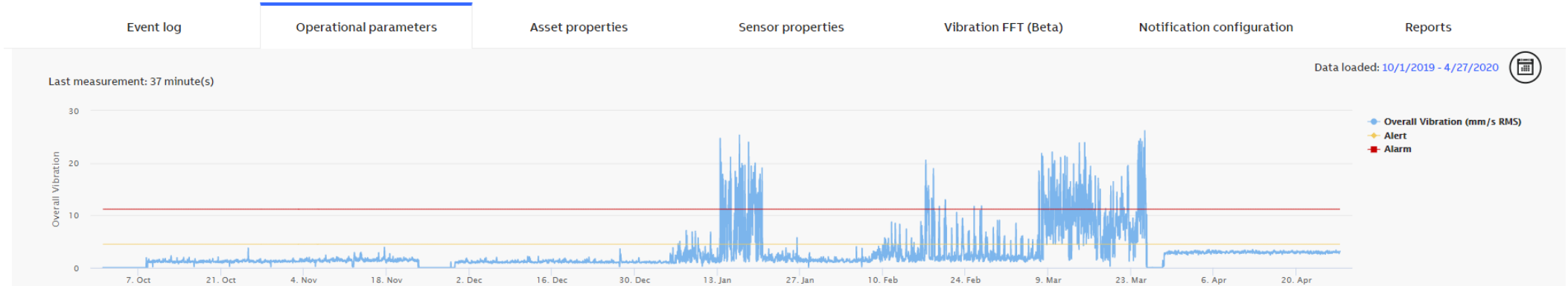
WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS

Smart Sensor

Analytical dashboard and smartphone app view



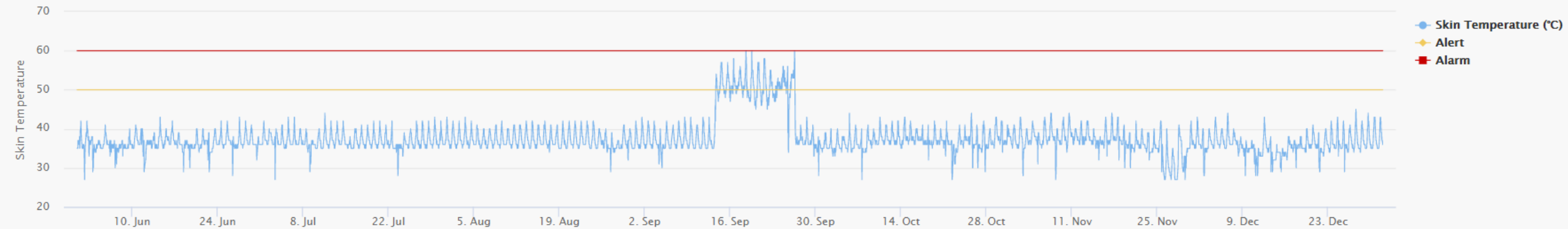
Fulfilling the value proposition at Customer – Early Fault Detection



- Bearing condition exhibit abnormalities crossing Alarm levels in January. Site inspection observed bearing noise and regreasing was performed.
- Condition improves for a period of time, with slight increase of levels within alert range. The trend is closely monitored
- In March, decision for bearing replacement is taken when condition crosses the alarm zone continuously. Bearing replacement is performed and condition improves upon start up.

Fulfilling the value proposition at Customer

Smart Sensor provides remote monitoring



- Site inspection revealed that the absorbent pad was stuck on the cooling fan cover affecting the air flow for cooling
- Sensors helps in picking up condition at site, preventing winding failure when exposed to high temperature

Smart Sensor

What can you do with it?

Imagine that you have a pump and motor in dry well with restricted access

Without sensor

Nobody ever goes near that motor.

When it fails you will be surprised, then...

- Pull the spare motor out of your warehouse
- Find an electrician and beg them to come
- Get lifting gear in place

It will take at least a day to replace, even if you have a spare on stock.

If the process or the driven equipment was damaged by the unexpected motor failure all times and cost can be multiplied by ten.



With sensor

Nobody ever goes near that motor.

You will get a warning before anything has happened, then ...

- Order a new motor from your nearest supplier
- Get lifting gear in place
- Planned engineer visit comes Tuesday with motor
- Run down and run up in an orderly fashion

Within two hours it is replaced.

