

Developing an Augmented Lubrication system using AI and Machine Learning

DATE:
07/09/2022



Tom
Rombouts



Wouter
Bogaerts

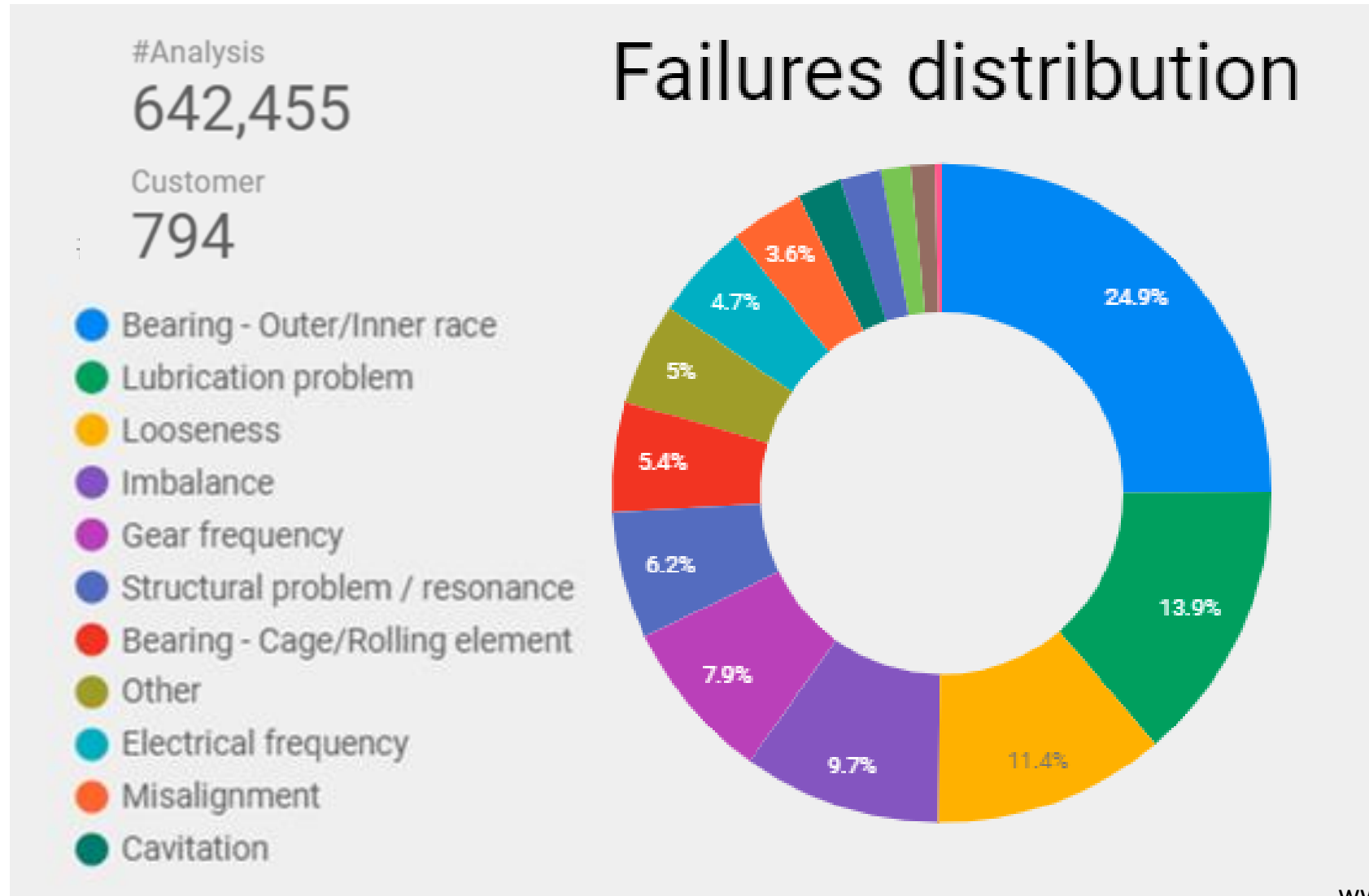


Why are we here?

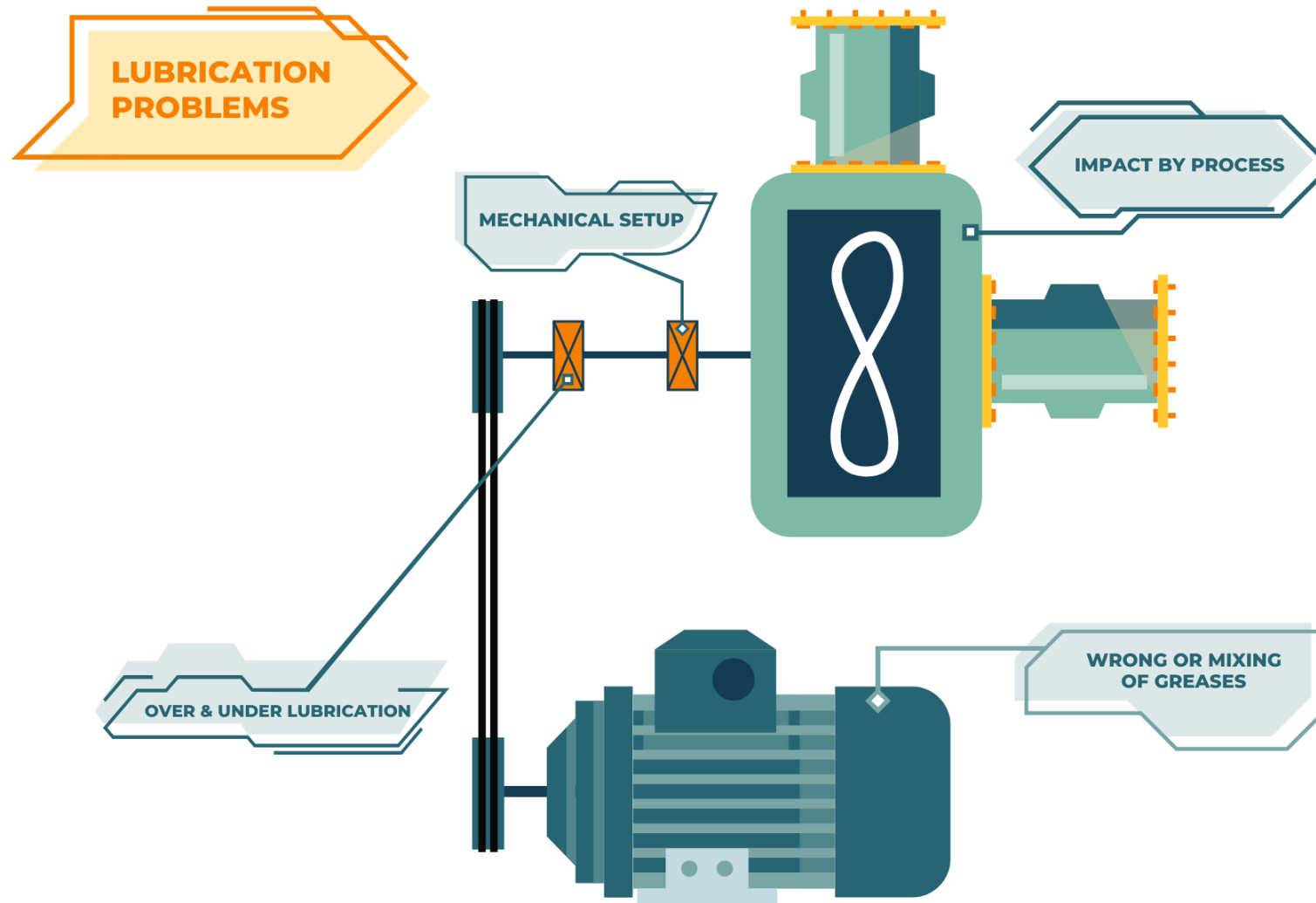


This is why Rotating Equipment fails...

