



ENGINEERING
TOMORROW



PE:Region seminar 2018

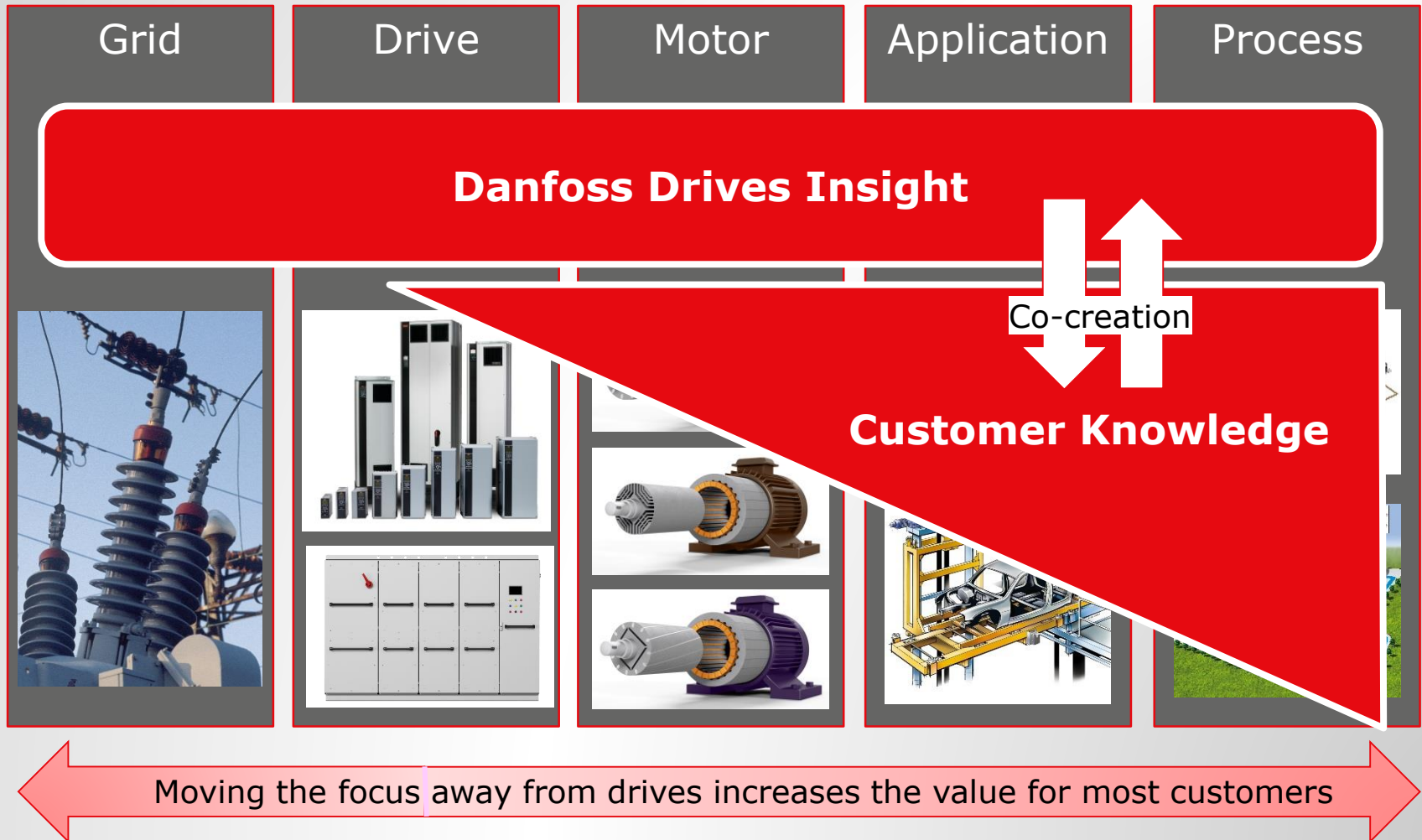
Reliability- centered maintenance in drive applications