Without a spare motor on stock, without an electrician on standby.



The Data

Variable Speed Drives

Ageing of critical components

Each component has specific quality characteristics, which must be understood and managed.

Preventive Maintenance is based on statistical methods, predictive maintenance is aiming to detect signals of potential problems from individual devices.

Unlike motors or many other devices with moving parts – drives are ‘silent’. Straight forward wear-out detection is challenging.

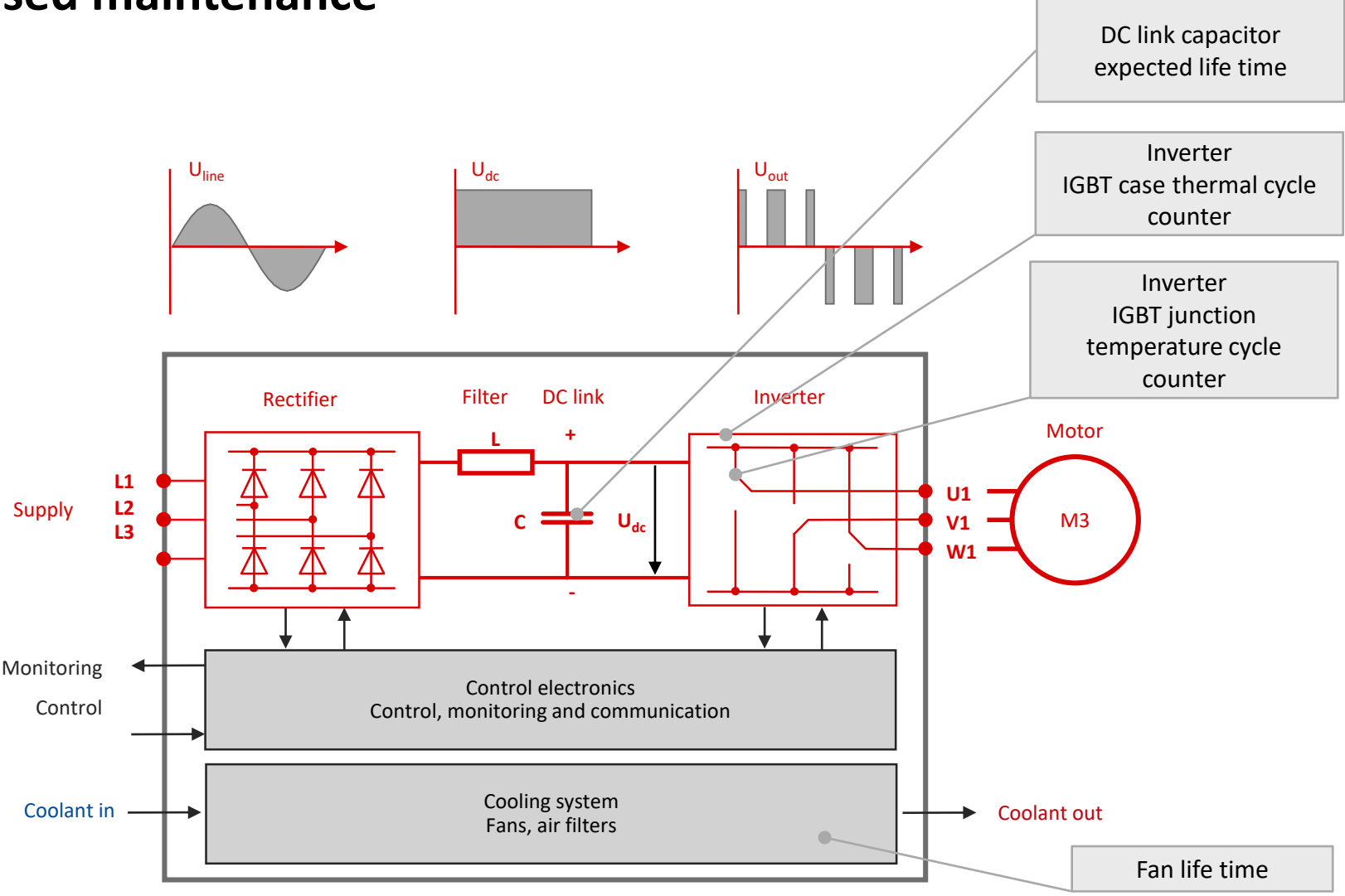
Main aging components:

- Semi conductors (IGBT's)
- Power capacitors
- Cooling Fans

	Preventive Maintenance	Predictive Maintenance
Aging components	✓	✓
Ambient conditions		✓
Usage patterns		✓



Condition based maintenance



Maintenance based on insight

Turning knowledge into actions

Data & Analytics

Knowledge & Actions



**Remote
Condition
Monitoring**

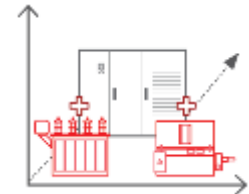
Monitoring as a service



Predictive Maintenance

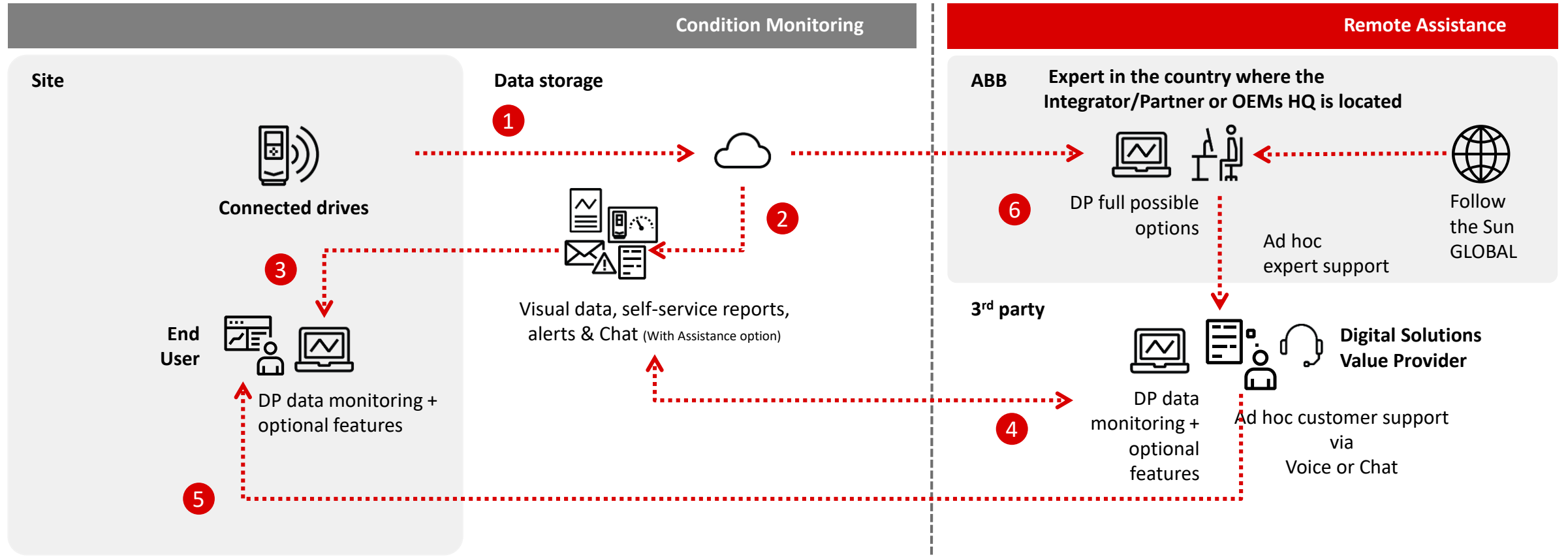


Optimization Services



Delivery concept: Cloud based Condition Monitoring Services for Drives

Condition Monitoring and Assistance: Service Providers Solution



Screen capture - Dashboard


Condition Monitoring for drives

EN myABB steve.hughes@gb.abb.com

Dashboard / Details by index 28 drives monitored

Overall condition

Availability




Real time status (updated every 5 minutes)

- OK
- Fault
- Warning
- Unknown

Details by index

Environment




Long term measurements (averaged over the last 30 days)

- OK
- Too high, rapidly aging your drive
- Tolerable but somewhat warm
- Unknown