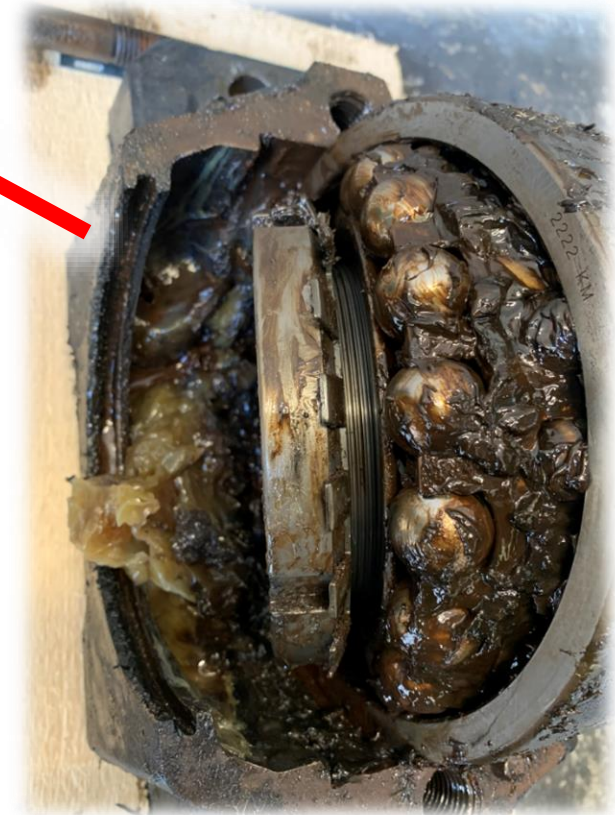
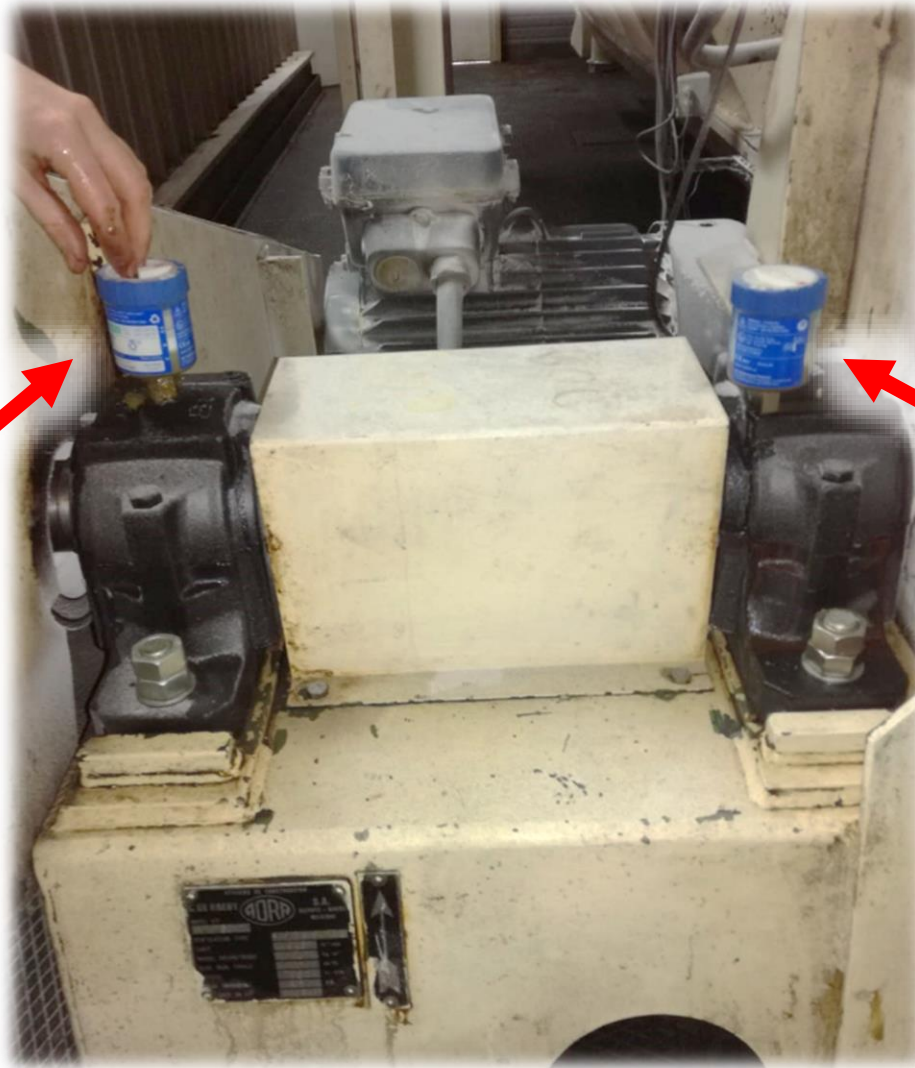
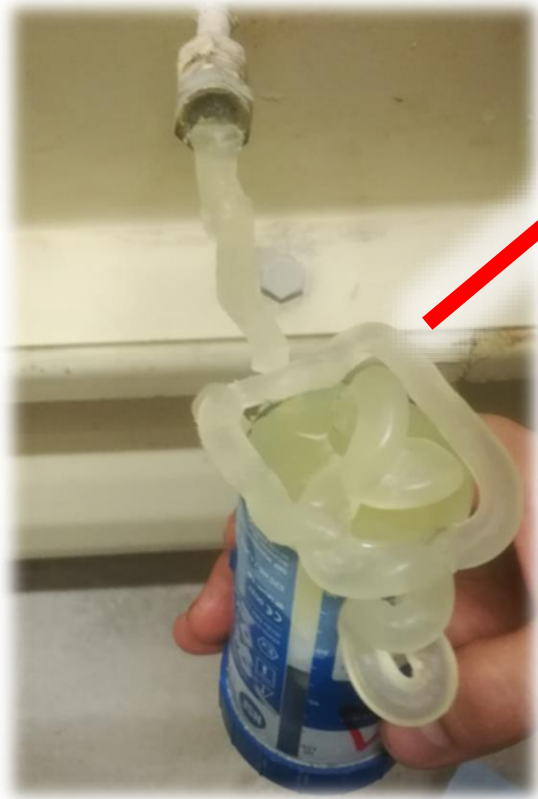
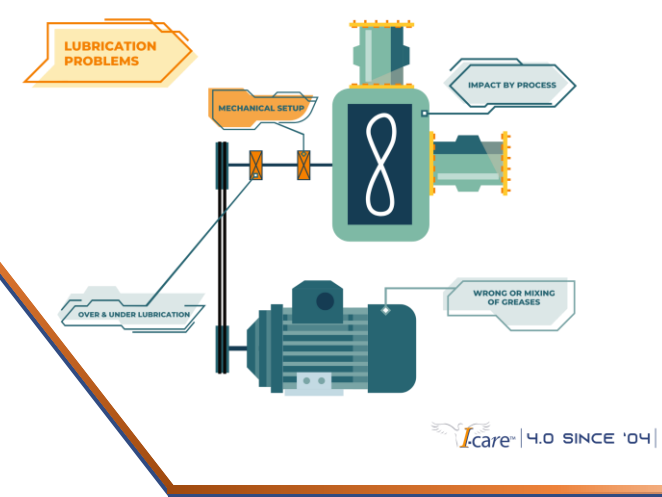
Generic failure distribution in the industry
Based on I-cares 2021 research



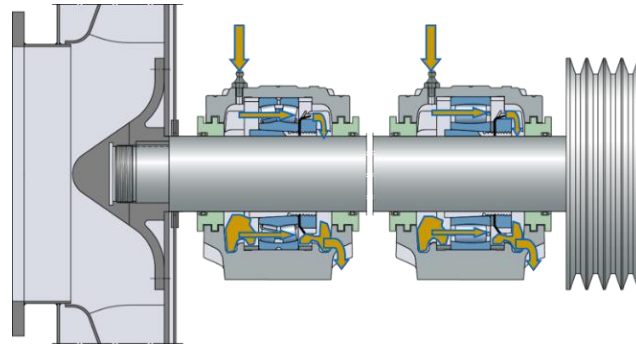
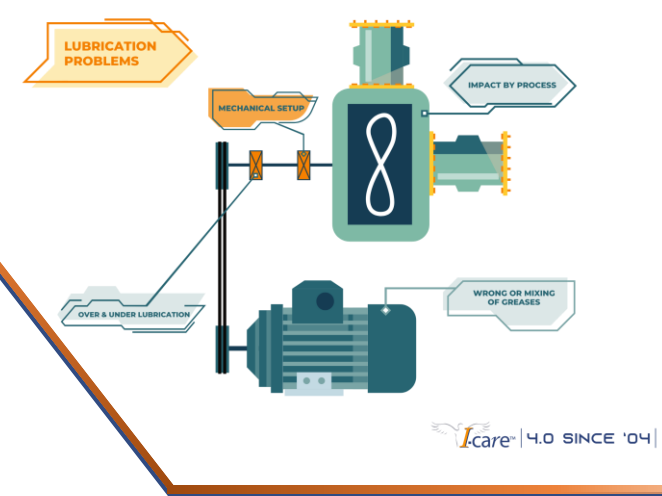
Where Lubrication goes wrong...



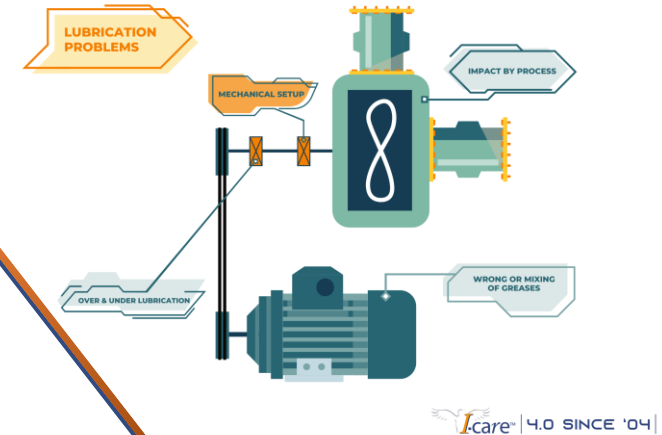
Where Lubrication goes wrong...