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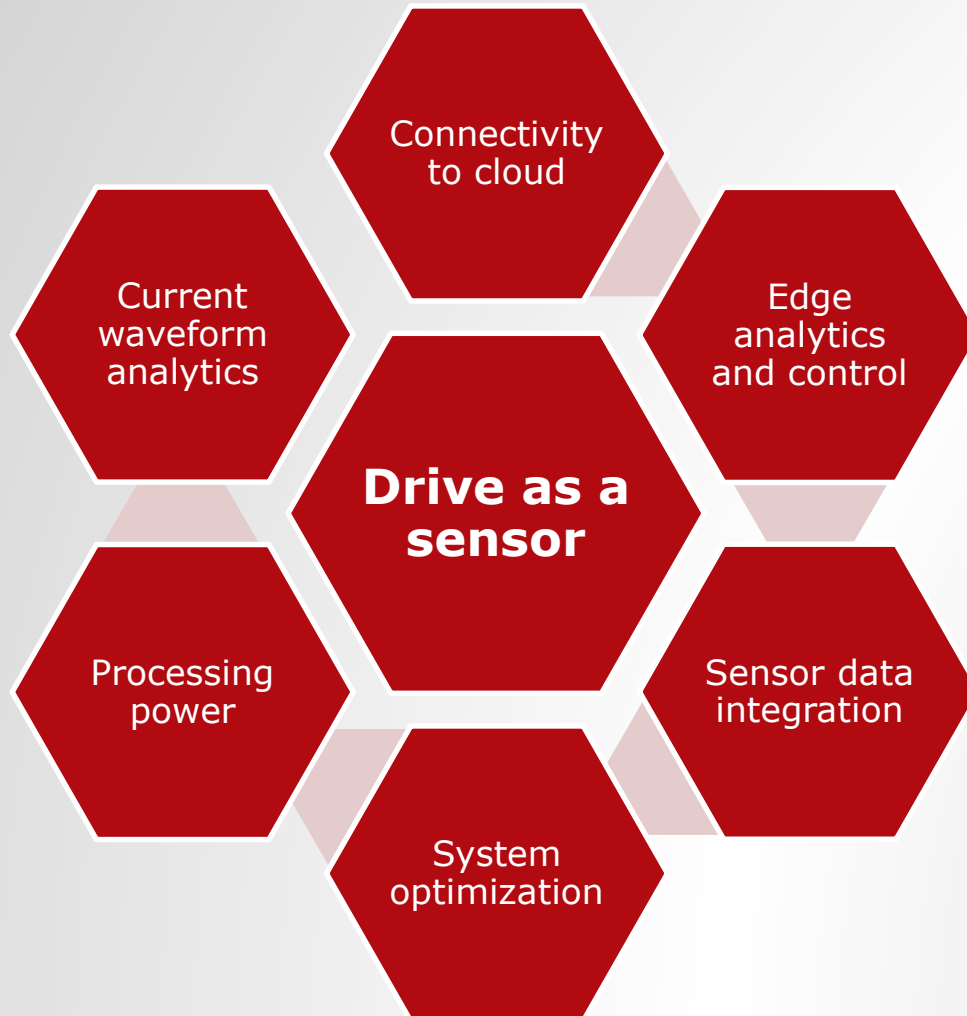
Intelligent drives

A large, faint, diagonal watermark of the Danfoss logo in a script font, spanning across the center of the slide.

Danfoss analytics create new value through co-creation with **customers**



Drive is the **best single sensor** in industrial processes



- The current and voltage sensors in a drive give huge amount of real time data
- Due to the amount of data it must be filtered and processed locally
- Data gives insight into the behavior of the industrial process and enables system wide optimization
- This can be exposed as services and analytics data
- These functionalities are continuously being added to our products

Reliability-centered maintenance

Reliability-centered Maintenance (RCM)

= The right information at the right time

RCM features are designed to determine the condition of in-service equipment in order to predict when service should be performed and prevent customer's downtime.

