SKF Condition Monitoring Technology Offer

Last updated: 2023-04-21

OVERVIEW

WE ARE EVERYWHERE

Bearings and units

Seals

Lubrication

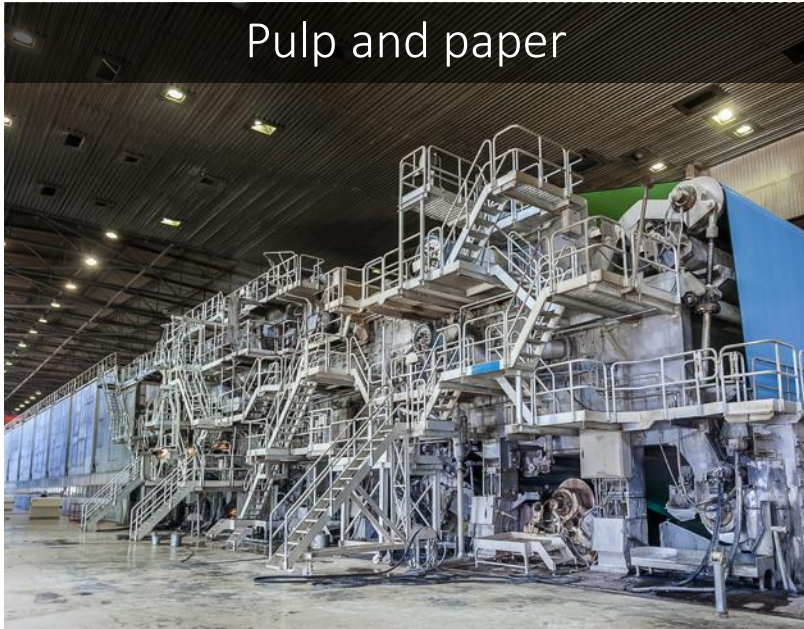SKF's combined offering

Condition monitoring

Services

Pulp and paper
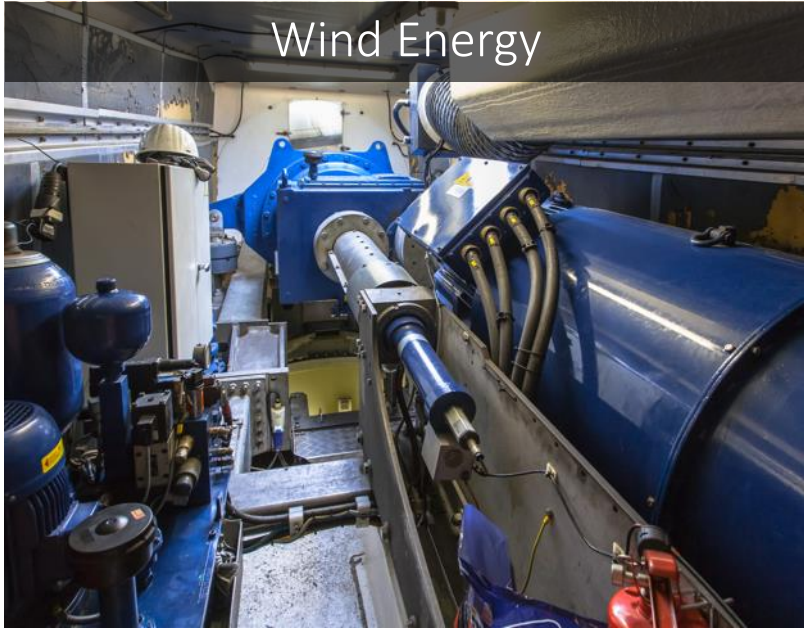
Marine

Mining and minerals

Energy

Metals

Cement

SKF

Wind Energy

Food and beverage

Chemicals

Railways

Manufacturing

From sensors to dashboards

SKF's core scope

System Configuration

Sensors

Data Management

Machine Health Analysis

Event Data

Customer Communication

KPIs on Events

KPIs on Alarms, Events etc.

KPIs on CoMo HW function

Service/ Maintenance Management

KPIs on Work Orders etc.

Additional Data (financial, supply chain etc.)

KPI Dashboard
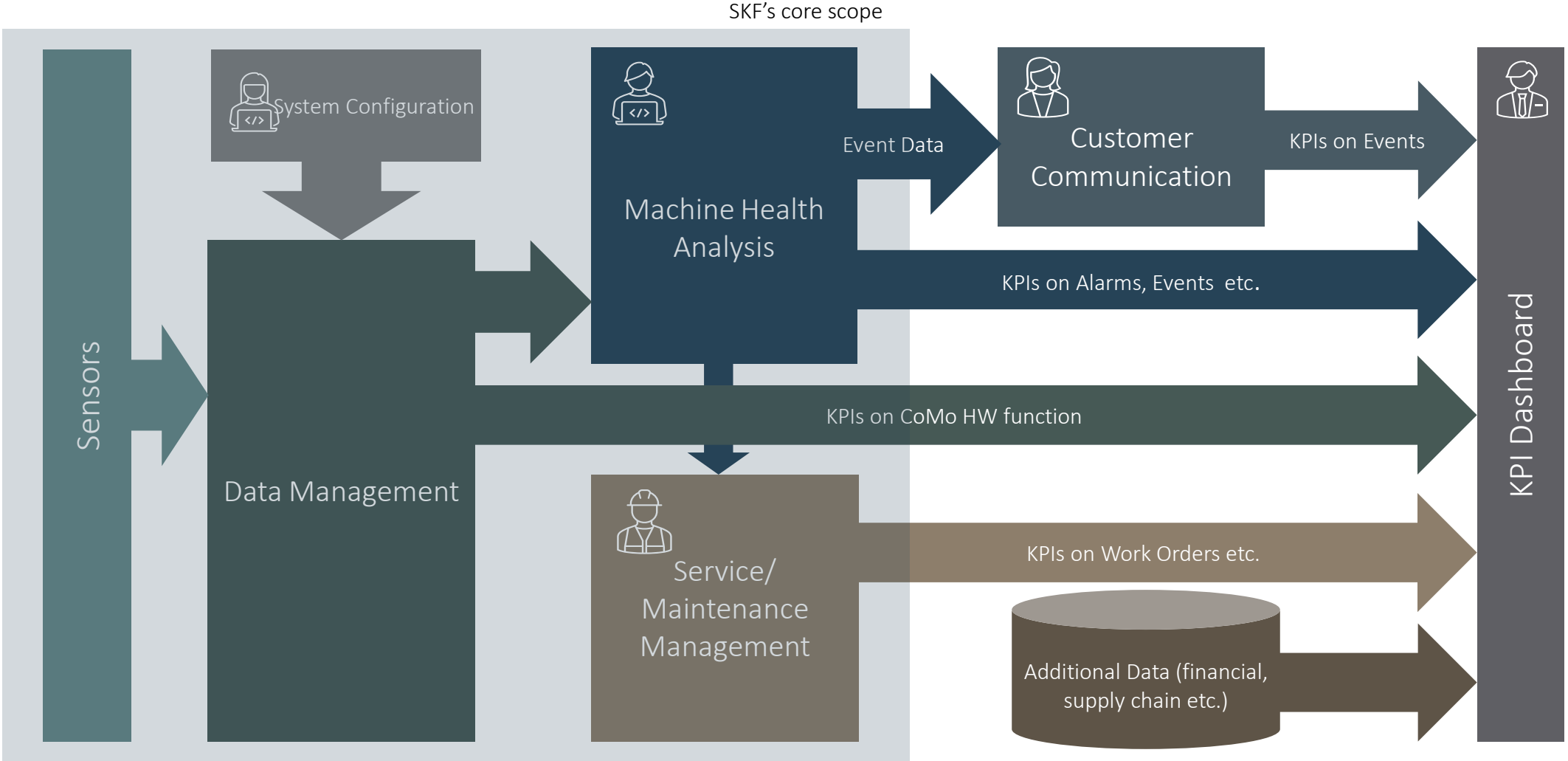
SKF's perspective in condition monitoring

- 100+ years at the heart of rotating equipment

- From the machine, looking out to the digital world

- Vibration monitoring technology is at the core of tracking rotating equipment health

- One size cannot fit all

Machine condition indicators
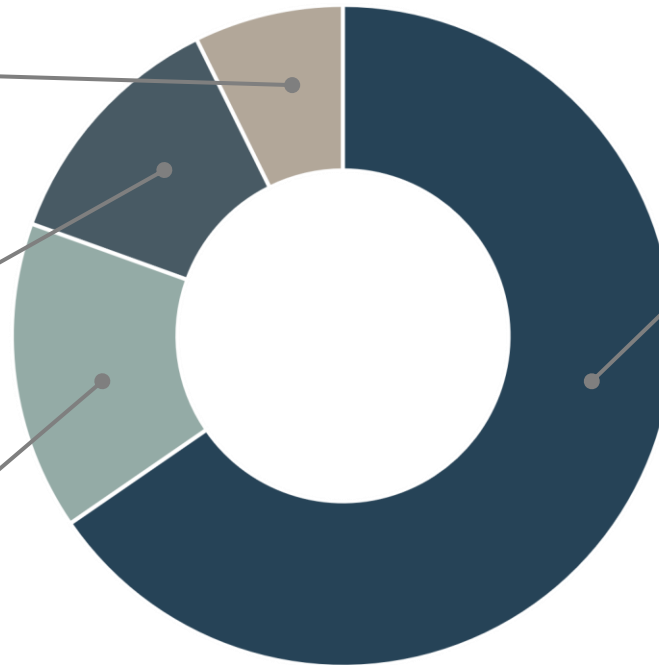

Electric motor test

Ultrasonics

Thermography

Lubricant analysis

Services

Condition Monitoring Technologies
(Frost & Sullivan 2018)

