Predictive Maintenance as part of a Circular Economy approach
The European Green Deal is our new growth strategy.

Ursula von der Leyen, President EU Commission

In the eyes of Americas manufacturers it is time to act on climate change.

Ross Eisenberg, North American Manufacturers Association

Tackling climate change is a shared mission for mankind.

Xi Jinping, President PRC

The challenge is to ensure this mobility is even safer, cleaner, fully connected and, above all, CO2-neutral.

Dr. Herbert Diess, Chairman of the Board of Management of Volkswagen AG
Carbon neutral manufacturing 2030
The target covers SKF’s emissions in the manufacturing phase of the product life cycle.
From a linear to a circular economy

The circular economy

Reduce
Recycle
Reuse

Take → Make → Waste
From a linear to a circular economy
- Substantially reduce cost and environmental impact with improved efficiency

Supply chain 4.0
Remanufacturing
Application (re)engineering

Asset
Lubrication management
Remote monitoring
Data analytics & Machine learning

Reduce
Recycle
Reuse
Redesign and improve

Enablers
- Digitalization
- Business model: From transactional to performance fee-based
- Striving for the environment
  - Striving for sustainability
  - Striving for clean-tech
Connected Industry is the largest segment for IoT

Global IoT market 2017 in $B:
- Total: 109.8
- Connected Industry: 34.6
- Smart Cities & Energy: 24.9
- Buildings & Living: 14.5
- Healthcare: 11.7
- Mobility: 9.6
- Natural Resources: 6.4
- Retail: 5.0
- Insurance: 3.1

1. Definition: Connected Industry is the largest segment of IoT that specifically focuses on manufacturing, in which industrial assets are connected to the internet.

Source: IoT Analytics Research
Predictive Maintenance: $4.8B in 2019 to $23.5B in 2024 (CAGR 39%)

- Up to 50%* reduction in downtime
- 3-5%* Increased machine useful life:
- Reduced environmental impact
- 10-40%* Reduction in maintenance costs
- 10-25%* Reduction in worker injuries:
- 10-20%* Reduced waste

* Studies on potential of industrial analytics McKinsey (2015)
Remote Monitoring
Remote Analysis

REP Center Brazil
Predictions vs Detections

- **Prediction w/ Auto diagnostics**
  - ML PdM

- **1st detection**
  - Traditional PdM

- **2nd detection**
  - Maintenance

- **Repair**
  - Maintenance

- **Time**
  - Usually between 1 and 2 weeks
  - Usually several weeks

Prediction times will vary depending on data quality and machine complexity.
There are various methods for Predictive Maintenance

- **Hardware Based**
  - Acoustic and vibration sensors: Requires HW manufacturing & deployment

- **Digital twins and expert analysis**
  - Mechanical eng. works with simulations to manually build a machine model – digital twin

- **Manual data driven modeling**
  - Data scientists manually build machine model based on historical data

- **Automated Machine Learning**
  - Unsupervised and automated machine modeling with no people in the loop
Automated Machine Learning

SKF Enlight AI

“Automated Machine Modeling”:
- SW selects its own algorithms
- Generates digital models of machines
- Continuously validates and maintains models

Dozens of algorithms
## All with clear advantages and challenges

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<tr>
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<th>Acoustic and vibration sensors</th>
<th>Digital twins and expert analysis</th>
<th>Manual data driven modeling</th>
<th>Automated Machine Learning</th>
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<td><strong>Accuracy</strong></td>
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<td><strong>Time to failure</strong></td>
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<td><strong>Cost</strong></td>
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Where to go? 180+ Companies in the market

Note: Companies are categorized according to their main field of activity, e.g., *Industrial Automation*: Only companies considered that have a notable use case on PdM; Companies are not mentioned more than once; PdM solutions may also make use of other providers not mentioned here. Startups often cover more than just one field and are therefore roughly allocated. Source: IoT Analytics Research
Predictive Maintenance capabilities

### Acoustic and vibration sensors
- IMx series for online vibration monitoring

### Digital twins and expert analysis
- Rotating Equipment Performance Centers

### Manual data driven modeling
- AI/ML reinforced with physical know how

### Automated Machine Learning
- Enlight AI

**Key Features**
- Accuracy
- Diagnostics
- Scalability
- Time to failure
- Cost
SKF Enlight AI Platform

Global Overview
Compare Site Performance

Site View
Easily compare machines operations

Machine View
Single machine view for a lower level investigation

Sensor View
Sensor raw data available for further technical analysis
Sustainability and Innovation ecosystem – Bruce Walker Ferguson

https://www.youtube.com/watch?v=NcvW1Zmj6Lw