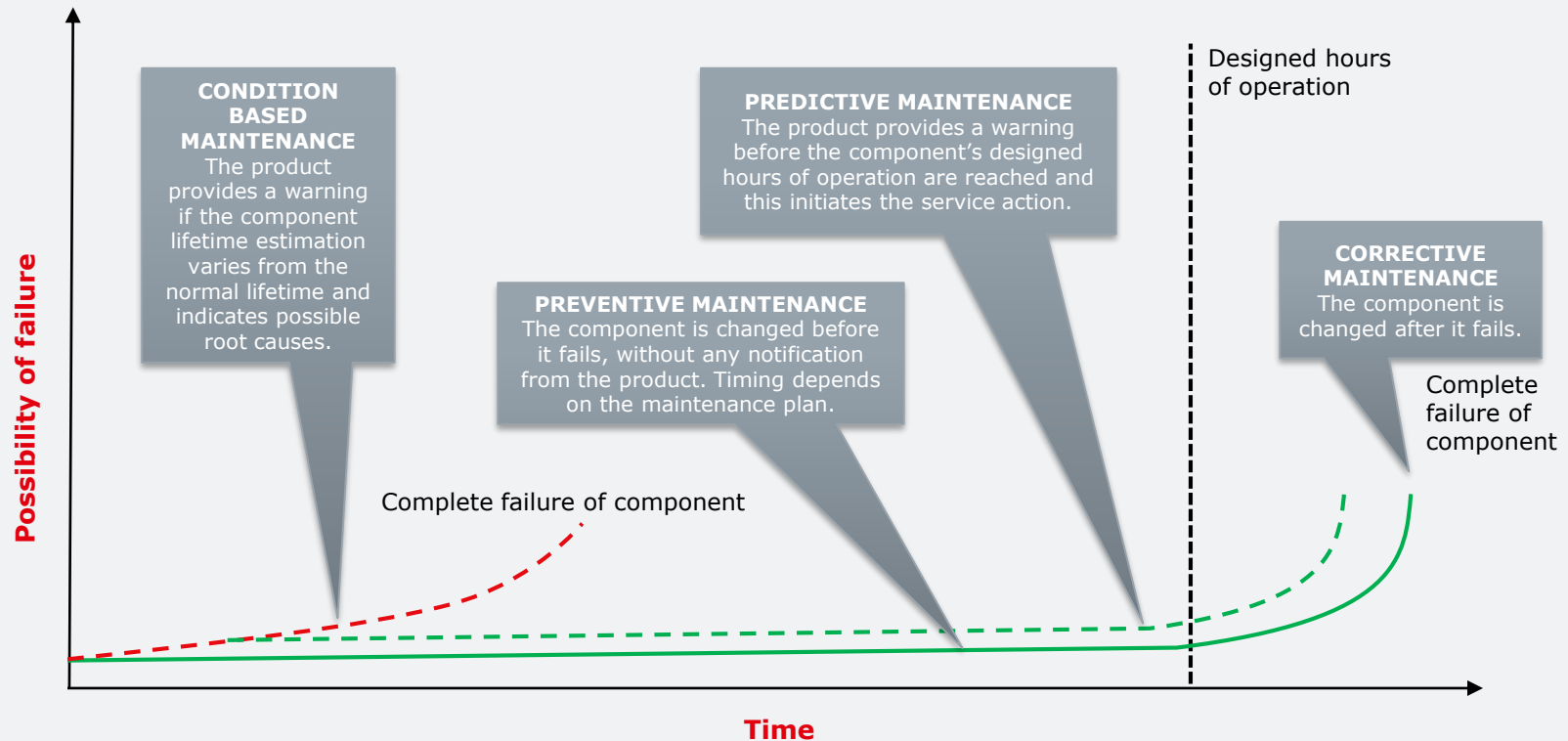
Danfoss benefits

- From reactive to proactive service
- Service product offerings
- Better help to customers
- Better future products based on data from field

Customer benefits

- Optimize use of resources and enables advance planning
- Reduce cost of unexpected downtime
- Reduce total cost of ownership
- Reduce stock of spare parts