Vibration

■ Vibration ■ Lubrication ■ Thermography ■ Others

https://www.skf.com/group/products/condition-monitoring-systems

SKF @ptitude Observer
SKF Enlight Centre

SKF Microlog dBX

SKF Multilog
IMx-8/16

SKF Enlight Collect IMx-1

SKF Enlight ProCollect
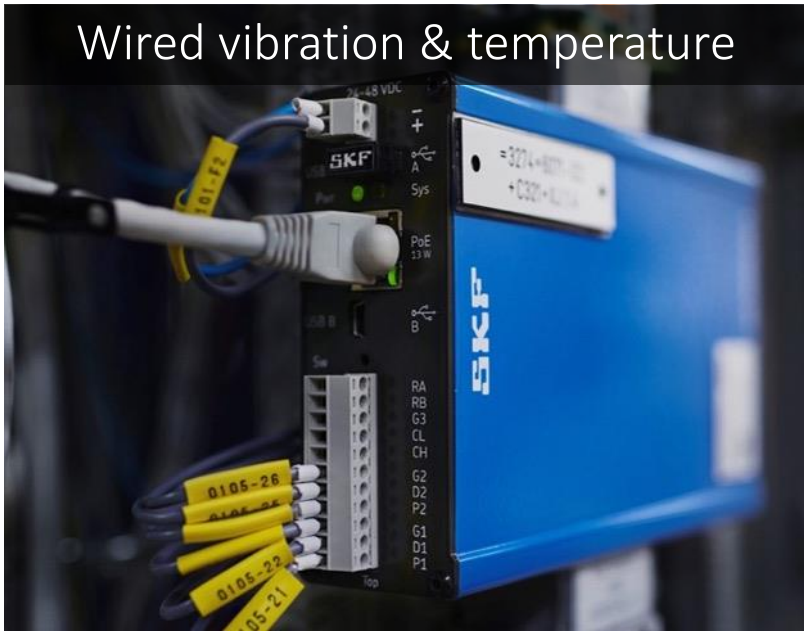
Technology and services

Wired vibration & temperature

Wireless vibration & temperature

Wireless vibration & temperature

Wired vibration & temperature

Wireless vibration & temperature

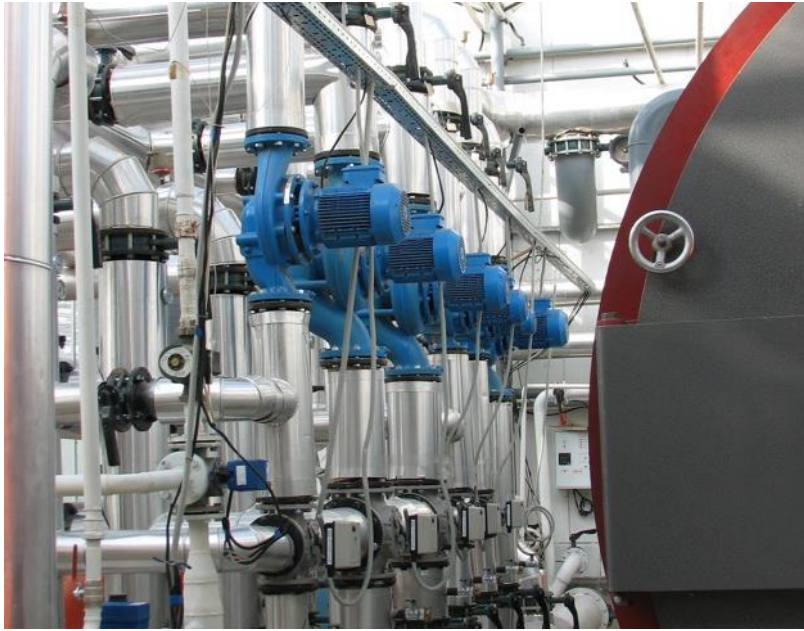Wireless lubricators

- Stationary equipment
- Steady speed and loads
- Clean environment
- Easy to access
- ISO standard vibration

Easy to monitor

Such assets are many, but relatively simple to monitor.

Challenging to monitor

Such assets are complex to monitor.

- Fixed & mobile assets
- Many assets
- Variable speed and loads
- Harsh environment
- Difficult to access
- Complex vibration

How does it all come together?

Mix of Data Acquisition Devices

Portables

Wired

Wireless

Customer O&M team and/or SKF Rotating Equipment Performance center

Expertise + AI based Condition Monitoring

Process data

Additional data sources

Root cause analysis

Corrective action recommendation

Customer O&M team

Expert support in Bearing selection

Installation & Alignment

Seals

Lubrication systems

TECHNOLOGY

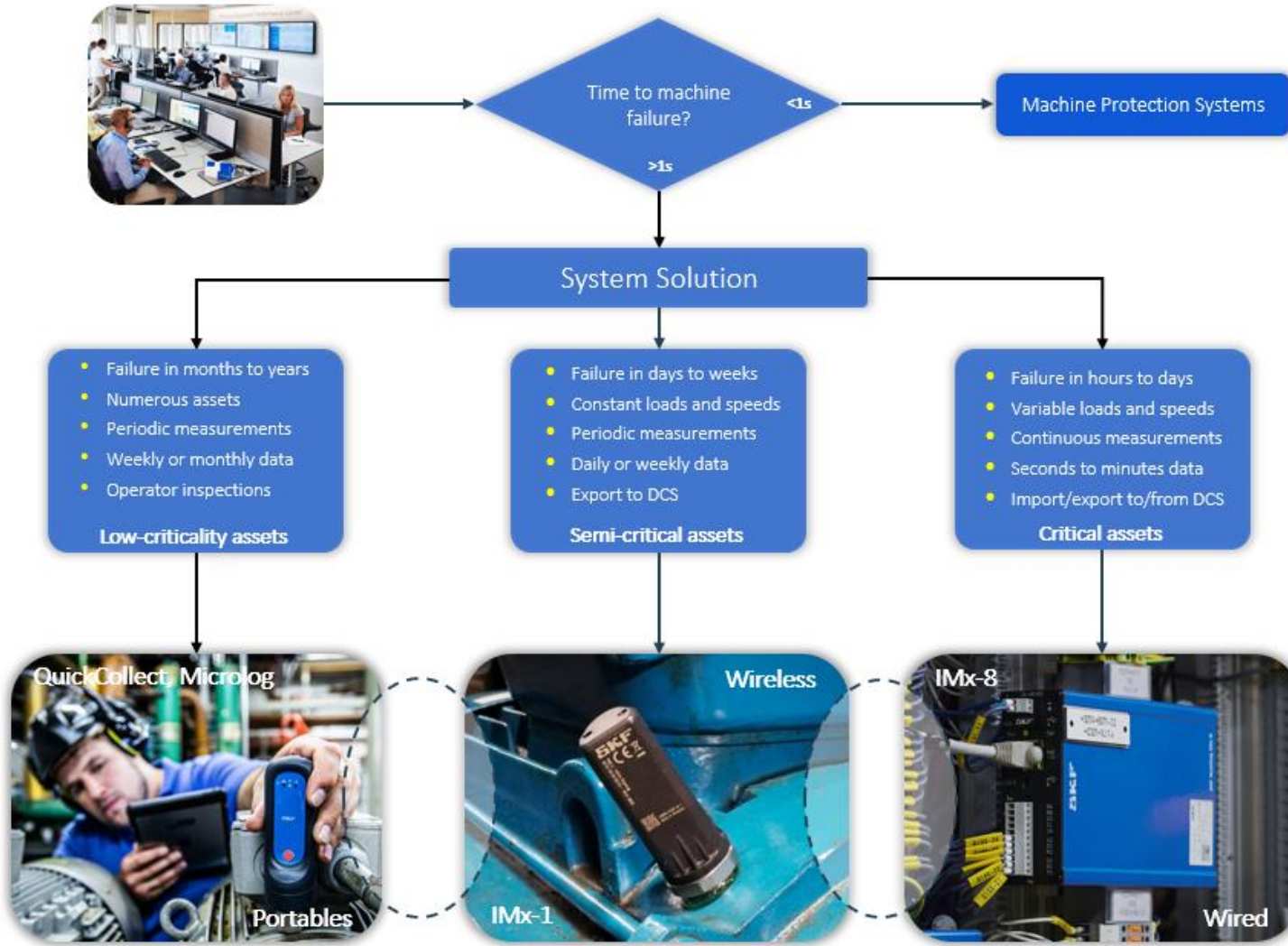# SKF Condition Monitoring Systems

- **One size cannot fit all**
  - A range of tools monitoring rotating equipment health

- **Portable hardware**
  - Manual data-collection and analysis.

- **Wireless hardware**
  - Automate manual data-collection and analysis at scale.

- **Wired hardware**
  - Challenging monitoring applications at scale.

- **Software**
  - Cloud and On-Premises

- **Services**

Selecting the right tools for the job

Select the right condition monitoring solutions based on the asset criticality and failure mode detection horizon

Time to machine failure?

<1s → Machine Protection Systems

>1s

System Solution

- Failure in months to years
- Numerous assets
- Periodic measurements
- Weekly or monthly data
- Operator inspections

Low-criticality assets

- Failure in days to weeks
- Constant loads and speeds
- Periodic measurements
- Daily or weekly data
- Export to DCS

Semi-critical assets

- Failure in hours to days
- Variable loads and speeds
- Continuous measurements
- Seconds to minutes data
- Import/export to/from DCS

Critical assets

QuickCollect, Microlog

Portables

Wireless

IMx-1

IMx-8

Wired

Portables: SKF Enlight ProCollect

Periodic data-collection
- Rugged Quickcollect hand-held wireless sensor.