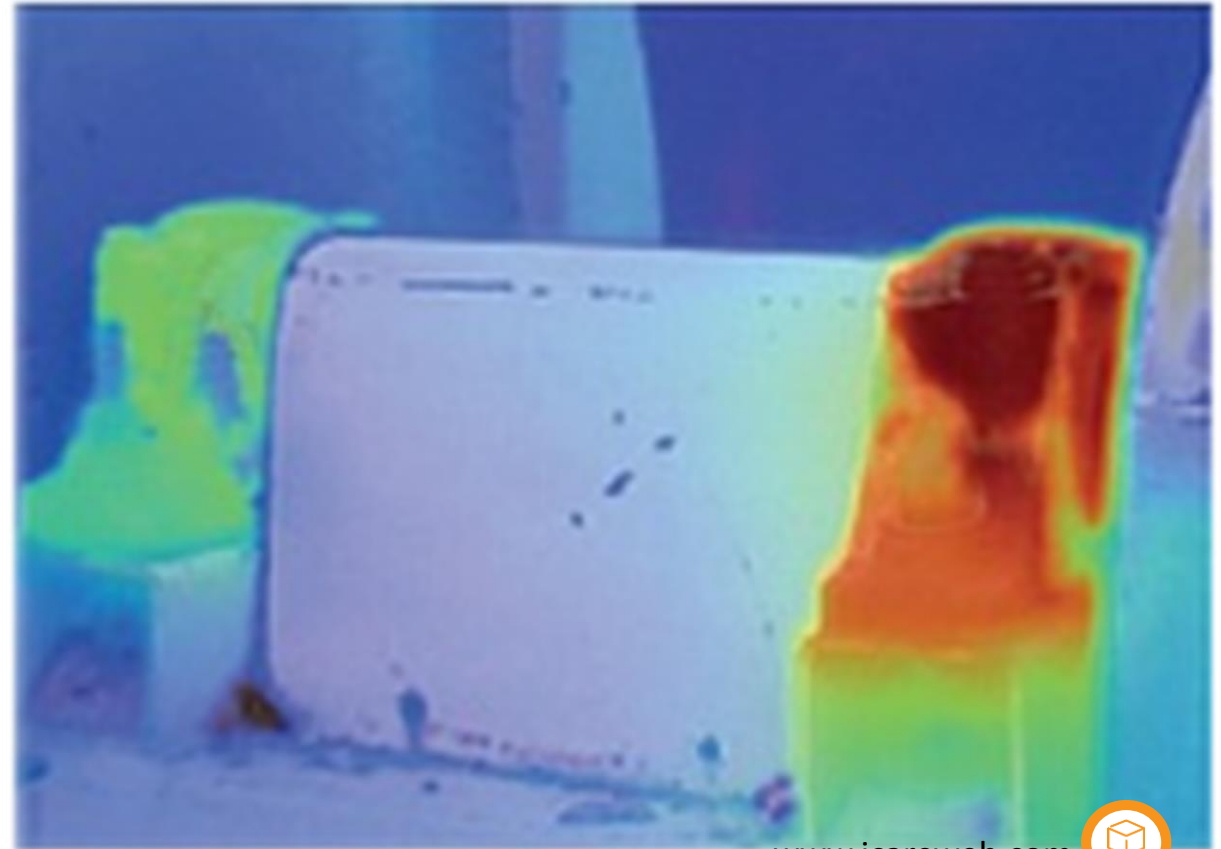
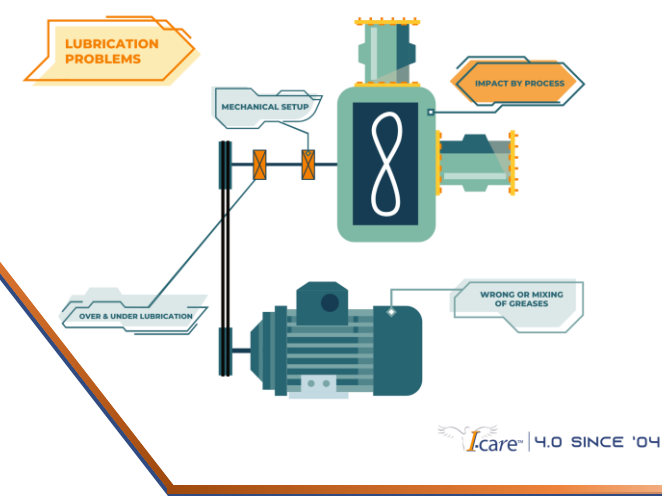
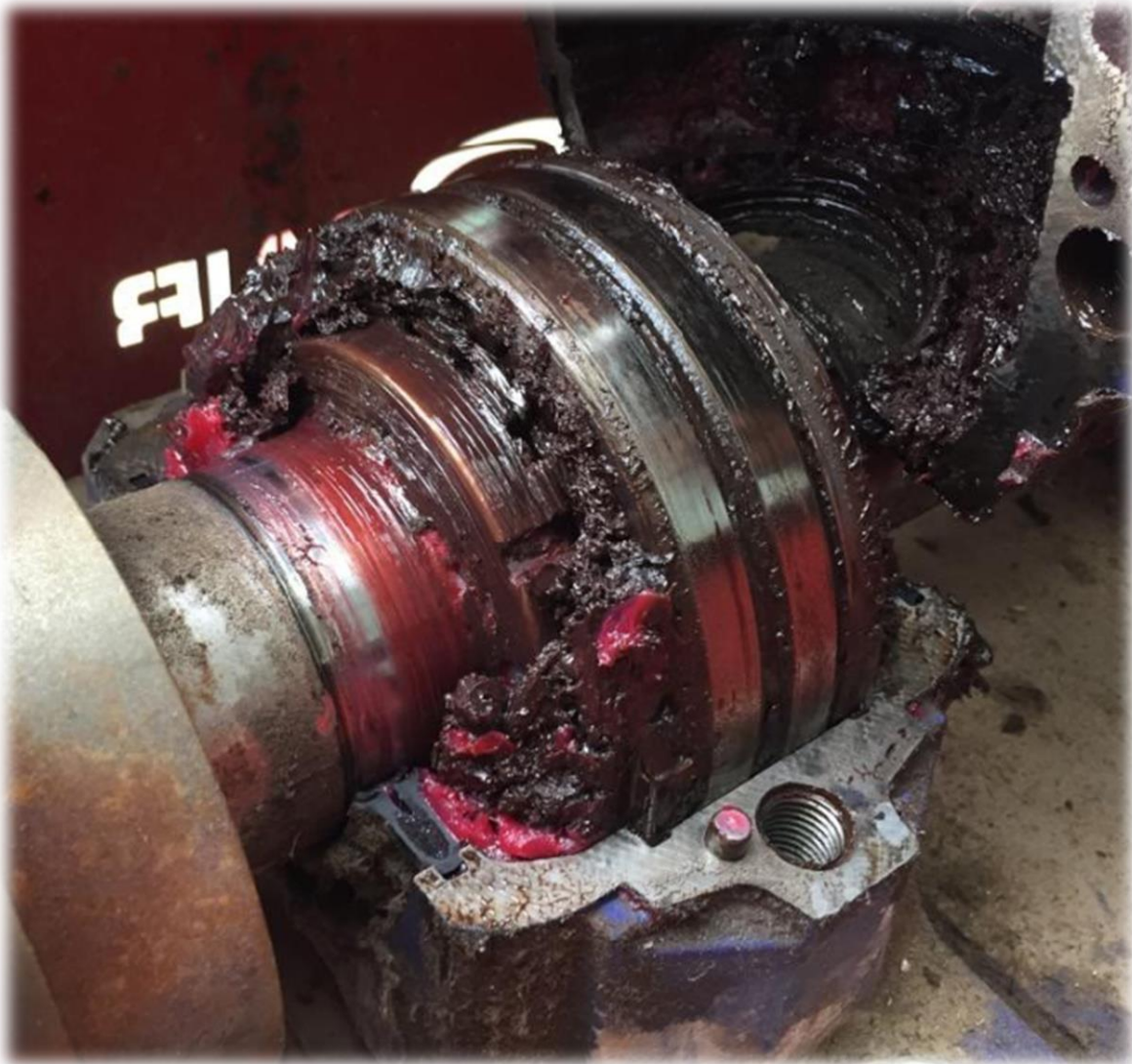
Where Lubrication goes wrong...



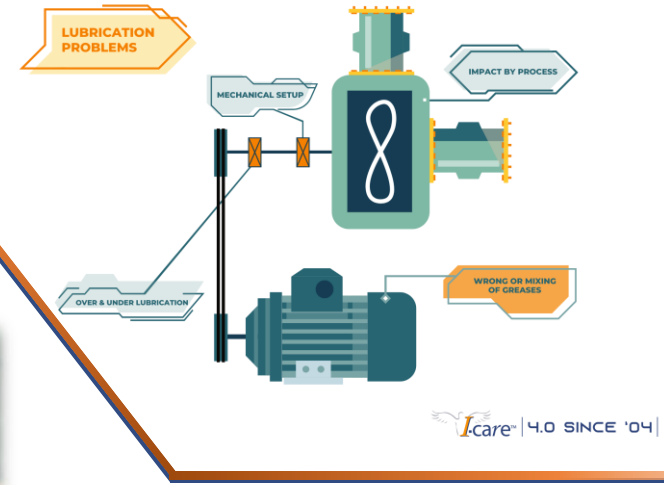
Where Lubrication goes wrong...



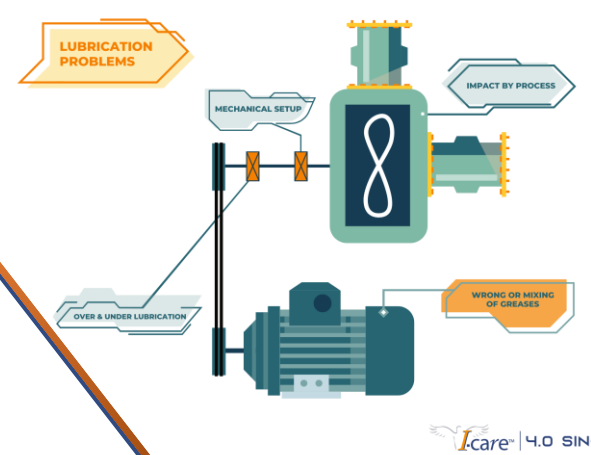
Over/under lubrication



Several / different / wrong types of grease applied



Several / different / wrong types of grease applied



Typische fysische eigenschappen:

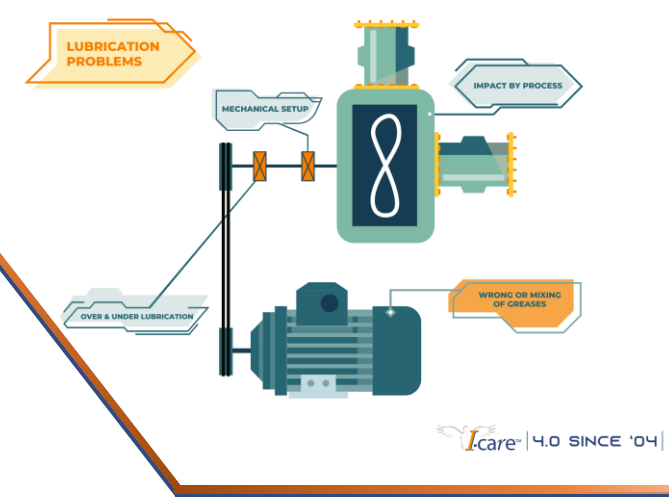
	Testmethode	EXTRALITH #00	EXTRALITH EP #1	EXTRALITH EP#2
Uitzicht		Glad, klevend	Glad, klevend	Glad, klevend
Kleur		Amber	Amber	Amber
NLGI klasse*	ASTM D-217	00	1	2
Basisolie		Mineraal	Mineraal	Mineraal
Verdikker		Lithium	Lithium	Lithium
Temperatuurbereik		-30°C tot 100°C	-20°C tot 140°C	-20°C tot 140°C
Viscositeit basisolie bij 40°C	ASTM D-445			
- bij 40°C		60 mm ² /s	100 mm ² /s	100 mm ² /s
- bij 100°C		7,1 mm ² /s	7,8 mm ² /s	7,8 mm ² /s
Bewerkte penetratie	ASTM D-217	400 - 430	310 - 340	265 - 295
Druppelpunt	ASTM D-2265	Min. 150°C	Min. 185°C	Min. 185°C

*NLGI klasse 000, 0 en 3 zijn ook beschikbaar op verzoek.