Definition of **maintenance strategies**



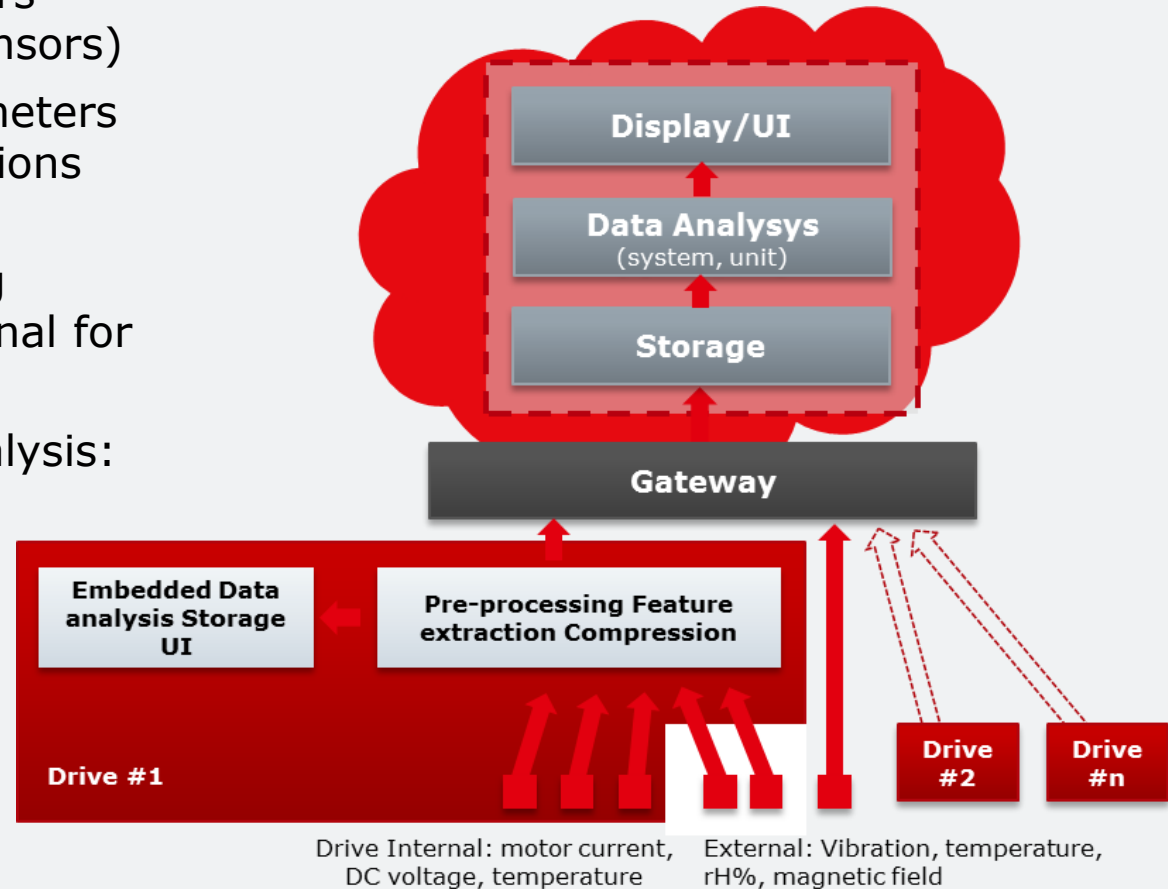
Reliability centered maintenance and IoT

Drive:

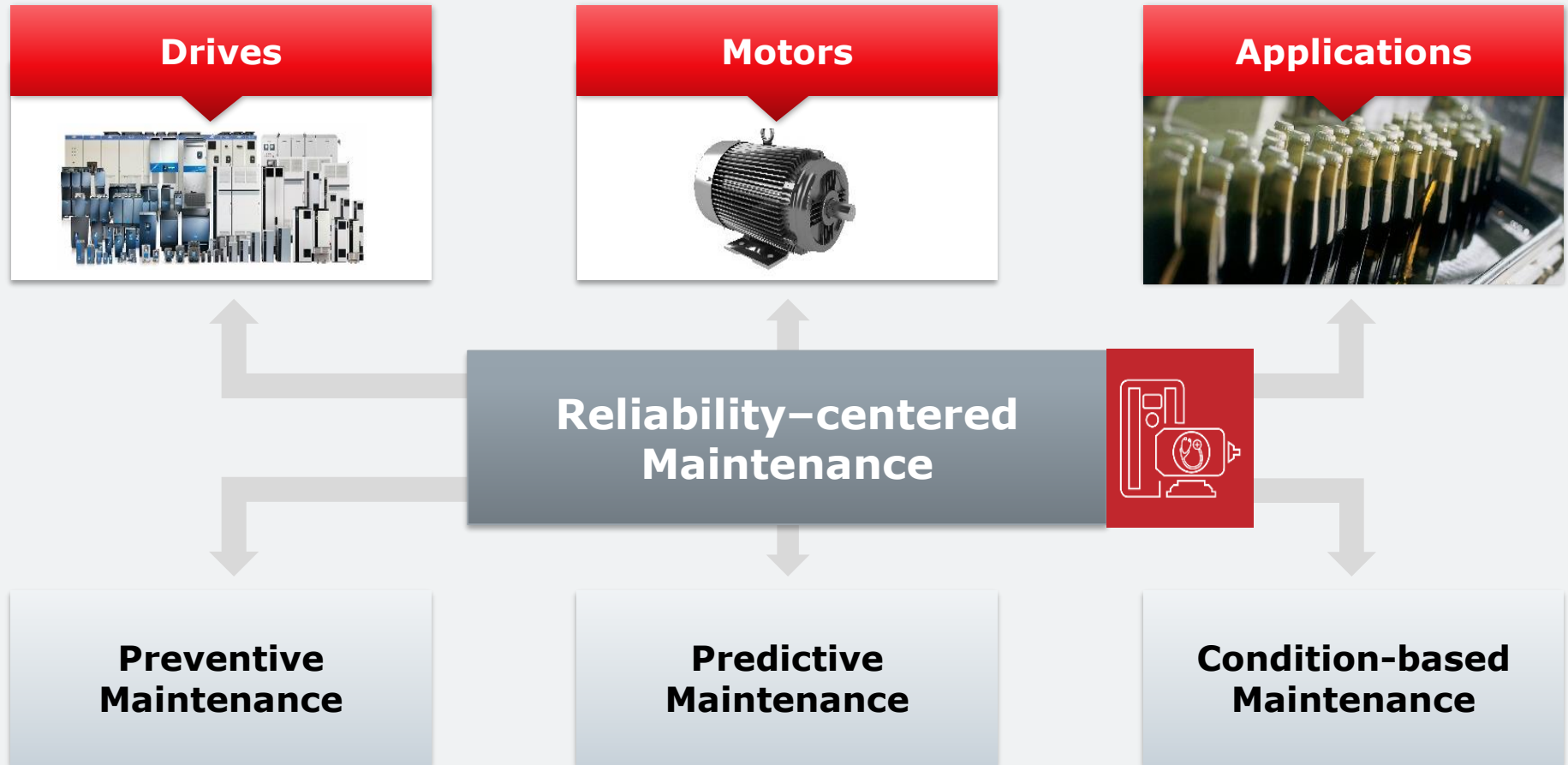
- ❑ collects data from sensors (internal and external sensors)
- ❑ calculates derived parameters (e.g. power) and estimations (e.g. flux, torque)
- ❑ applies signal processing techniques to various signal for fault feature extraction

Two possibilities for data analysis:

- ❑ Embedded in the drive
- ❑ Cloud analytics



Scope of the RCMT program



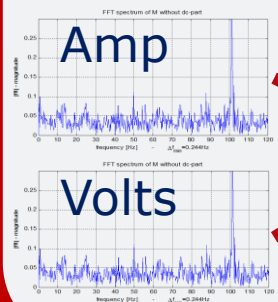
Use case examples



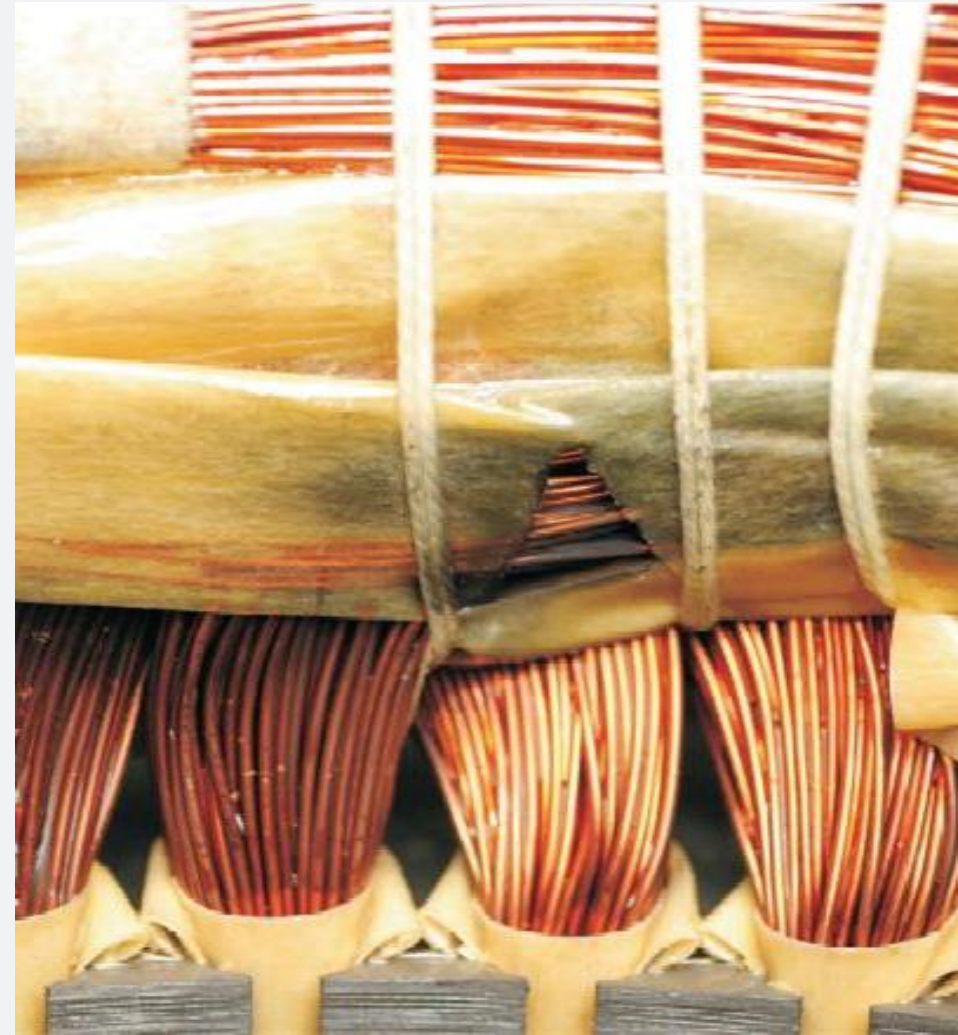
Motor current analytics – stator winding fault detection