Condition indicators
- Machine vibration, bearing condition, temperature
- Trends, time-waveform, spectrum

Operator inspection rounds
- Replace paper log-sheets and enhance with condition indicators
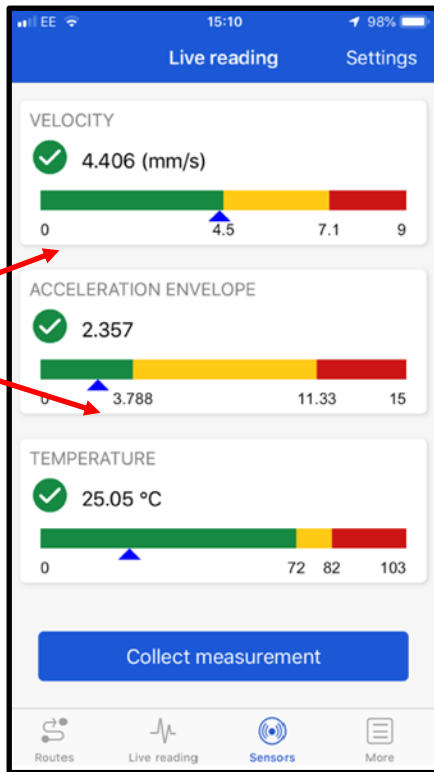
Mobile tablet/phone operation
- App connected to cloud-based software

Portables: SKF Enlight ProCollect

Detection

Inform

Data

Diagnosis

Portables: GoPlant from SKF
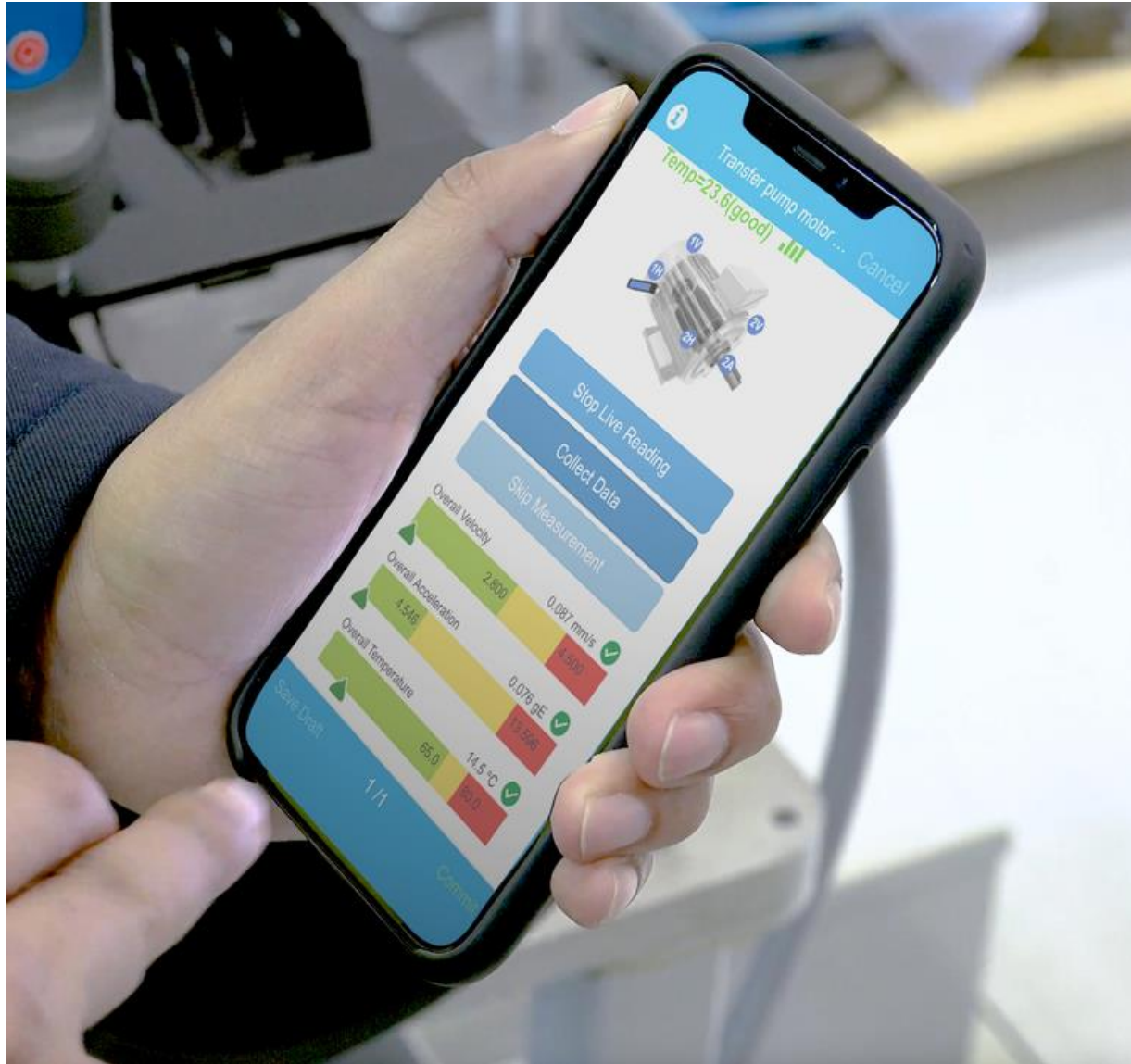
Operator inspection rounds
- Replace paper log-sheets and enhance with condition indicators

Periodic vibration data-collection
- Rugged Quickcollect hand-held wireless sensor.

Condition indicators
- Machine vibration, bearing condition, temperature
- Trends, spectrum

Stand alone host software
- Easy to implement
- On-premises
- Cloud

Portables: SKF Microlog Analyzer dBX

Large screen.
Fast measurements.
Easy to use.

Periodic data-collection
– Rugged wired sensors and Microlog vibration analyser.

Condition indicators
– Machine vibration, bearing condition, speed, phase angle, temperature.

Analysis data
– Multi-channel, trend, time-waveform, spectrum, waterfall, cascade, bode, orbit.
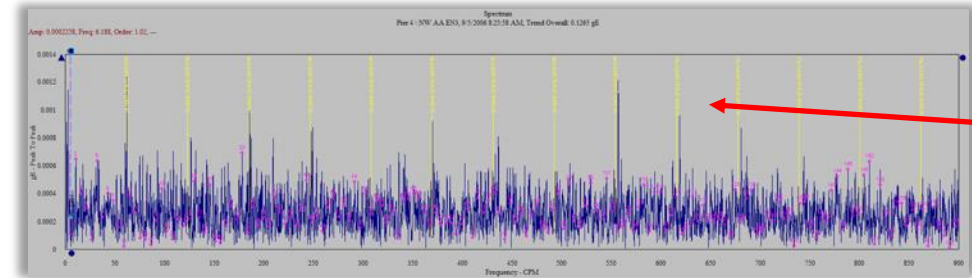
Condition monitoring specialist tool
– On-site analysis and trouble-shooting on all asset classes
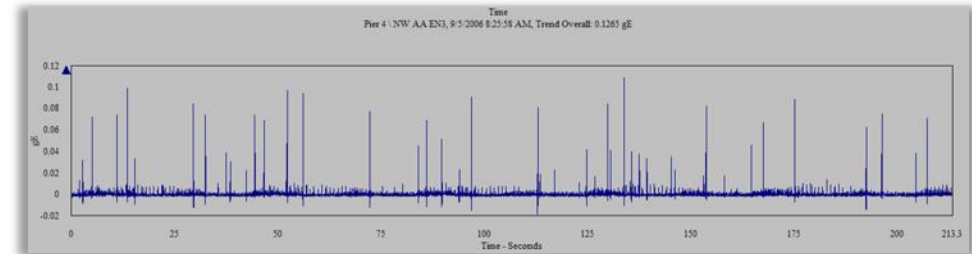– Software support on-premises or cloud.

Portables: SKF Microlog Analyzer dBX

Periodic data

Diagnosis

Anomaly detection

Feedback

Wireless: SKF Enlight Collect IMx-1

Hourly & periodic data-collection
- Rugged stud-mounted wireless sensor.

Condition indicators
- Machine vibration, bearing condition, temperature
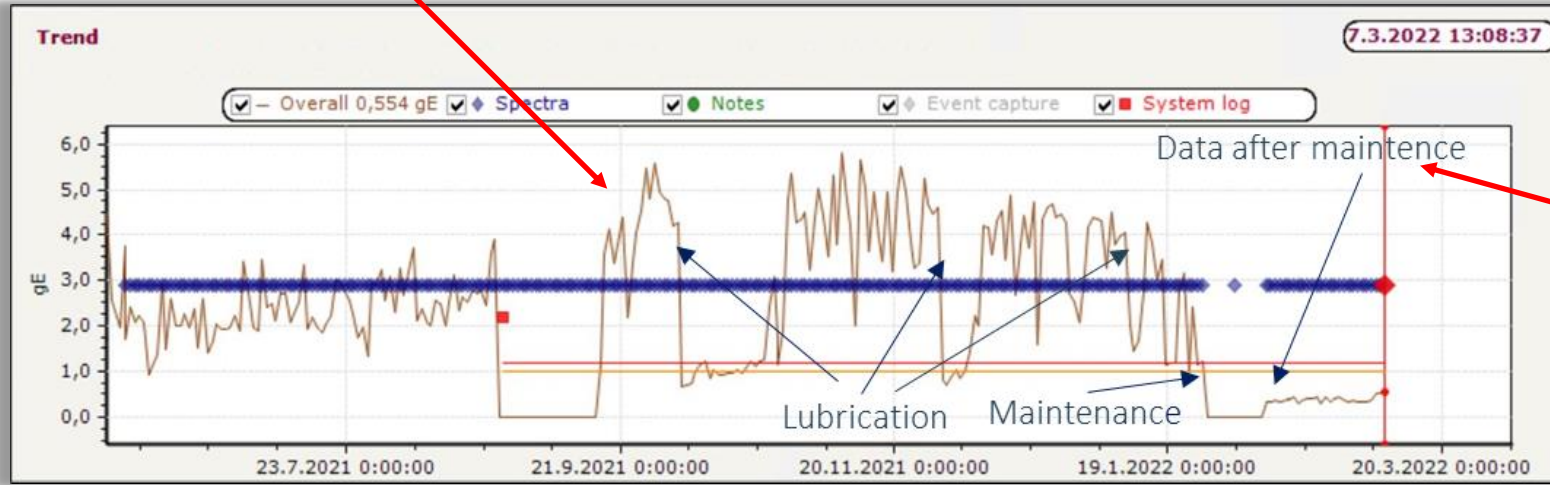- Trend, time-waveform, spectrum, waterfall.