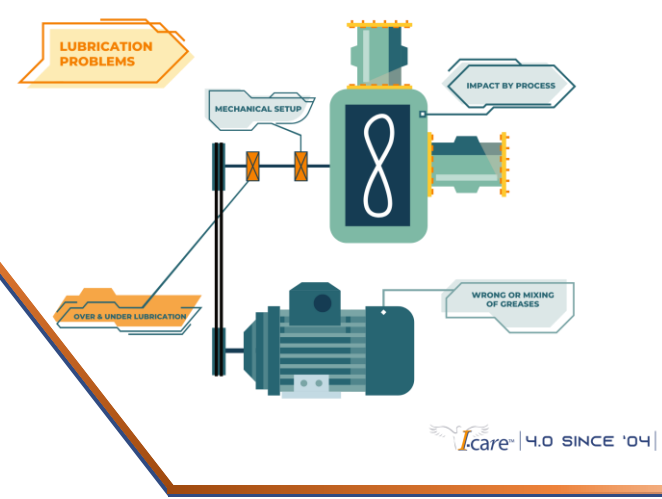
	DENOMINATION	40 °C	100 °C	NLGI	THICKENER	OIL
9183	WOLF/CHAMPION CALCIUM LITHIUM EP2 HEAVY	1100	48	2	LITHIUM-CALCIUM	MINERAL



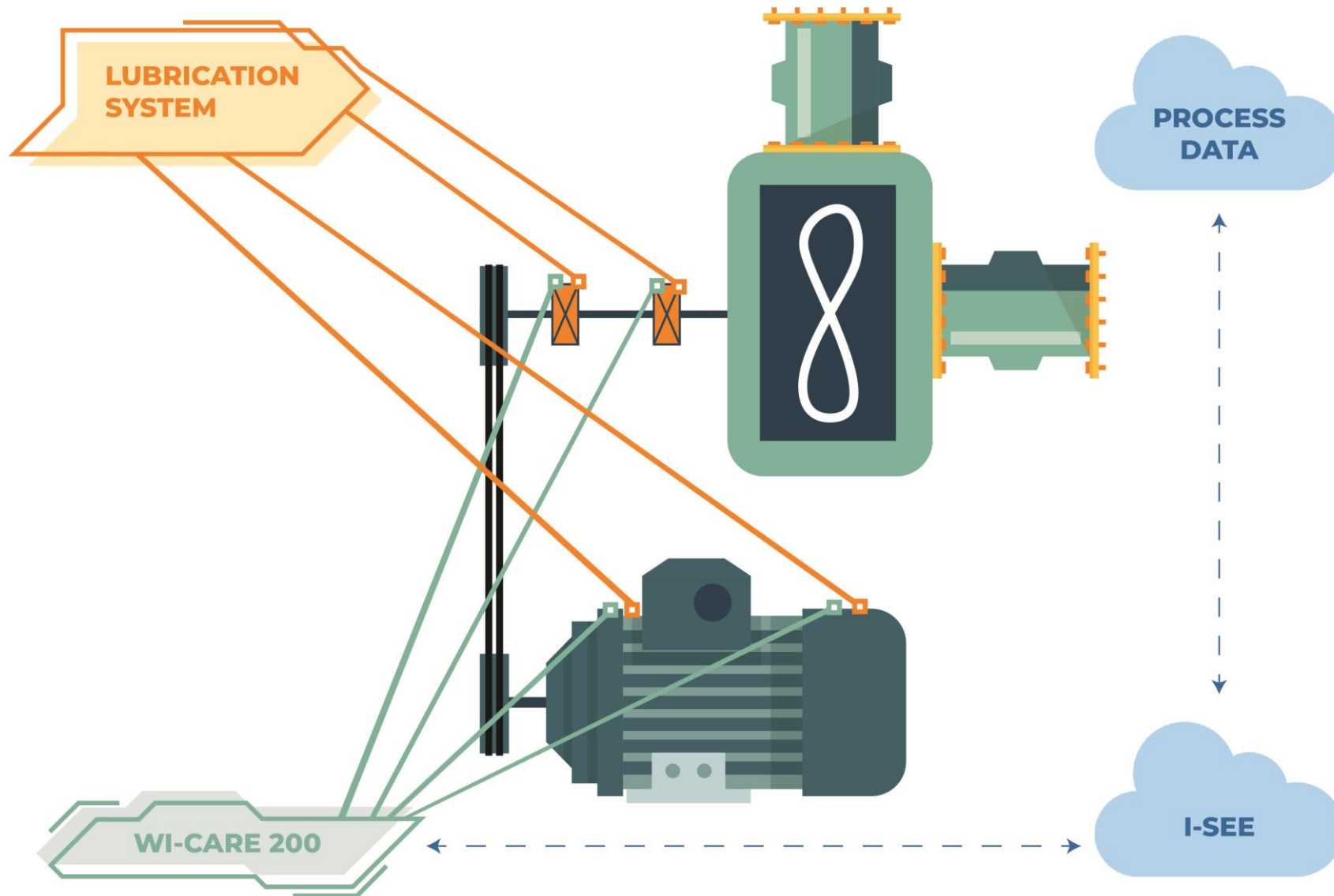
Switch to H1 - Food Approved greases



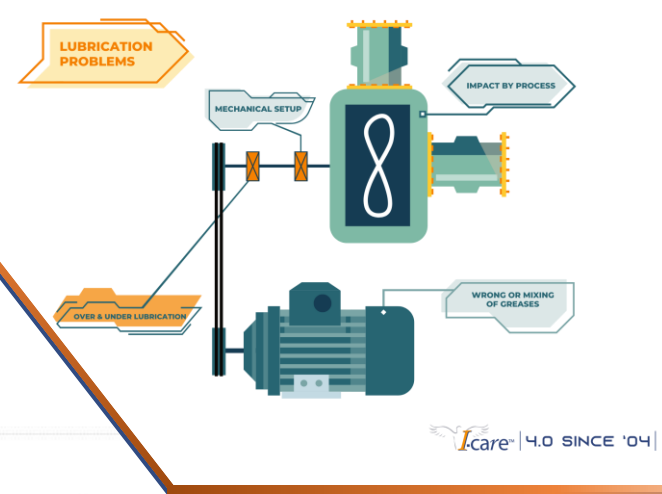
Over/under lubrication



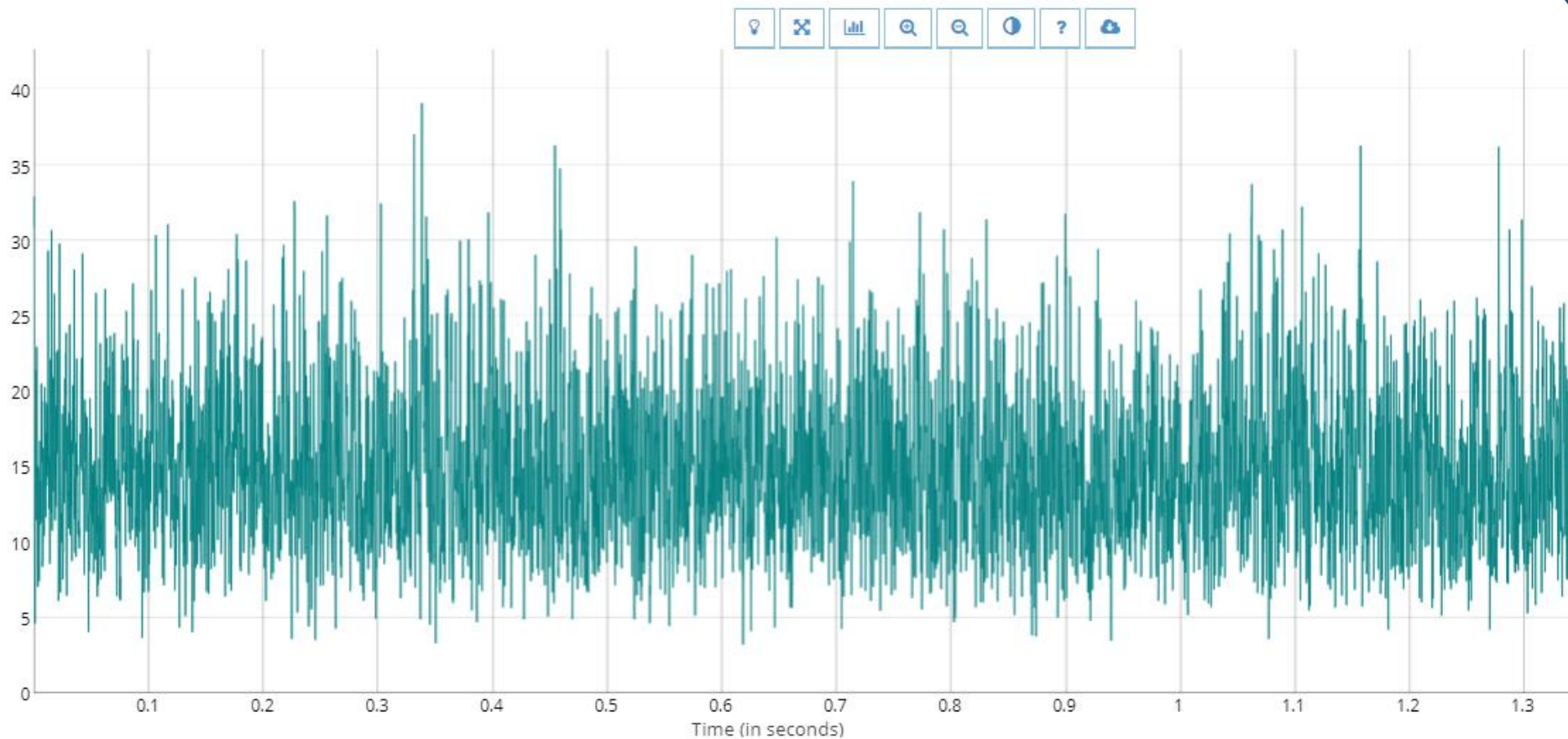
How the Wi-LubeCare provides a solution...