Condition-Based Maintenance


Reliability



Long term measurements (averaged over the last 30 days)

- Faulted <0.1% of the time
- Faulted >1% of the time
- Faulted >0.1% & <1% of the time
- Unknown

Stress



Long term measurements (averaged over the last 30 days)

- OK
- Too heavy, rapidly aging your drive
- Tolerable but somewhat heavy
- Unknown

Latest expert analyses

- 2020-05-20 4159 - DRIVES SERVICE (ACS800-01 - Wall-mounted 6-pulse drive) by ABB Expert
- 2019-10-23 4159 - DRIVES SERVICE (ACS800-01 - Wall-mounted 6-pulse drive) by ABB Expert
- 2019-07-22 4159 - DRIVES SERVICE (ACS800-01 - Wall-mounted 6-pulse drive) by ABB Expert
- 2019-05-16 4159 - DRIVES SERVICE (ACS800-01 - Wall-mounted 6-pulse drive) by ABB Expert
- 2019-01-07 4159 - DRIVES SERVICE (ACS800-01 - Wall-mounted 6-pulse drive) by ABB Expert

[Show older analyses](#)

Email alert settings for

all drives

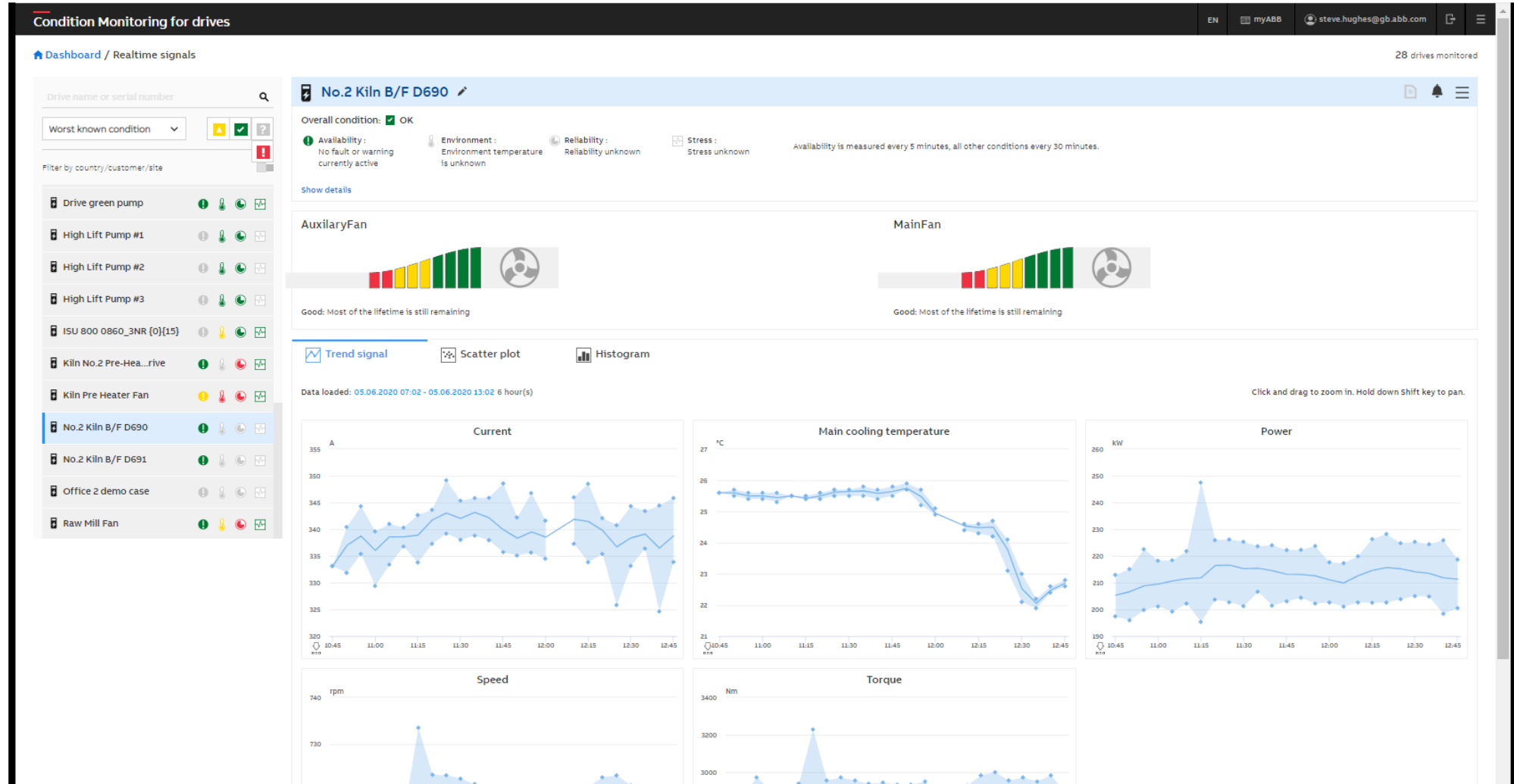
Drive alerts

- Faults
- Warnings
- Parameter changes
- No realtime data received (>1h)
- *Control board temperature: > 0 °C
- *IGBT temperature: > 0 °C
- *IGBT temperature (ACS880,ACx580): > 0 %
- *IGCT temperature: > 0 °C
- *Cooling air temperature: > 0 °C
- *Water inlet temperature: > 0 °C
- *Air Ambient temperature: > 0 °C
- *Bridge temperature: > 0 °C

* These alerts are based on the drive types and is not applicable for all the drives. Select the drive individually to view the applicable e-mail alerts for each.

Save

Screen capture - Operational Data Trends



Screen capture - Condition Based Maintenance

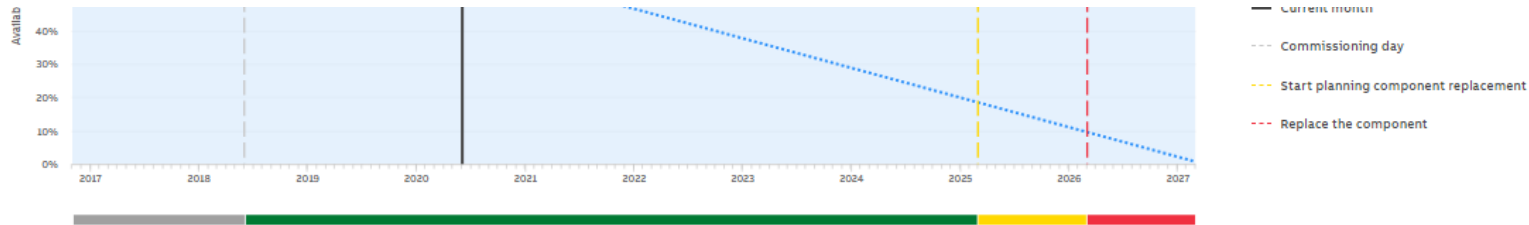
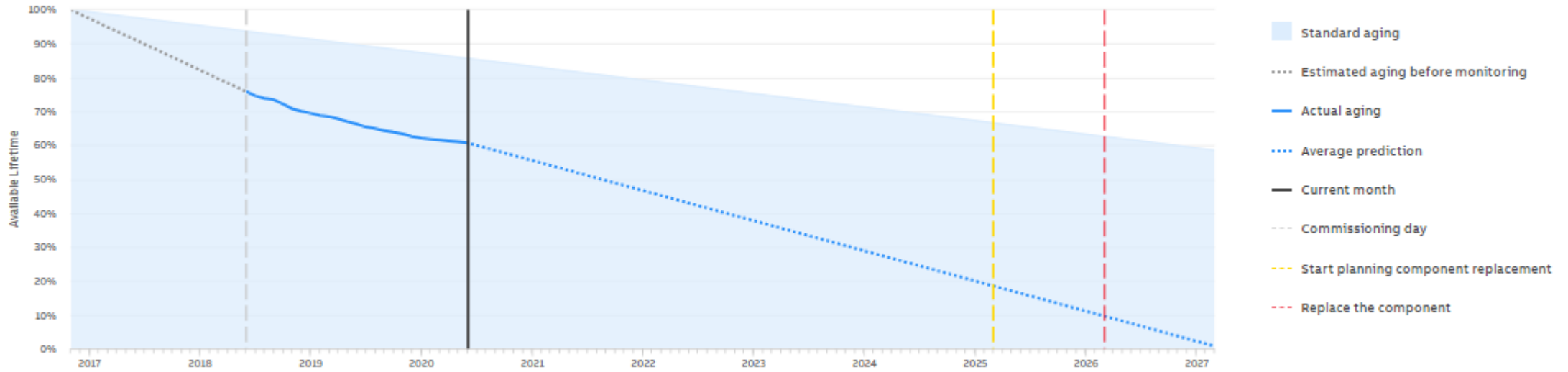
Condition-Based Maintenance