- Usually, motor winding isolation failures do not occur suddenly – the fault starts with a single turn-to-turn short-circuit and it develops in time
- By analyzing the motor current signature, the drive can detect motor winding damage at early stage

Drive translates voltage & current into machine status

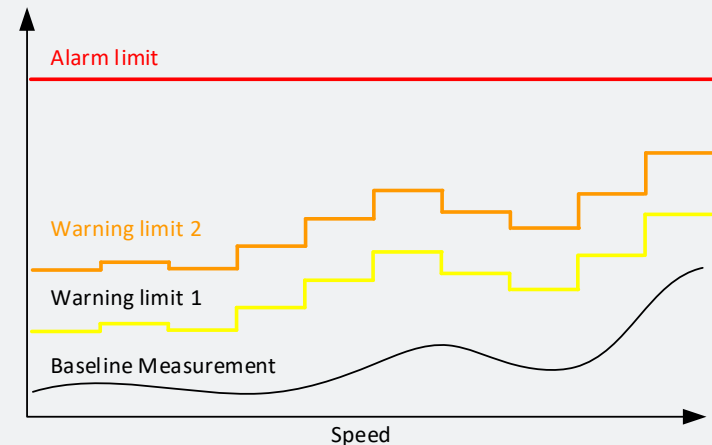
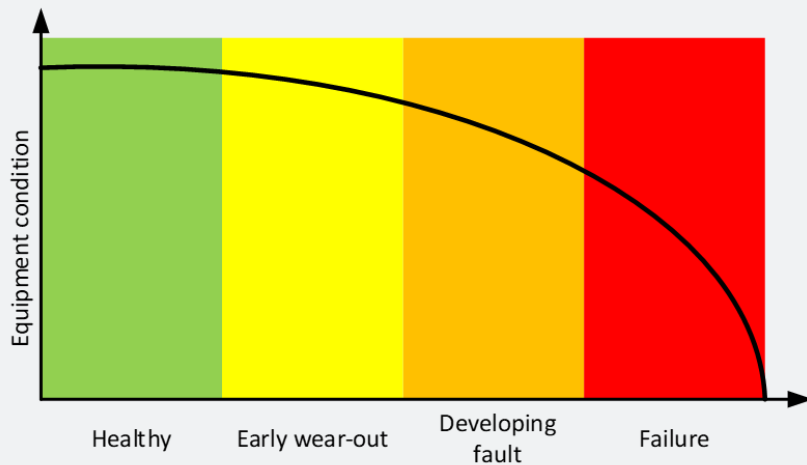