Case 1: Under lubrication: Acceptance testing of new E-motor



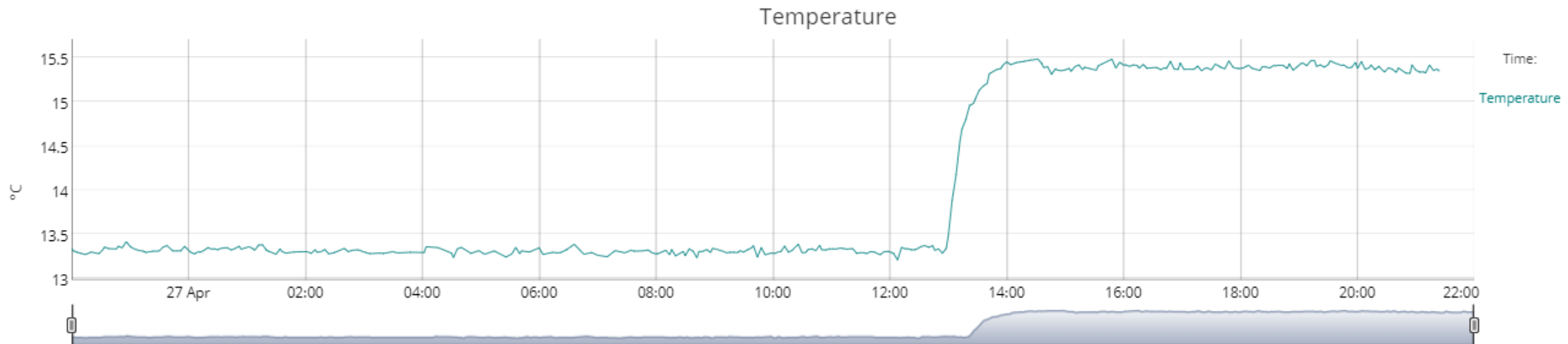
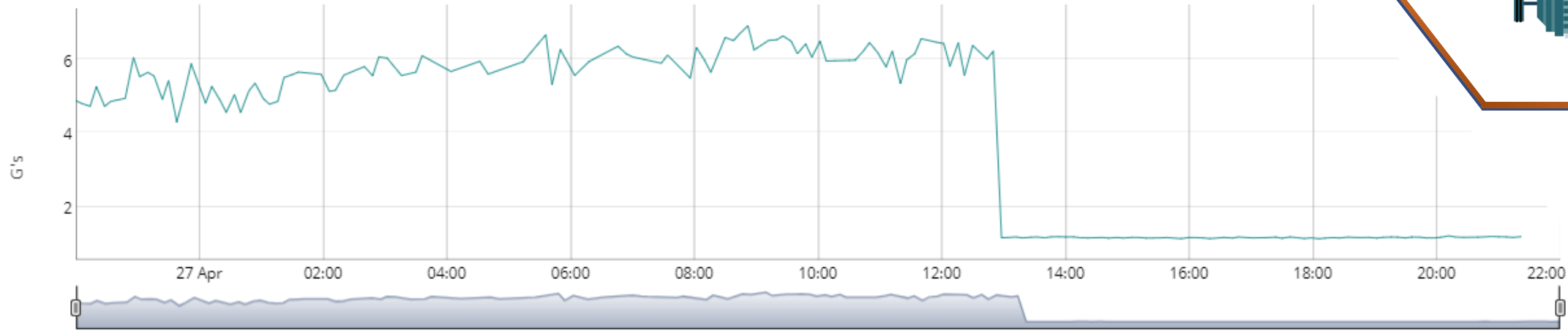
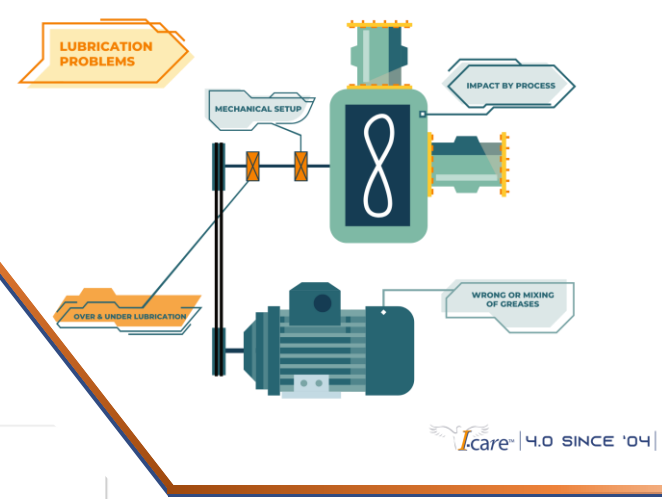
HVAC - Motor DE direction? 25-04-2020 04:00



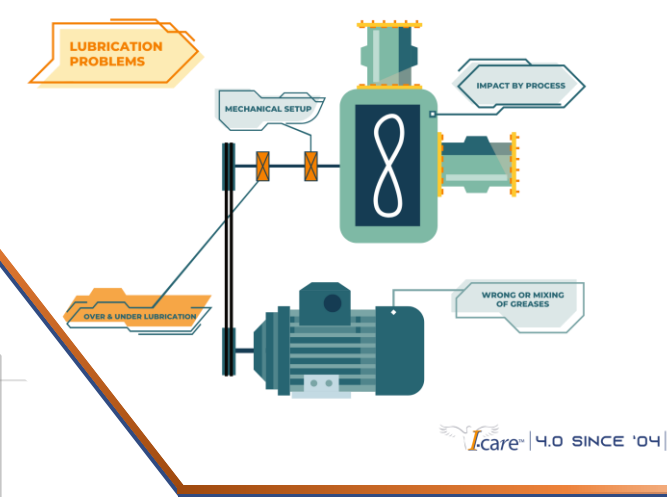
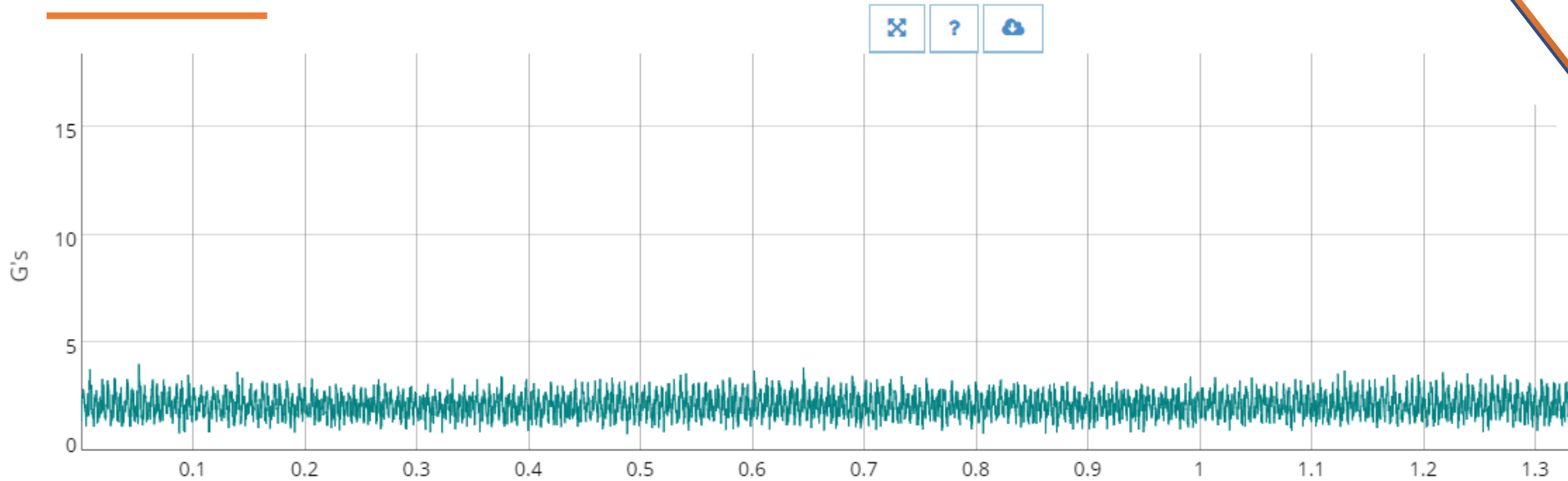
Measured RPM: 2694 (Active)
Custom RPM:

Time:
Amp:

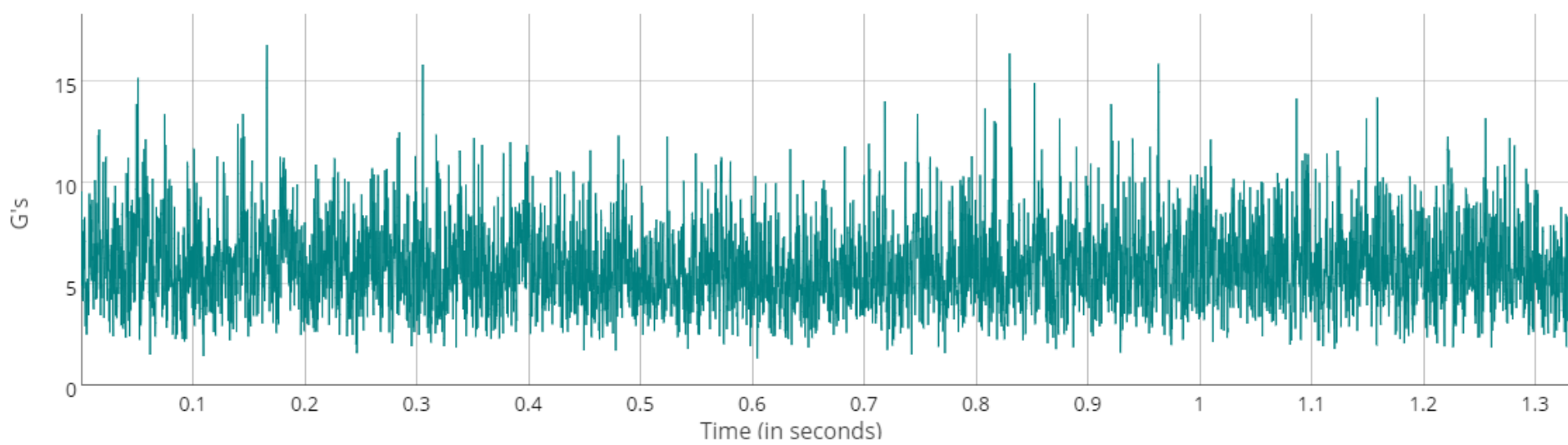
Case 1: Under lubrication: Acceptance testing of new E-motor