Switch to [Signal view](#)

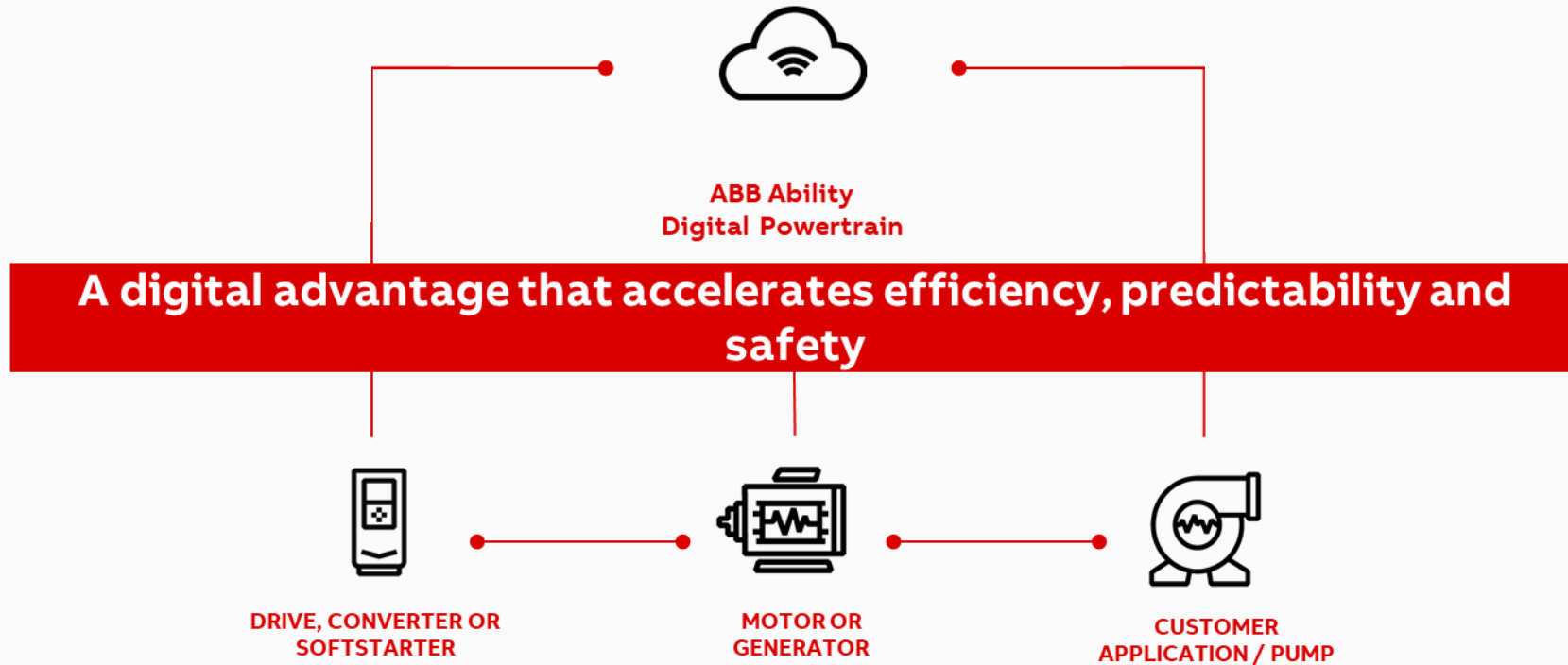
Condition-Based Maintenance provides you with the lifetime condition of drive components. You can find the analysis in details below.