Automation of manual routes
- Vibration analysis routes
- Inaccessible locations

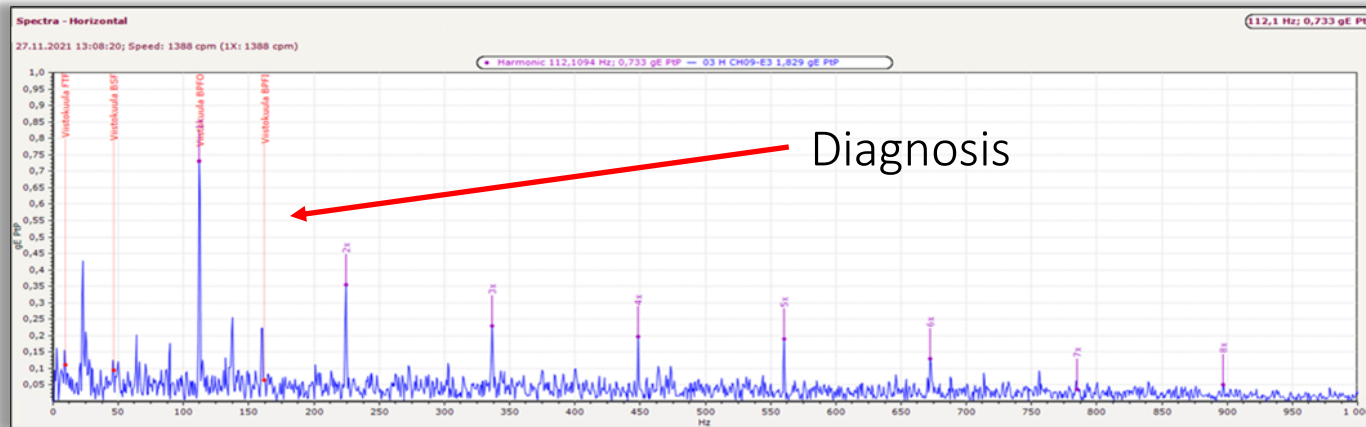## Condition monitoring specialist tool
- Anomaly detection and diagnostics on semi-critical assets such as large fans
- Software support on-premises or cloud

Wireless: SKF Enlight Collect IMx-1

Wired: SKF Multilog IMx-8/16

Advanced parallel data acquisition
- Continuous measurements
- Adapt for variable speeds and loads

Condition indicators
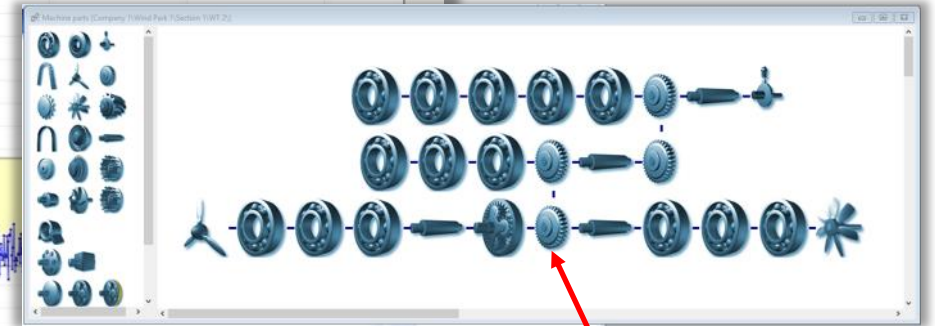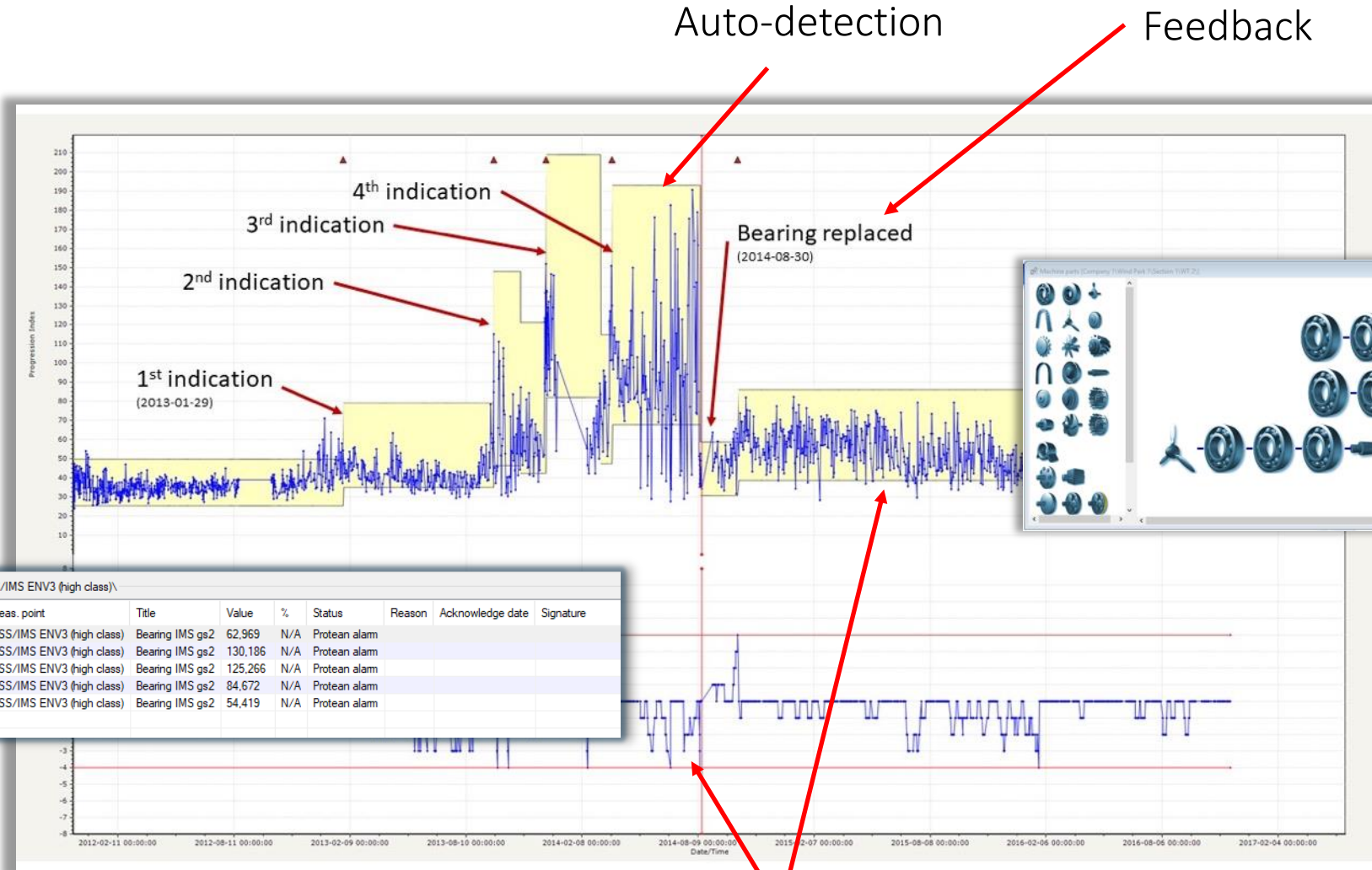- Machine vibration, bearing condition, speed, phase angle, temperature.

Analysis
- Multi-channel synchronous measurements
- Trend, time-waveform, spectrum, waterfall, cascade, bode, orbit

Challenging applications
- Wind turbines, rolling mills, marine thrusters, conveyor drives, paper machines
- Advanced fault detection and diagnostics
- On-premises or cloud
- Connection to DCS

Wired: SKF Multilog IMx-8/16

Wired: SKF Multilog IMx-M

- **API-670 machinery protection**
  - High channel density racks
  - Reduced cabinet footprint

- **Condition monitoring**
  - Advanced multi-channel parallel data acquisition
  - Variable speeds and loads

- **Condition indicators**
  - Radial vibration, axial position, speed, phase angle, temperature

- **Analysis**
  - Multi-channel, synchronous measurements, trend, time-waveform, spectrum, waterfall, cascade, bode, orbit

- **Complex projects**
  - Greenfield contractors deploying across all classes of equipment from pump systems to turbo-machinery

Wired: SKF industrial sensors

- Garbage in = garbage out

- Vibration: acceleration, velocity, displacement

- Temperature: dual vibration + temperature, PT 1000 thermocouple

- Application optimised: complex specification selected with SKF experience from reliable suppliers

- Piezo-electric technology: industry-proven sensing solution over wide range of frequencies and environments. MEMS technology still in infancy.

- Eddy Current Probe technology for machine protection systems

Software solutions

On-Premises

- Software application and database installed locally

- Capability - and need - to manage installation, upgrades, and database maintenance on-site

- Data secured and shared across the internal network. No internet connection permitted or possible

On Cloud

- Software application and database installed on internet-based host: e.g. Amazon Web Services

- No customer capability - or desire - to manage installation, upgrades, and database maintenance.