Case 1: Under lubrication: Acceptance testing of new E-motor



After lubrication



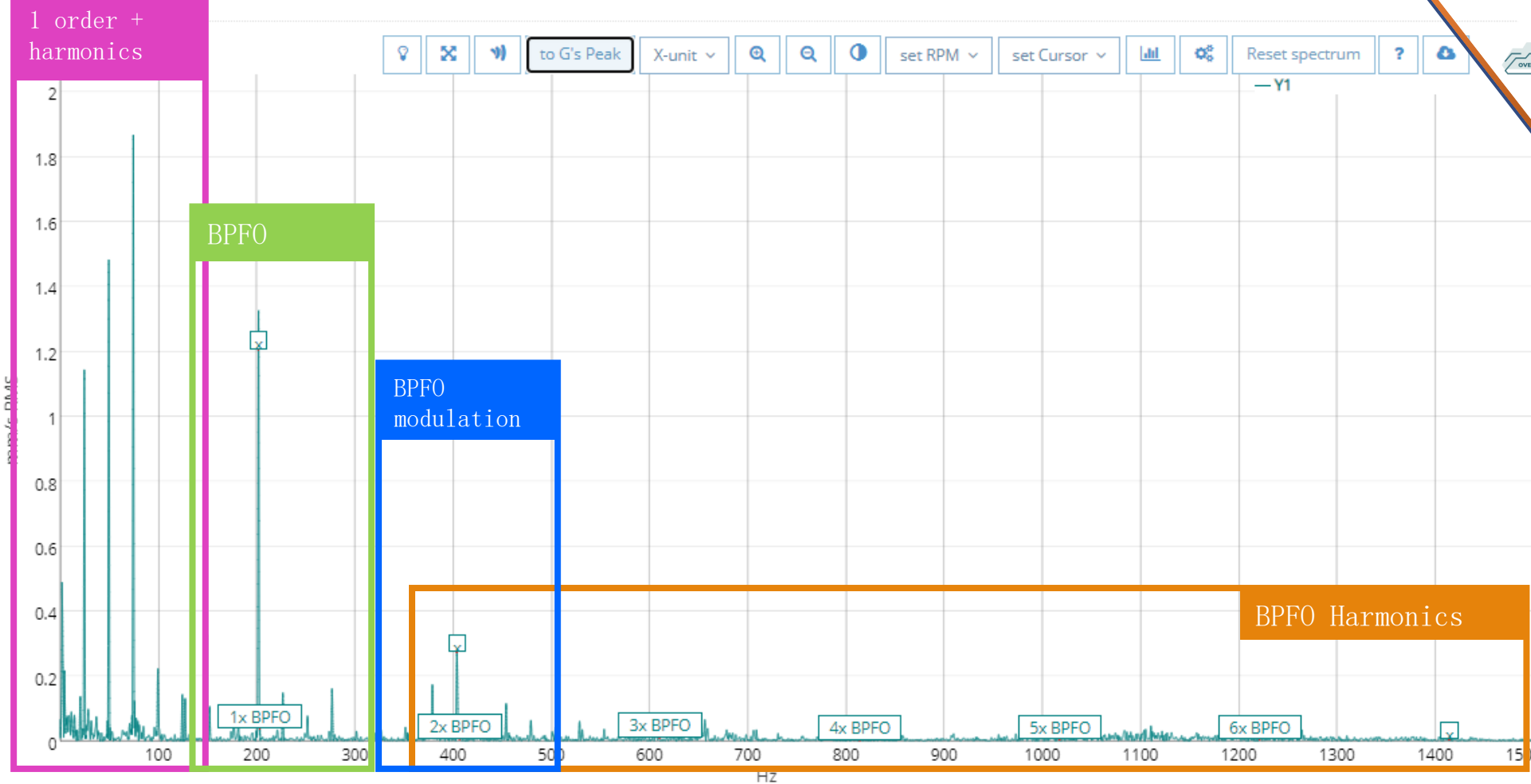
HVAC - Motor DE direction?
🕒 26-04-2020 09:41
Results ▾

Before lubrication

Case 2: Mechanical Setup

Fan C142A - Fan Not Drive End Horizontal 22-09-2020 03:54

to G's Peak X-unit set RPM set Cursor Reset spectrum ?



Measured RPM: 1497 (active)

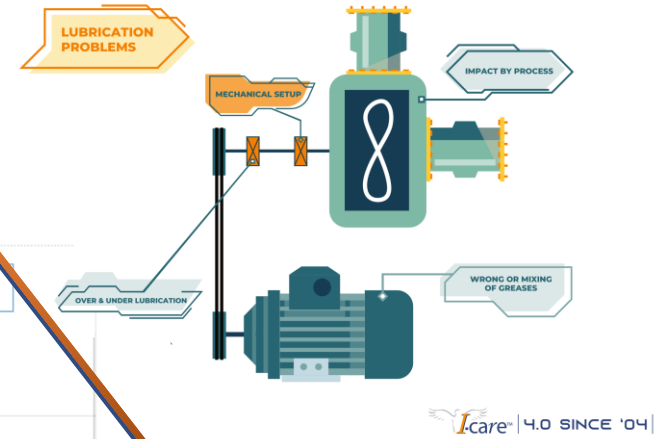
Custom RPM:

TMK 22222 BPFO

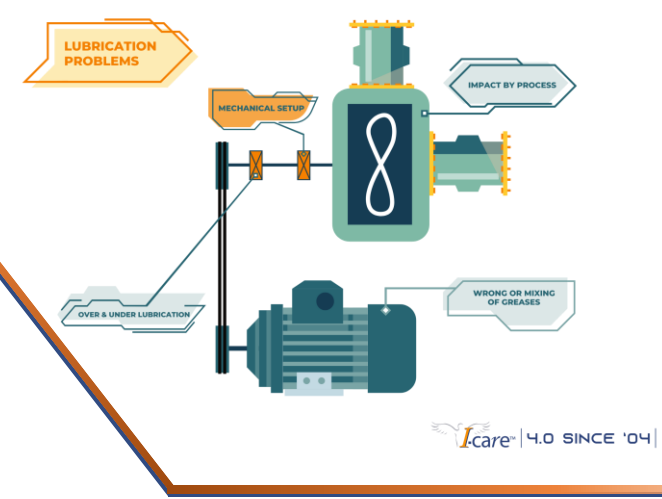
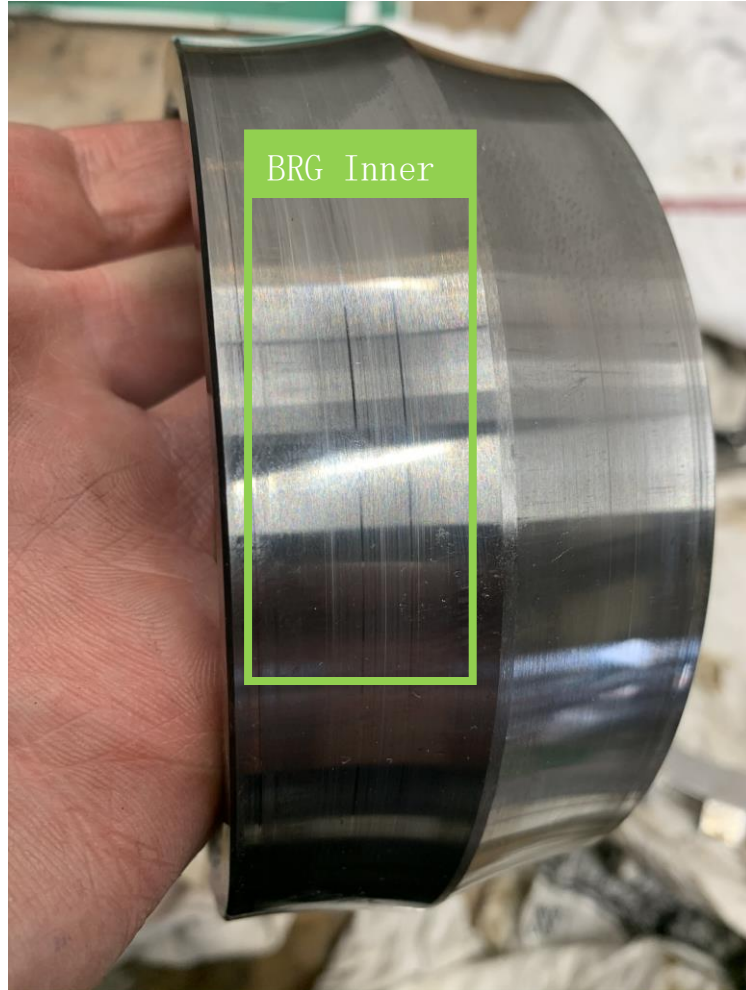
Freq: 202.119 Hz

Order: 8.1

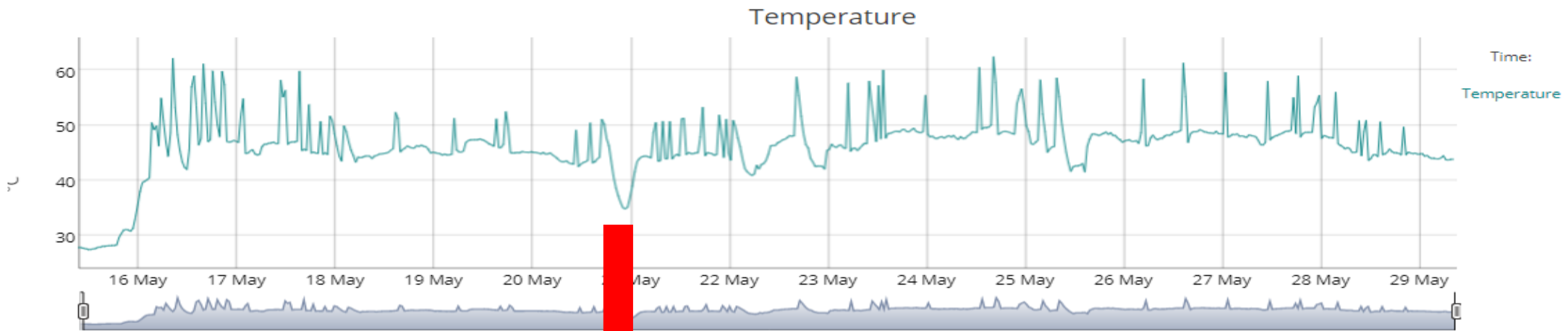
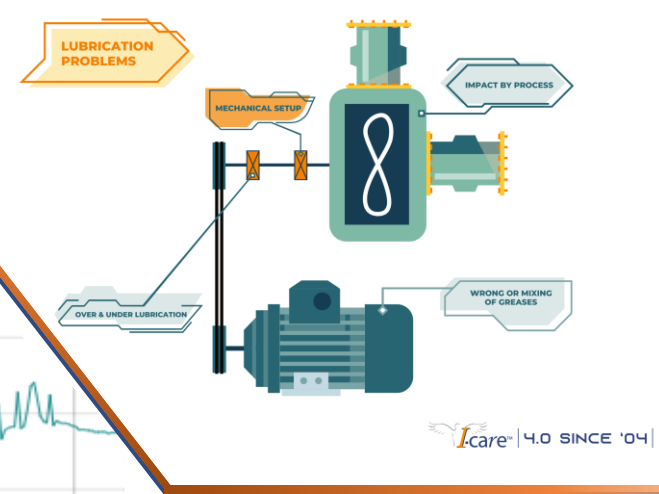
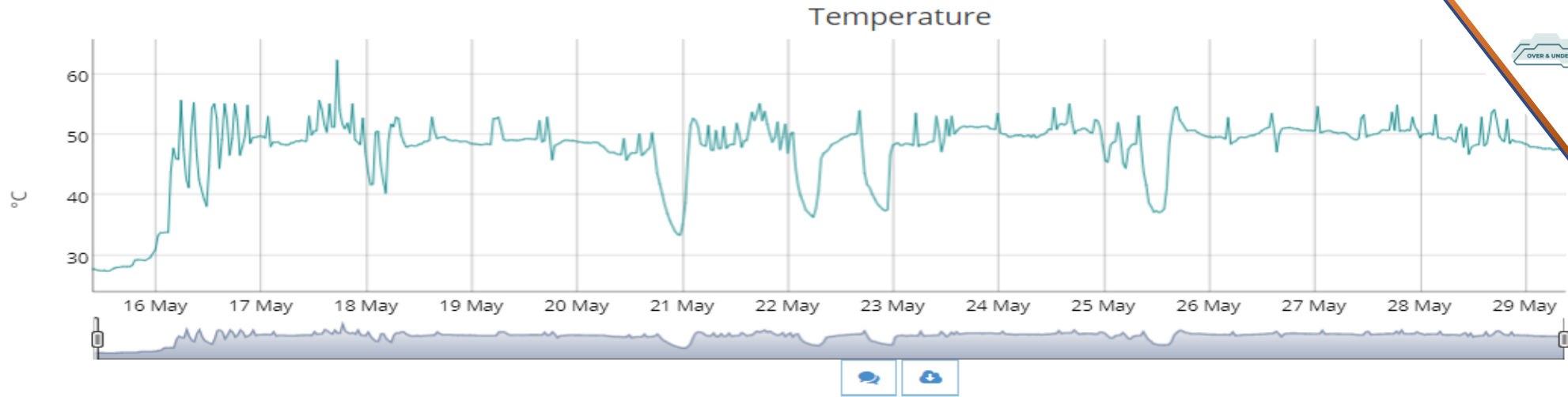
Amp: 1.14329 mm/s RMS