Cooling **Converter Module** DC link Capacitor

Annual aging status



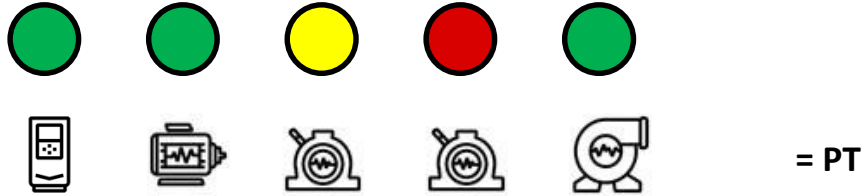
Digital Powertrain



Why is it important to monitor the complete Powertrain?

The weakest element limits the uptime

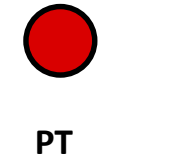
Individual component condition KPIs



Devices are logically grouped as powertrains

Powertrain Name	Hannover Messe 2019		
Selected Components	Bearings	Drives	Motors
	Dodge P2B510-ISN-045MLR Dodge P2B-GTM-45M	ACS880 demo 1	M3BP 160MBL 6

Powertrain condition



The condition of the most degraded component determines the condition of the powertrain!



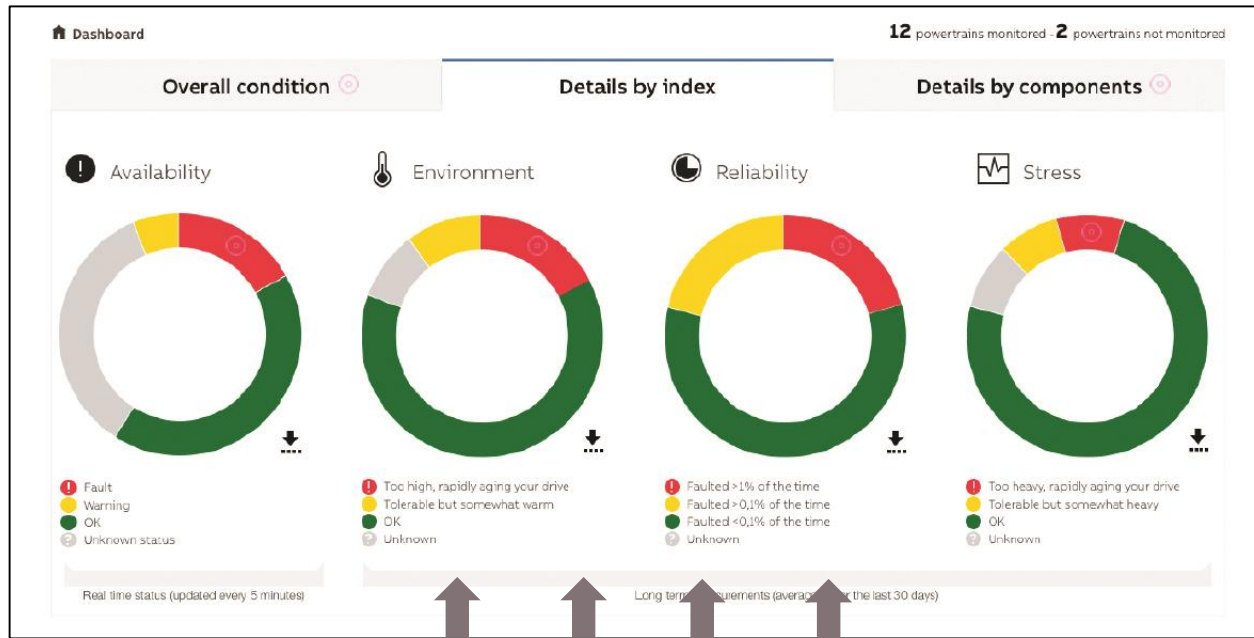
Maintenance Manager



Production Manager



Finance Manager



Energy Manager



Safety Manager



IT Manager



Maximising Productivity

Condition Monitoring of Drives and Rotating Equipment-The Journey from Reactive to Proactive Maintenance

Summary



- Find the right maintenance strategy
- Reduced “unplanned” down time
- Increase productivity



- New or existing plant?
- Where to start?
- Marathon not a sprint
- Rolling plan



- Identify pain points
- Identify critical assets
 - Effect of failure
 - Value
 - Spares availability
 - Difficulty in change over or repair



- Optimise maintenance costs
- Increase overall value
- Reliability centred
- Financially optimised

ABB