Machine status



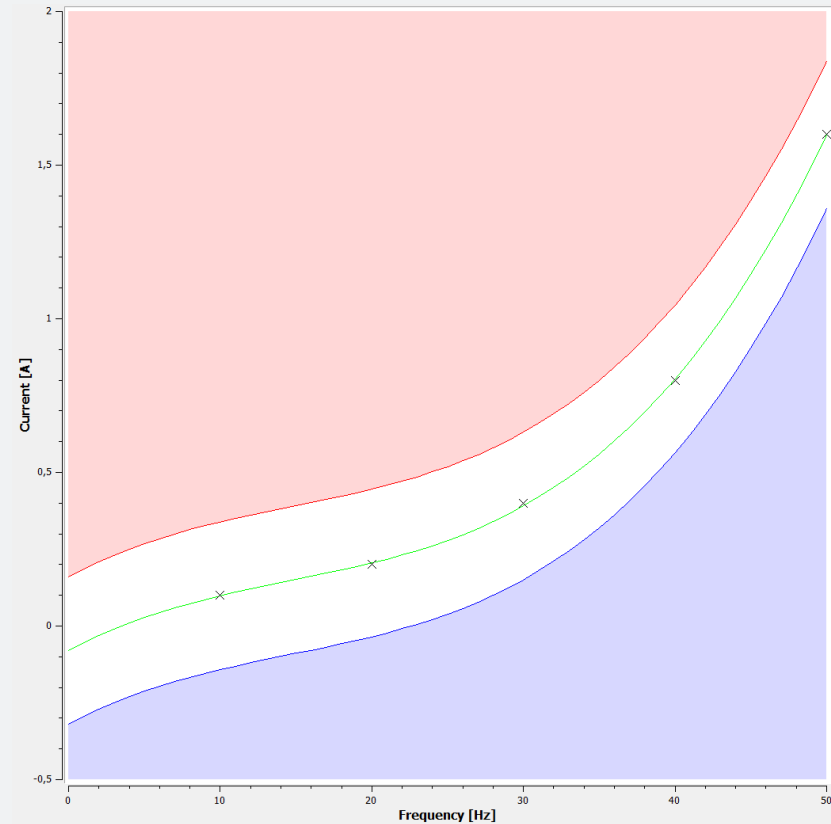
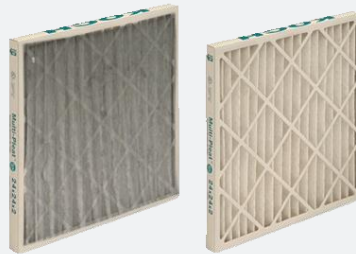
RMS Vibration monitoring

- ❑ External vibration sensor (4..20 mA)
- ❑ Overall vibration measurement– no frequency domain measurement
- ❑ The function can be used to detect faults such as:
 - ❑ Mechanical unbalance & eccentricity,
 - ❑ Mechanical looseness,
 - ❑ Shaft misalignment,
 - ❑ Mechanical resonance
 - ❑ Etc.
- ❑ Drive correlates vibration with motor speed

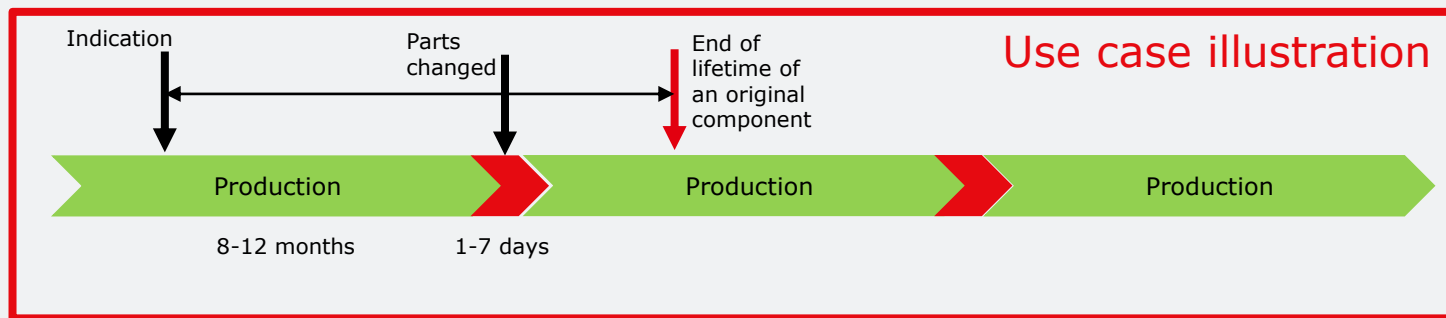


Load envelope monitor

- ❑ The function **learns the load curve** of the application and detects whenever the load moves above or under the baseline level
- ❑ The function is useful fault detection in various applications with passive load:
 - ❑ Fouling, sanding, broken impeller or **wear-out of pumps**
 - ❑ **Clogged filters** and leakages in ventilation systems
 - ❑ **Friction** in machines