- Data secured and shared across the internet. Enable benefits from economy of scale

Software: SKF @ptitude Observer

- **Expert diagnostics and analysis**
  - Used with IMx-1, IMx-8/16, Microlog

- **Detect issues**
  - Auto-detection & machine learning
  - Manual alarm & event log.

- **Diagnose issues**
  - Automated rule-based AI methods
  - Manually with multiple complex vibration analysis plots and trends.

- **Share data and results**
  - Plant data historians (OPC-UA)
  - External corporate dashboards
  - Maintenance management systems

Software: SKF Enlight Centre
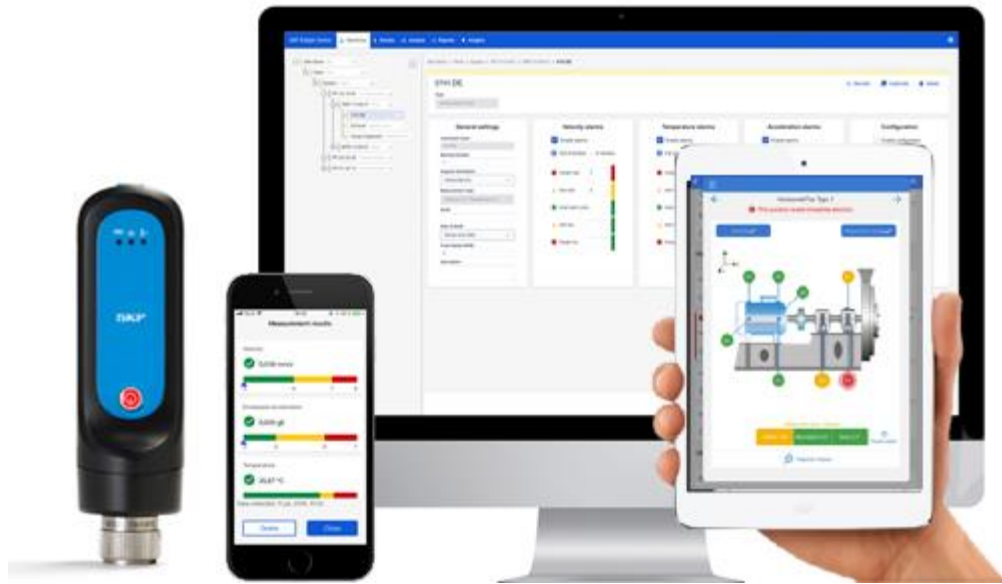
- **Non-expert cloud-based visualisation**
  - Used with QuickCollect and ProCollect

- **Detect issues**
  - Auto-detection
  - Manual alarm & event log

- **Diagnose**
  - Manually with vibration analysis plots and trends

- **Share data and results**
  - Cloud-to-cloud
  - Maintenance management
  - Corporate dashboards

Software: SKF Enlight AI
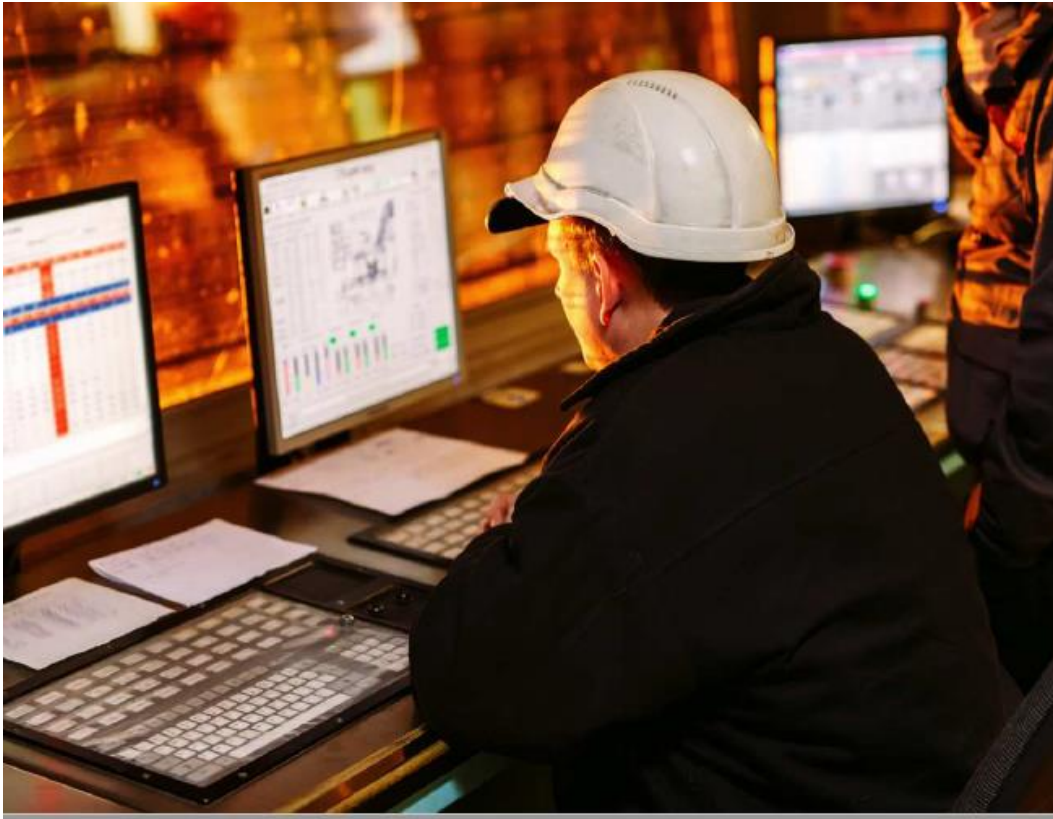
Not a single product - behind the scenes algorithms

- Auto-detection, machine learning and rule-based diagnostic tools for vibration
- Process data analytic AI as custom project

Data-reduction

- How depends upon asset criticality
- Automatically handle the easy 80%
- Leave the hard 20% to human experts