Case 2: Mechanical Setup



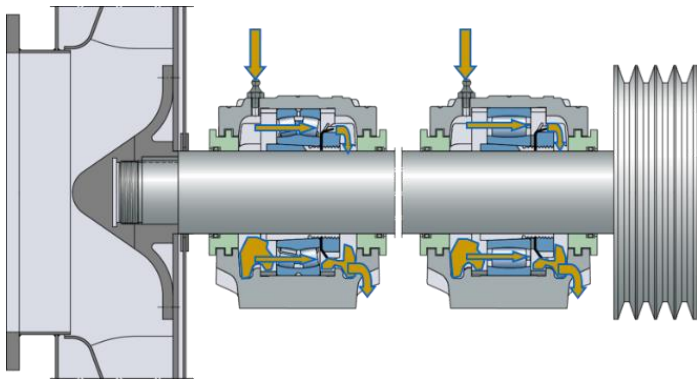
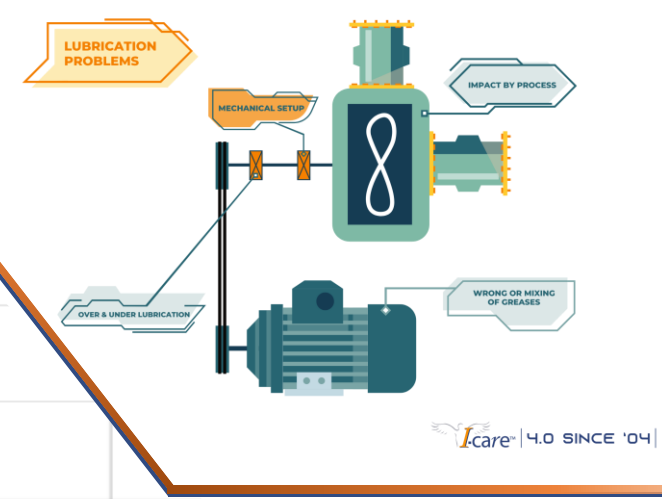
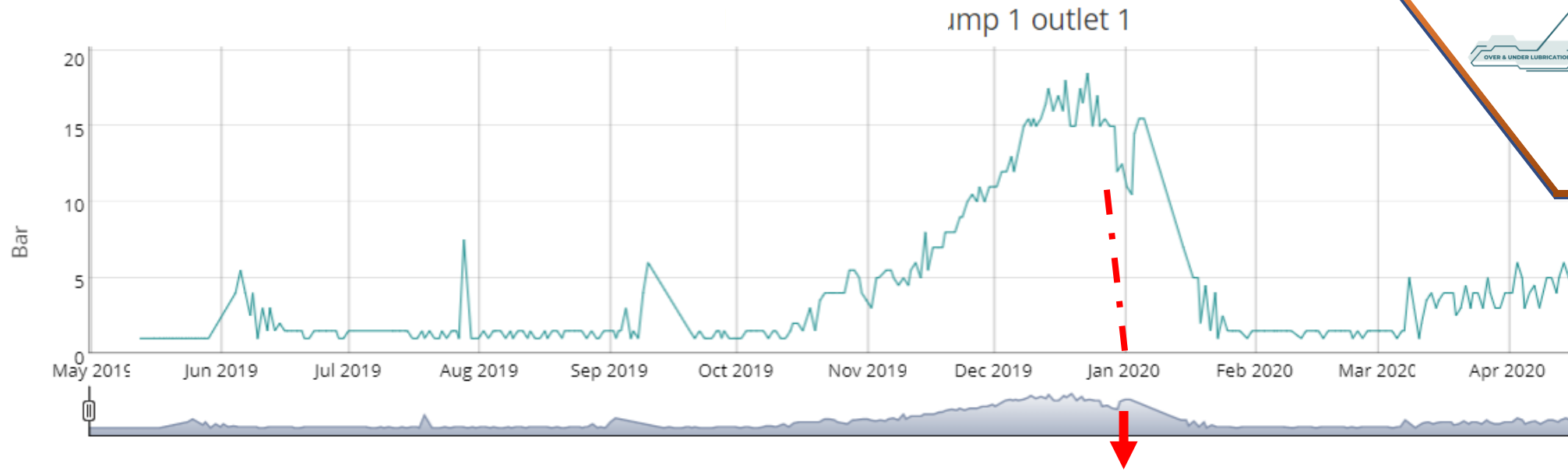
Case 3: Mechanical Setup



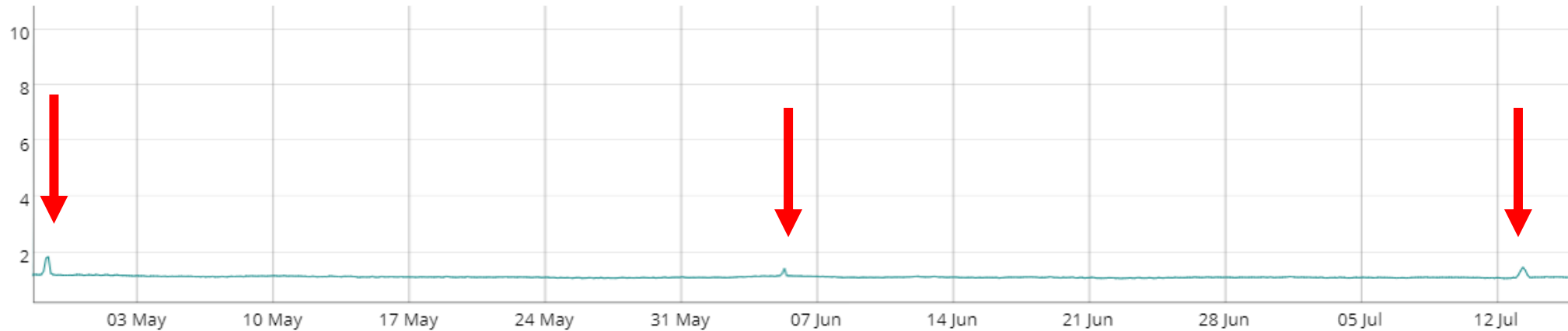
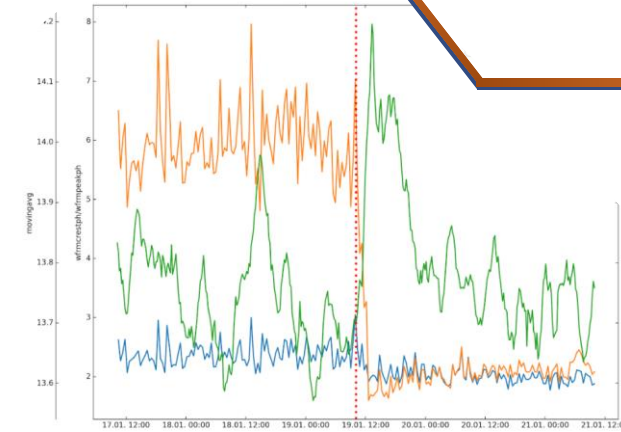
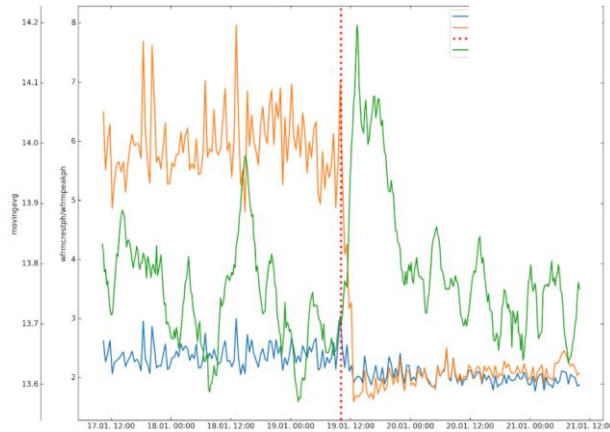
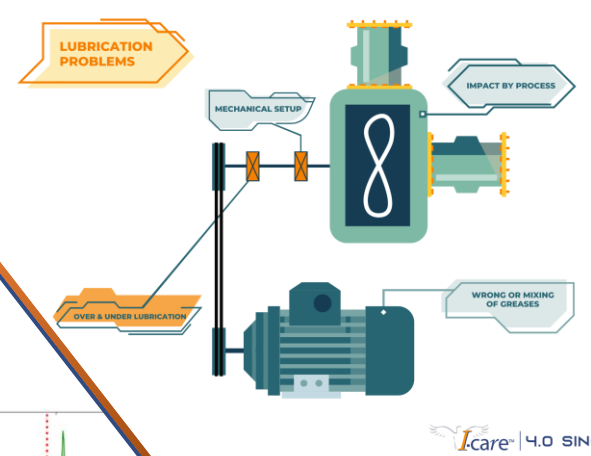
**Temperature spikes during shutdown of machine
Grease life-time!!!**