Predictive maintenance – Drive IGBT lifetime



Examples:

- Paper machines
- Steel processing
- Plastic extrusion
- Vessels
- Oil drilling

Data



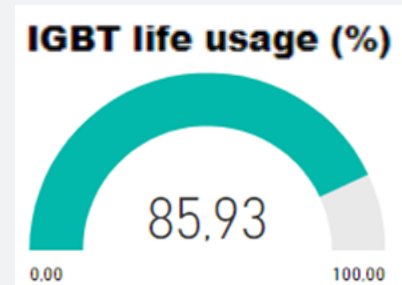
Parameters
fed to cloud
(Spark)

(Parameters: IGBT
case temps etc.)

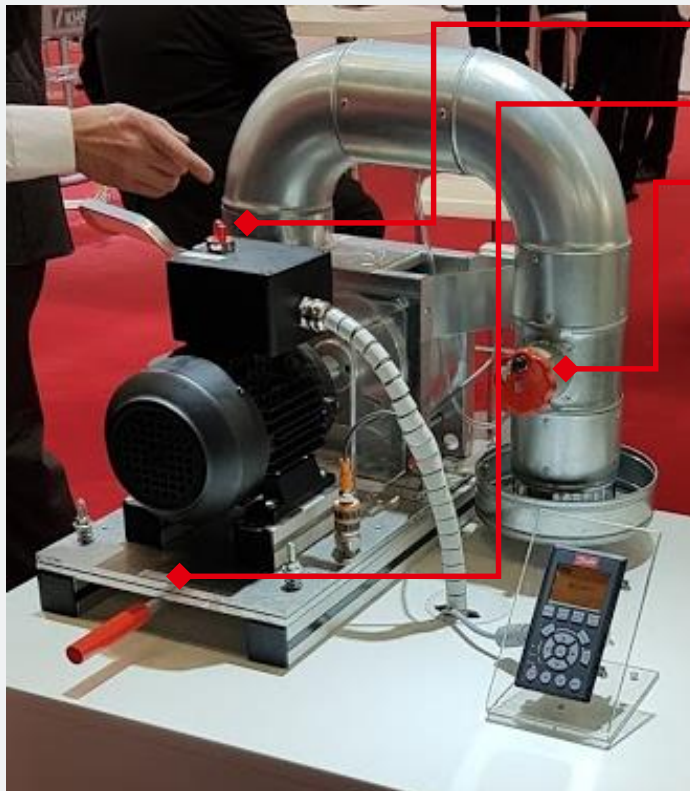
Cloud algorithms

Lifetime model

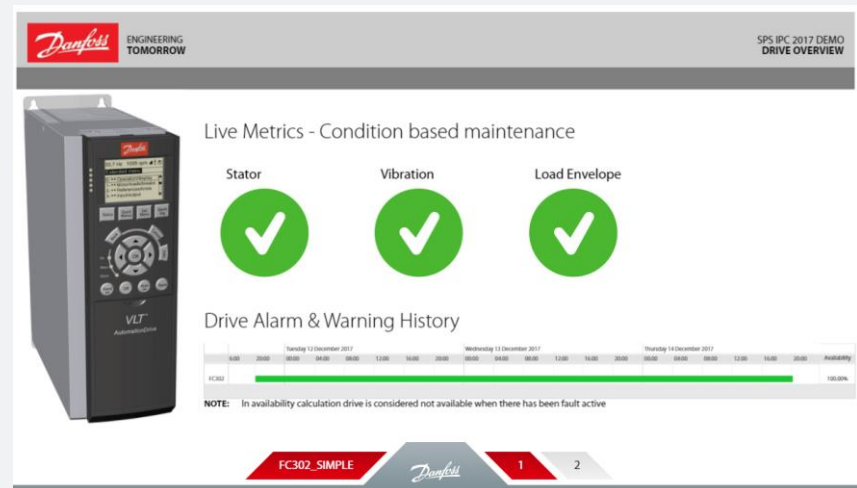
Visualization



Demonstration set-up



1. **Motor monitoring** → Stator winding fault
2. **Vibration monitoring** → shaft misalignment
3. **Application monitoring** → reduced air flow (e.g. clogged air filter)





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