Different tools needed for different assets

- SKF @ptitude Observer: Protean analytics
- SKF Insight Rail: IRAD/IRSA

Connection to external dashboarding

Connection to SKF dashboarding

Questions?
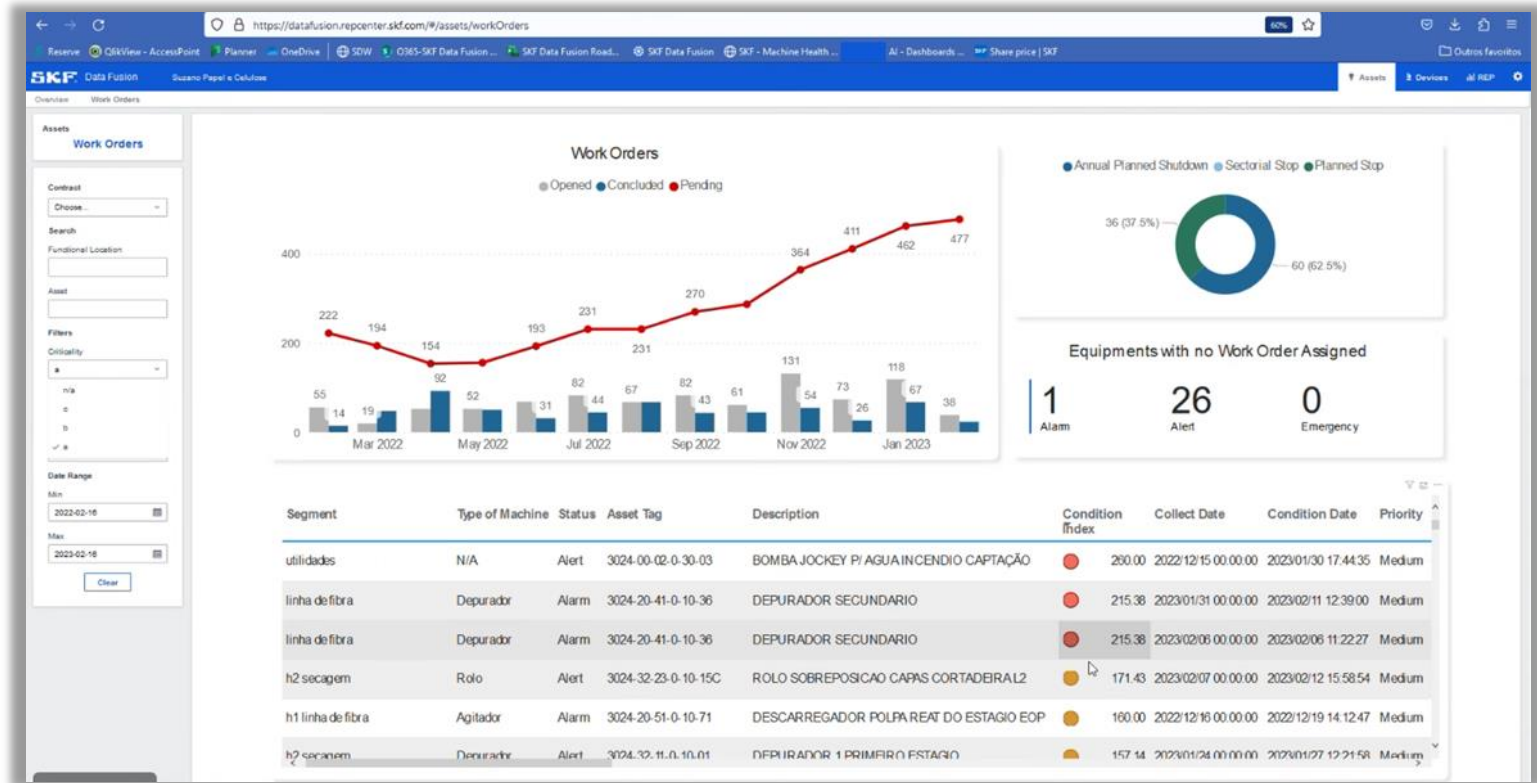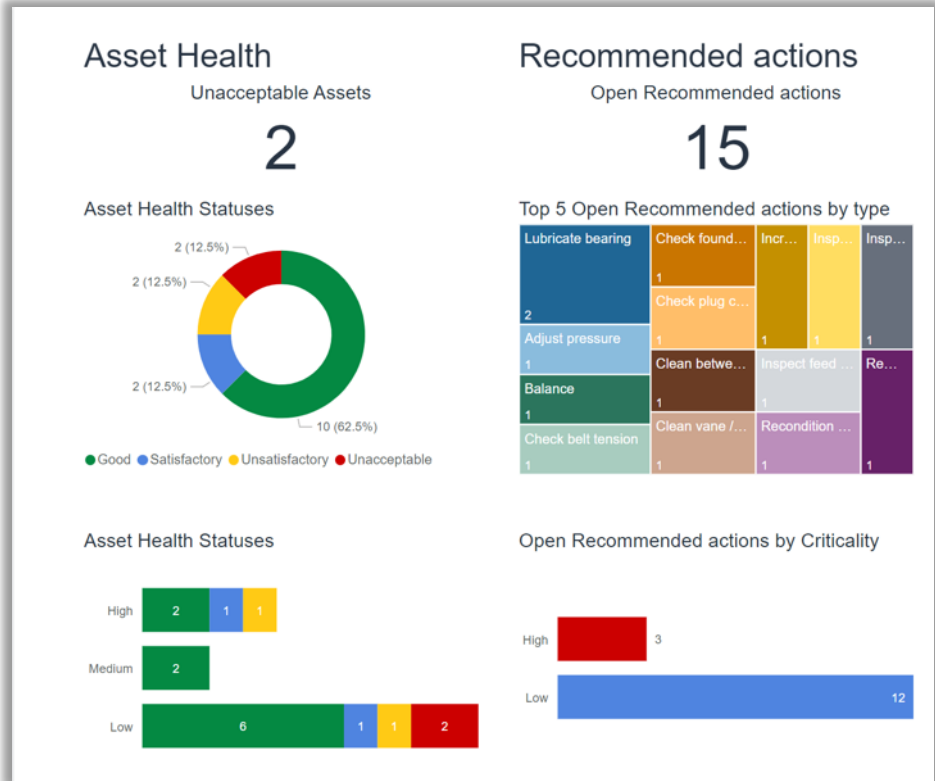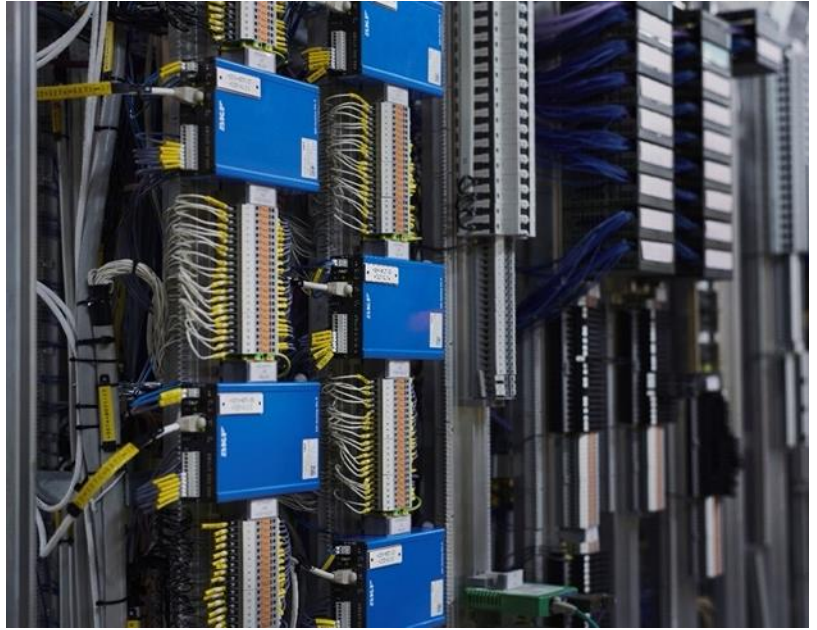
APPENDIX
TECHNOLOGY CAPABILITY

Failure mode detection horizon?

< 1 second → Machine Protection Systems

> 1 second

System Solution

Balance-of-plant
- Failure in months to years
- Many kinds of assets
- Periodic measurements
- Weekly or monthly data

Offline   Portables

Semi-critical assets
- Failure in days to weeks
- Constant loads and speeds
- Periodic measurements
- Daily or weekly data

Online   Wireless

Critical assets
- Failure in hours to days
- Variable loads and speeds
- Continuous measurements
- Seconds to minutes data

Online   Wired

Technical features: QuickCollect

- Overall level measurements and time-waveforms

- Vibration : acceleration (10 Hz-10 kHz), ISO velocity (10 Hz-1 kHz)

- Bearings & gears: SKF Acceleration Enveloping (ENV3)

- Temperature

- Configurable FFT resolution

- ProCollect App - Android or iOS

- Cloud-based host software

- Sensor environment: -20 to +60°C, IP65

- Rechargeable battery: full working day under normal use

- External sensor support

- Rugged handheld ergonomics - 1.8m drop test.

- Hazardous area certified - ATEX/IECEx/NEC Zone 1

Technical features: QuickCollect App
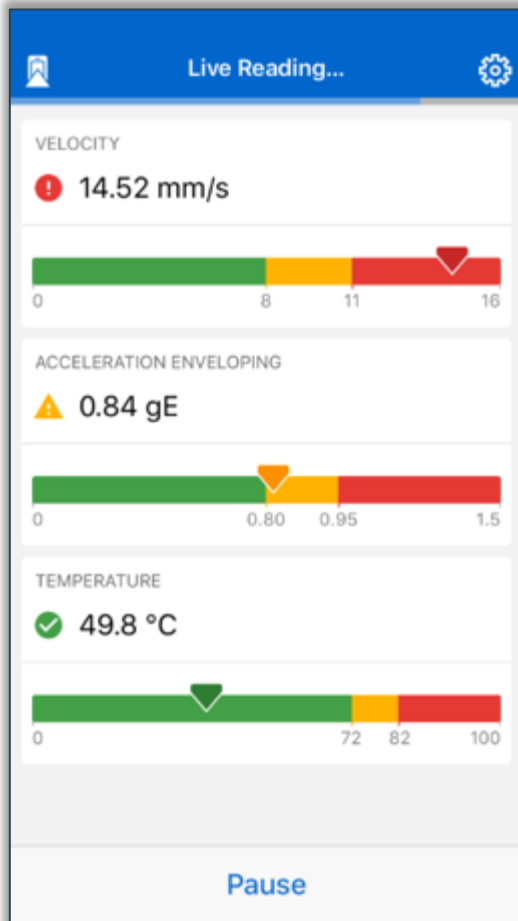
- Free App available on iOS and Android

- Provides display for QuickCollect sensor
  - 'Live' overall updates for velocity, gE band 3, temperature
  - Fixed FFT display of velocity, gE band 3

- Alarm levels
  - Predefined based on ISO levels of machine size and operating speed
  - Customer set levels.

- Email the data .csv file from phone to SKF for advice

- Take a picture of the condition or location of the machine with the phone
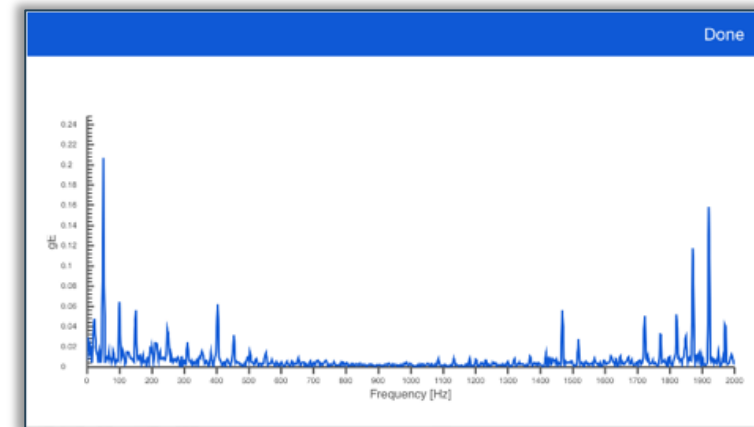
Technical features: Pulse App
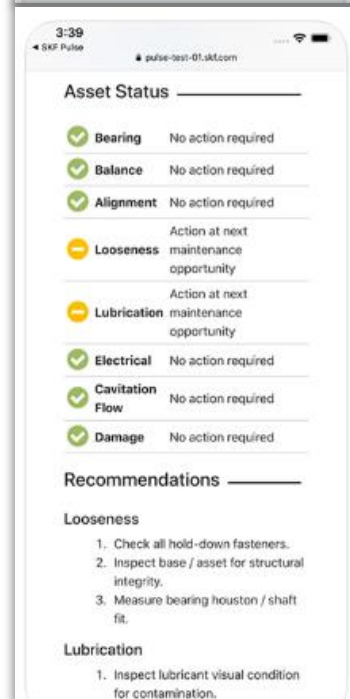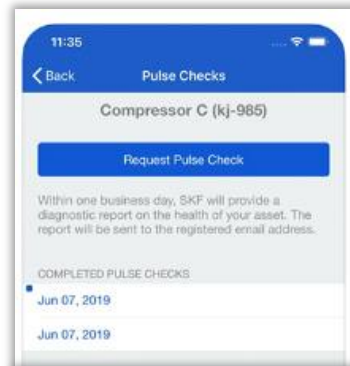
- Free App available on iOS and Android

- Provides display for QuickCollect sensor
  - 'Live' overall updates for velocity, gE band 3, temperature
  - Fixed FFT display of velocity, gE band 3
  - Trend last 5 measurements

- Alarm levels
  - Predefined based on ISO levels of machine size and operating speed
  - Customer set levels.

- Build assets in the phone with machine details

- Pay-per-use request to SKF for vibration diagnosis
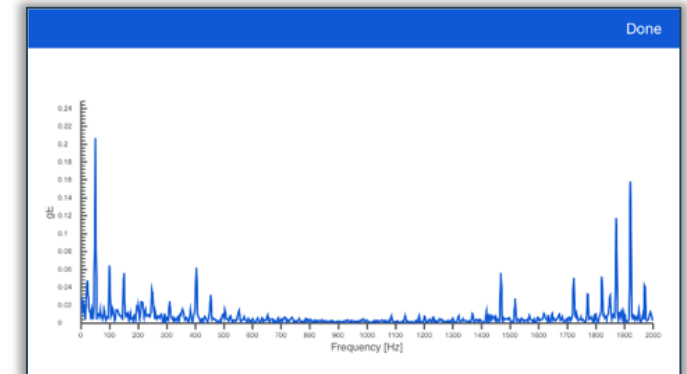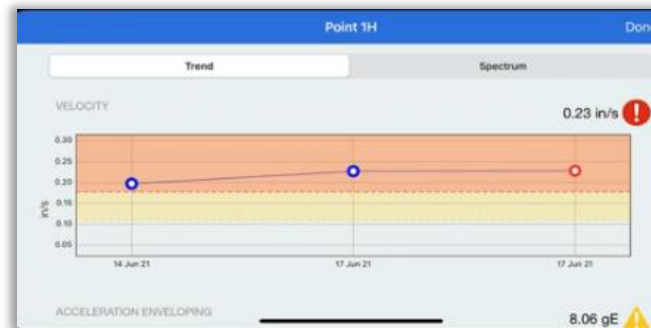
Technical features: GoPlant from SKF

- Advanced inspection techniques, including visibility rules

- Collect vibration and temperature readings with the QuickCollect sensor

- Data can be exported in multiple data formats including csv and Excel

- Capture asset and product barcodes, camera input, sketches and digital signatures

- Show the operator previous or historical answers while they are in front of an asset

- Embed instructions, reference documents, maps and images

- Branch on answer logic, intra-form math

- Grade and score responses

- Synchronize with external databases for SKUs, equipment lists and others

- Android or iOS app

Technical features: Microlog dBX

- Next generation vibration analyzer & data-collector

- 4 channels of high-speed parallel data-acquisition

- Large 10.1" touch-screen for manual expert analysis

- Overall level measurements and time-waveforms

- Vibration : acceleration (DC-40 kHz), ISO velocity (10 Hz-1 kHz)

- Bearings & gears: SKF Acceleration Enveloping (ENV 1,2,3,4)

- Configurable high resolution FFT and maximum frequency

- Cloud-based or on-premises host software

- Rechargeable batteries: full working day under normal use

- Rugged handheld ergonomics - 1.2m drop test, IP65

- Fast route data-collection with Multi-Point-Automation (MPA)

- RFID reader for automated point identification

- Onboard Apps: Route data-collector, real-time FFT, balancing, bump-test, raw-data recorder, order-tracking, run-up/coast-down, orbits.

Technical features: IMx-1

- Overall level measurements and time-waveforms

- Vibration : acceleration (10 Hz-10 kHz), ISO velocity (10 Hz-1 kHz)

- Bearings & gears: SKF Acceleration Enveloping (ENV3)

- Temperature

- Configurable FFT resolution, measurement and transmit rates: 1/hour to 1/week.

- Cloud-based or on-premises host software

- Local alarm logic with configurable thresholds

- Sensor environment: -40 to +85°C, IP69K

- Non-replaceable battery: 4 to 6 years life (dependent upon configuration and environment)

- Inter-node range: 10-20 m

- Gateway IP65 for outdoor use

- Gateway: +24 Vdc or PoE

- ATEX/IECEx certified (Zone1/Zone 2)

Technical features: IMx-8/16

- Continuous monitoring with permanently installed sensors

- 8 or 16 channels of high-speed parallel data-acquisition

- 4 digital inputs for up to 4 shafts, or external analog triggers.

- Overall level measurements and time-waveforms

- Vibration : acceleration (DC-40 kHz), ISO velocity (10 Hz-1 kHz)

- Bearings & gears: SKF Acceleration Enveloping (ENV 1,2,3,4)

- Configurable high resolution FFT and maximum frequency.

- Cloud-based or on-premises host software

- Power supply: +24Vdc or Power-over-Ethernet (PoE)

- Compact dimensions - DIN-rail mounted paperback book, for reduced enclosure footprint.

- Multi-Parameter-Gating and Adaptive Alarming for variable speeds and loads.

- Modbus TCP/IP - direct connection to DCS for live import/export of data for multiple purposes.

- Onboard wireless connectivity for connection to WLAN or cellular networks

Technical features: @ptitude Observer
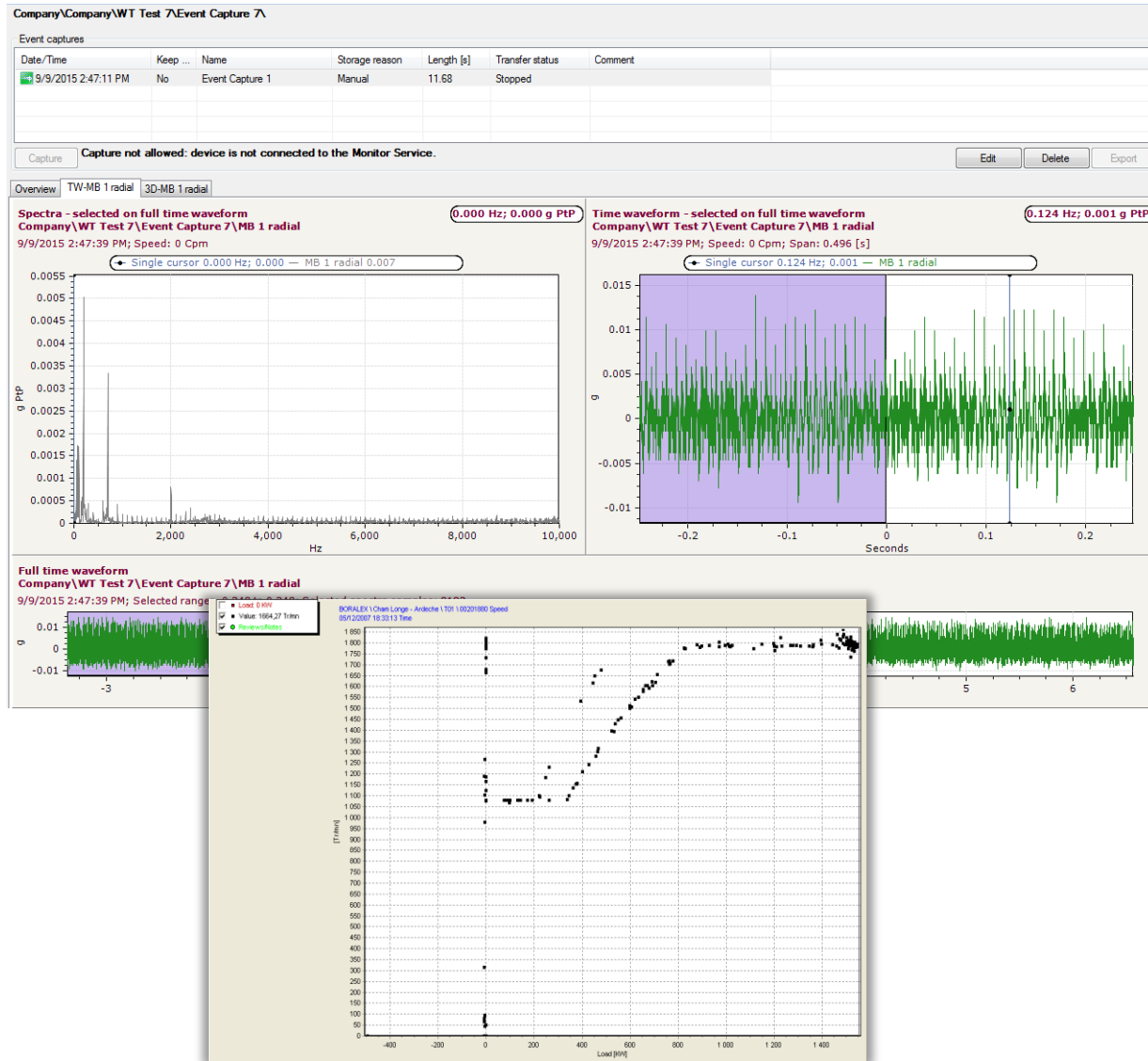
- Cloud or on-premises

- Analysis plots: trend, multi-trend, bode, orbit, shaft-centerline, polar, waterfall, cascade, topology, cepstrum.

- Gear inspection plot, roll-profile plot, event and run-cycle capture

- Scalar, vector & band-alarming

- Automated ML/detection - Protean analytics

- Automated diagnostics - rule-based machine parts model

- Load and speed monitoring – adaptive alarming, operating classes

- Live views and process HMI

- Rail track monitoring

- Connectivity: Modbus RTU, TCP/IP configuration for DAD

- Connectivity: OPC-UA, Phoenix API

- Email or SMS alerting

- Cyber security: encryption TLS, AES-CBC, password.

- MS SQL database

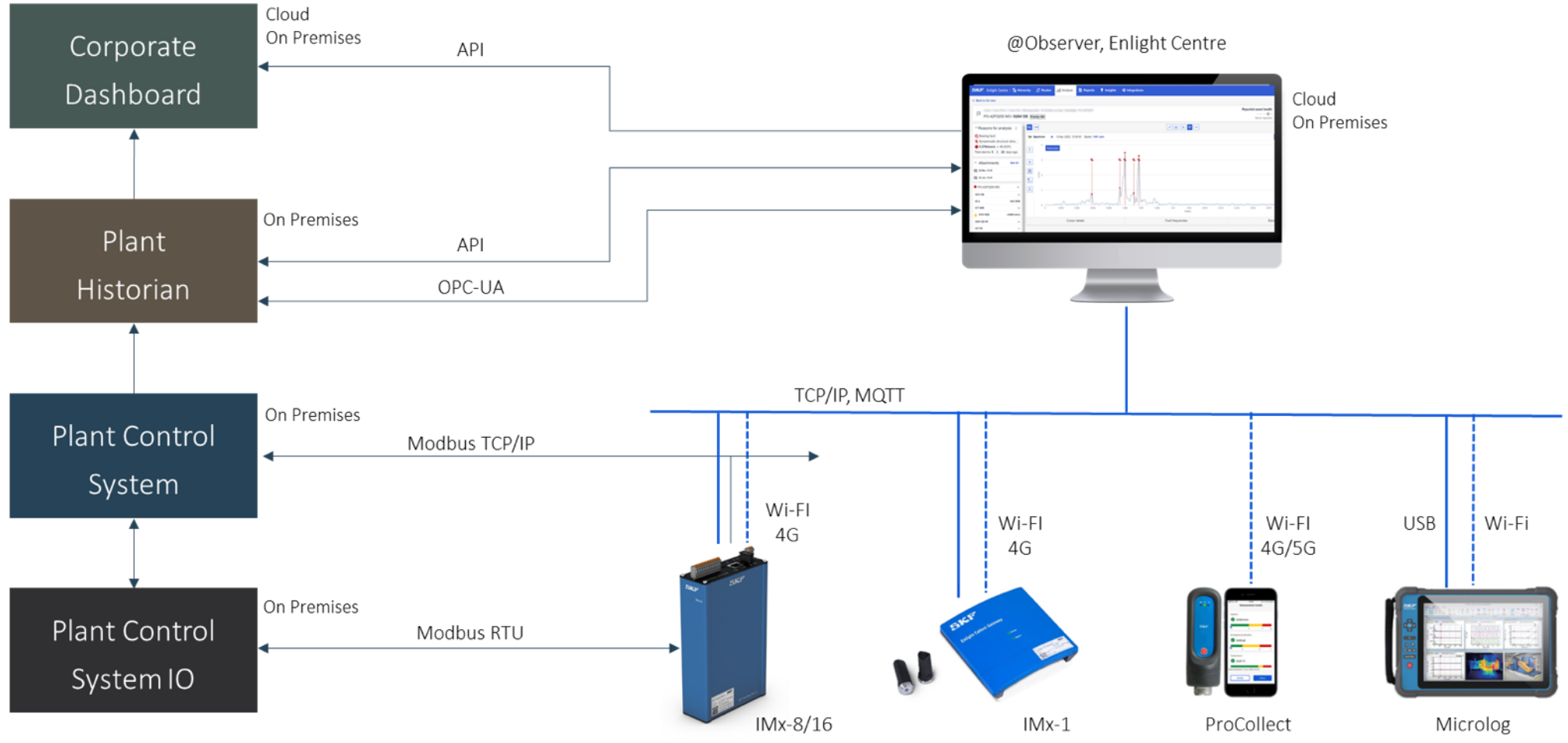- User rights management, multiple language support

Technical features: SKF Enlight Centre

- Cloud only (AWS)

- Quickcollect/ProCollect vibration data-collection

- Operator inspection rounds

- Route management

- Alarm management - streamlined auto-detection

- Vibration analysis - fixed speeds and loads

- Reporting dashboards

- API connection to third parties

Connection to other systems

Corporate Dashboard
- Cloud
- On Premises

Plant Historian
- On Premises

Plant Control System
- On Premises

Plant Control System IO
- On Premises

@Observer, Enlight Centre
- Cloud
- On Premises

API

API

OPC-UA

TCP/IP, MQTT

Modbus TCP/IP

Modbus RTU

Wi-FI 4G — IMx-8/16

Wi-FI 4G — IMx-1

Wi-FI 4G/5G — ProCollect

USB / Wi-Fi — Microlog

Capability by machine fault

Machine faults

Detection ✅ Diagnosis ✅

Machine faults	Quickcollect (Detection / Diagnosis)	Microlog (Detection / Diagnosis)	IMx-1 (Detection / Diagnosis)	IMx-8/16 (Detection / Diagnosis)
Unbalance	✅ ✅	✅ ✅	✅ ✅	✅ ✅
Misalignment	✅ ✅	✅ ✅	✅ ✅	✅ ✅
Looseness	✅ ✅	✅ ✅	✅ ✅	✅ ✅
Rolling element bearings – early stage	✅ ✅	✅ ✅	✅ ✅	✅ ✅
Rolling element bearings – late stage	✅ ✅	✅ ✅	✅ ✅	✅ ✅
Resonance	✅ ❌	✅ ✅	✅ ✅	✅ ✅
Rotor/shaft rubs	❌ ❌	❌ ✅	❌ ❌	✅ ✅
Hydraulic/aerodynamic (e.g. cavitation)	✅ ✅	✅ ✅	✅ ✅	✅ ✅
Gears – early stage	✅ ✅	✅ ✅	✅ ✅	✅ ✅
Gears – late stage	✅ ✅	✅ ✅	✅ ✅	✅ ✅
AC motor issues	✅ ❌	✅ ✅	✅ ❌	✅ ✅
DC motor issues	✅ ❌	✅ ✅	✅ ❌	✅ ✅
Belt drive issues	✅ ✅	✅ ✅	✅ ✅	✅ ✅
Beat vibration	✅ ❌	✅ ✅	✅ ❌	✅ ✅

Capability by application (1)

Critical assets	Quickcollect	Microlog	IMx-1	IMx-8/16
Steam turbines	✗	✓	✗	✓
Gas turbines	✗	✓	✗	✓
Compressors	✗	✓	✗	✓
Large pumps	✗	✓	✗	✓
Large fans/blowers	✗	✓	✗	✓
Large gearboxes	✗	✓	✗	✓
Main paper machine	✗	✓	✗	✓
Conveyor drives	✗	✓	✓	✓
Horizontal & vertical mills	✗	✓	✓	✓
Mining trucks	✗	✓	✗	✓
Wind turbines	✗	✓	✗	✓
Marine propulsion	✗	✓	✗	✓
Rolls stands	✗	✓	✗	✓
Planetary gearboxes	✗	✓	✗	✓

Capability by application (2)

Semi critical assets	Quickcollect	Microlog	IMx-1	IMx-8/16
HVAC systems	✓	✓	✓	✗
Cooling Tower Fans (CTF's)	✗	✓	✓	✗
Mixers	✓	✓	✓	✗
Medium pumps	✓	✓	✓	✗
Medium fans	✓	✓	✓	✗
Medium gearboxes	✓	✓	✓	✗
Paper machine auxiliaries	✓	✓	✓	✓
Vibrating screens	✗	✓	✓	✓
Machine tool spindles	✗	✓	✗	✓
Machine tool grinders	✗	✓	✗	✓
Extruders	✗	✓	✗	✓
Marine pumping systems	✓	✓	✓	✓

Capability by application (3)

Low criticality assets	Quickcollect	Microlog	IMx-1	IMx-8/16
Small pumps	✔	✔	✔	✖
Small fans	✔	✔	✔	✖
Small gearboxes	✔	✔	✔	✖
Conveyor idler rolls	✔	✔	✔	✖

Capability by vibration measurements

Vibration measurements	Quickcollect	Microlog	IMx-1	IMx-8/16
Acceleration	No	Yes	Yes	Yes
Velocity	Yes	Yes	Yes	Yes
Displacement	No	Yes	No	Yes
SKF Acceleration Enveloping (ENV #)	3	1,2,3,4	3	1,2,3,4, custom
Frequency range (Maximum F_{max})	10 Hz	40 kHz	10 kHz	40 kHz
Frequency range (Typical F_{max})	10 kHz	40 kHz	10 kHz	40 kHz
FFT resolution (anomaly detection)	800 lines	1600 lines	800 lines	3200 lines
FFT resolution (analysis)	3200 lines	25,600 lines	3200 lines	6400 lines
Acceleration digital waveform	Yes	Yes	Yes	Yes
Tachometer/trigger input	No	Yes	No	Yes
Speed measurement	Manual input	Yes	Calculated	Yes
Phase angle measurement	No	Yes	No	Yes
External trigger (analogue)	No	No	No	Yes
External trigger (via Modbus)	No	No	No	Yes

Capability by vibration analysis tools

Vibration analysis (in supporting software)	Quickcollect	Microlog	IMx-1	IMx-8/16
Multi-channel	1	4	1	8 or 16
Trend	✓	✓	✓	✓
Trend auto ML	✗	✗	✗	✗
Adaptive alarming	✗	✗	✓	✓
FFT spectrum	✓	✓	✓	✓
Waterfall plot	✓	✓	✓	✓
Cascade plot	✗	✓	✗	✓
Time-waveform (TWF)	✓	✓	✓	✓
Long TWF (for low speeds)	✗	✓	✓	✓
Time synchronous averaging	✗	✓	✗	✓
Orbit plot	✗	✓	✗	✓
Shaft centre-line	✗	✓	✗	✓
Order tracking	✗	✓	✗	✓
Polar plot (balancing)	✗	✓	✗	✓