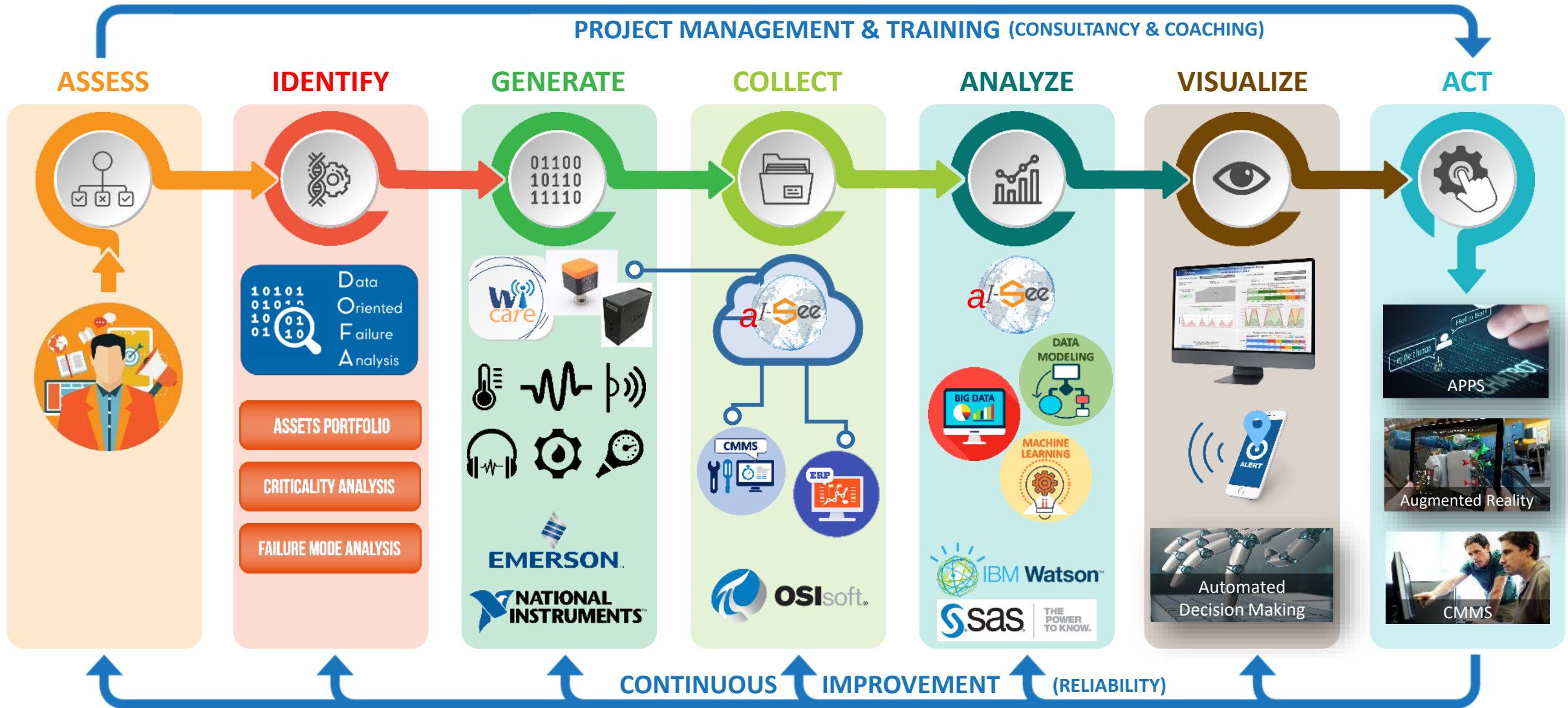
Case 39: Condition based bearing clean-out



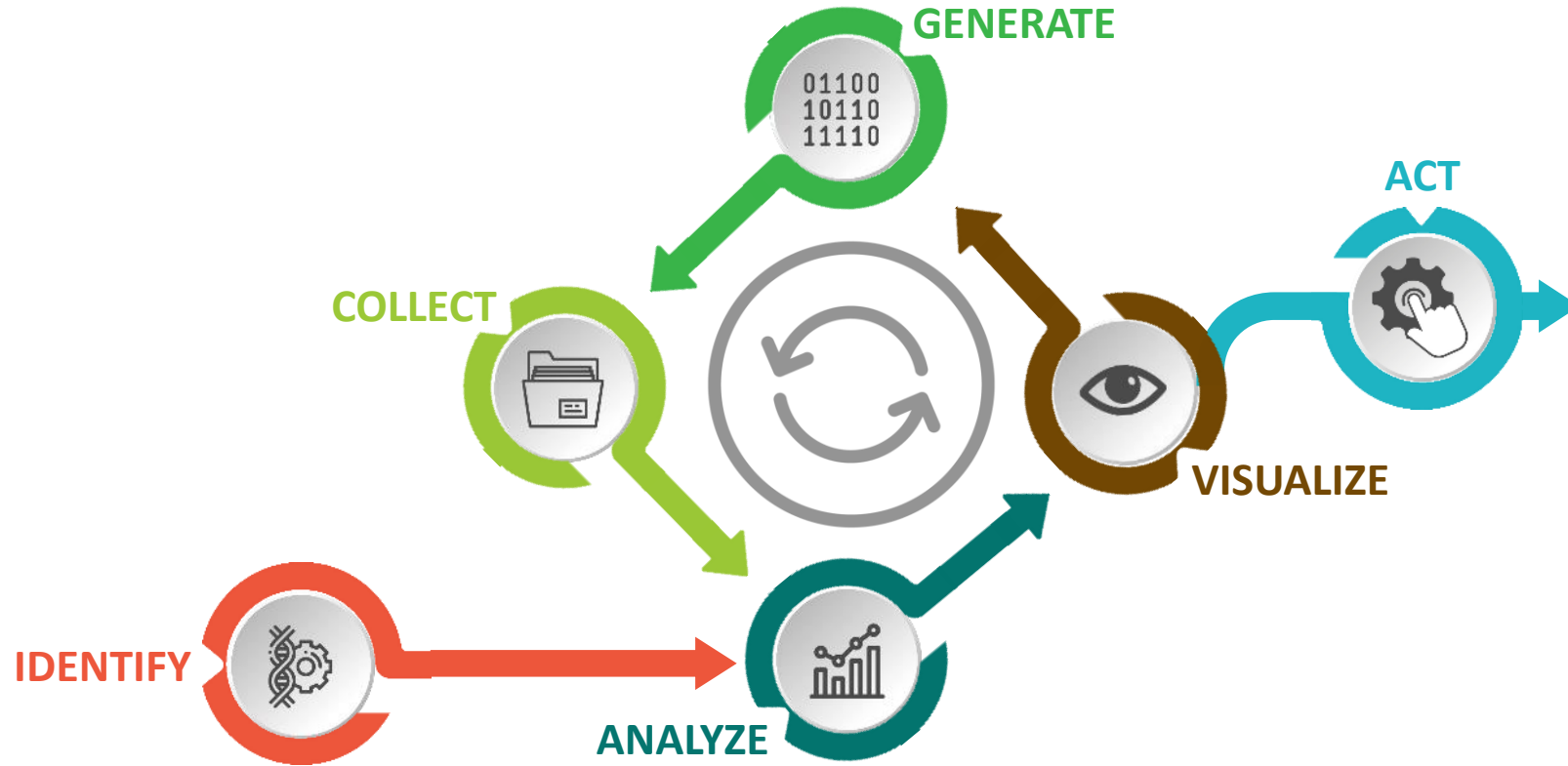
Case 37: Optimization of Bearing greasing interval (Macro)



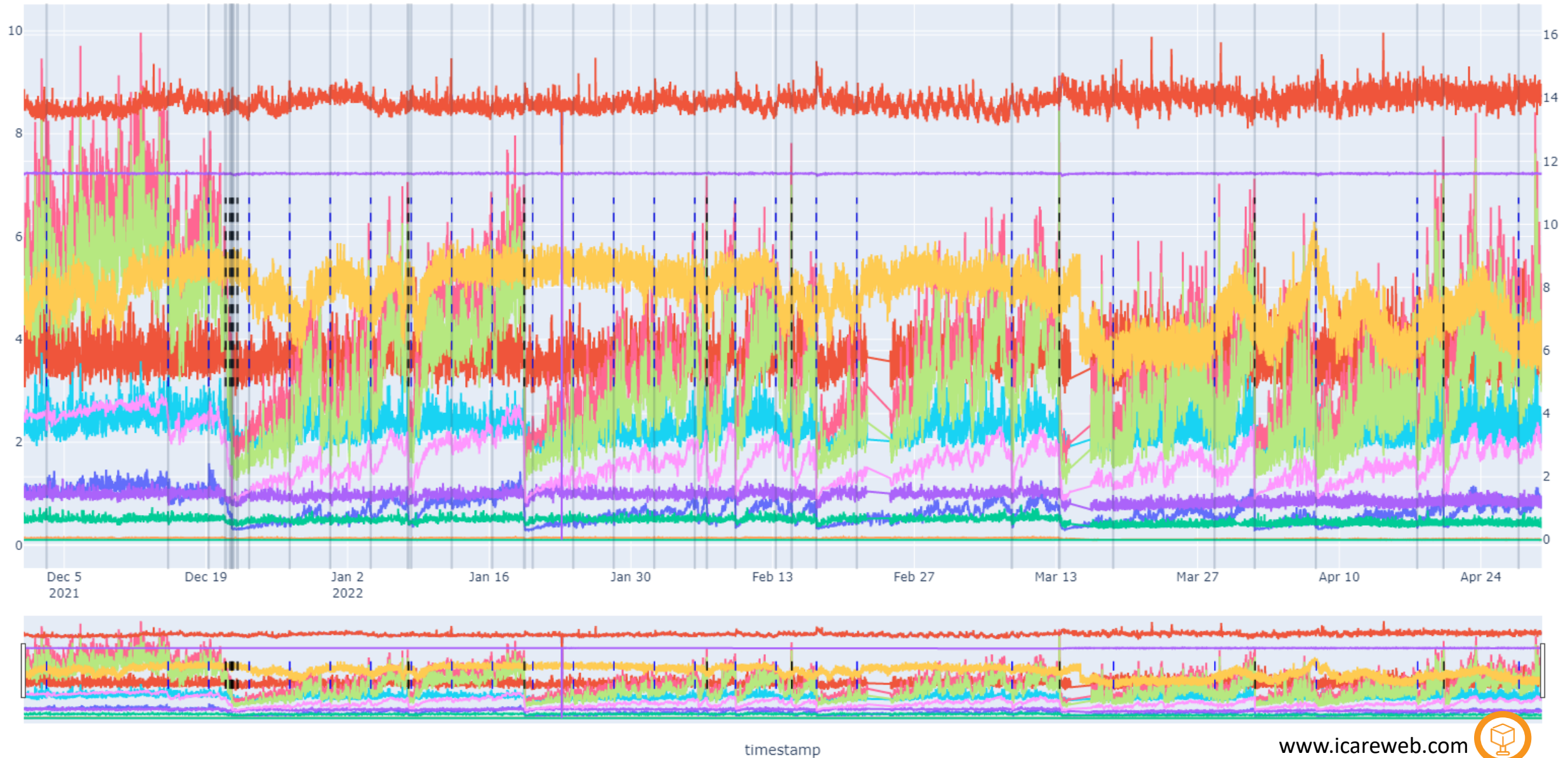
Introduction | Industry 4.0 & beyond : I-care's roadmap



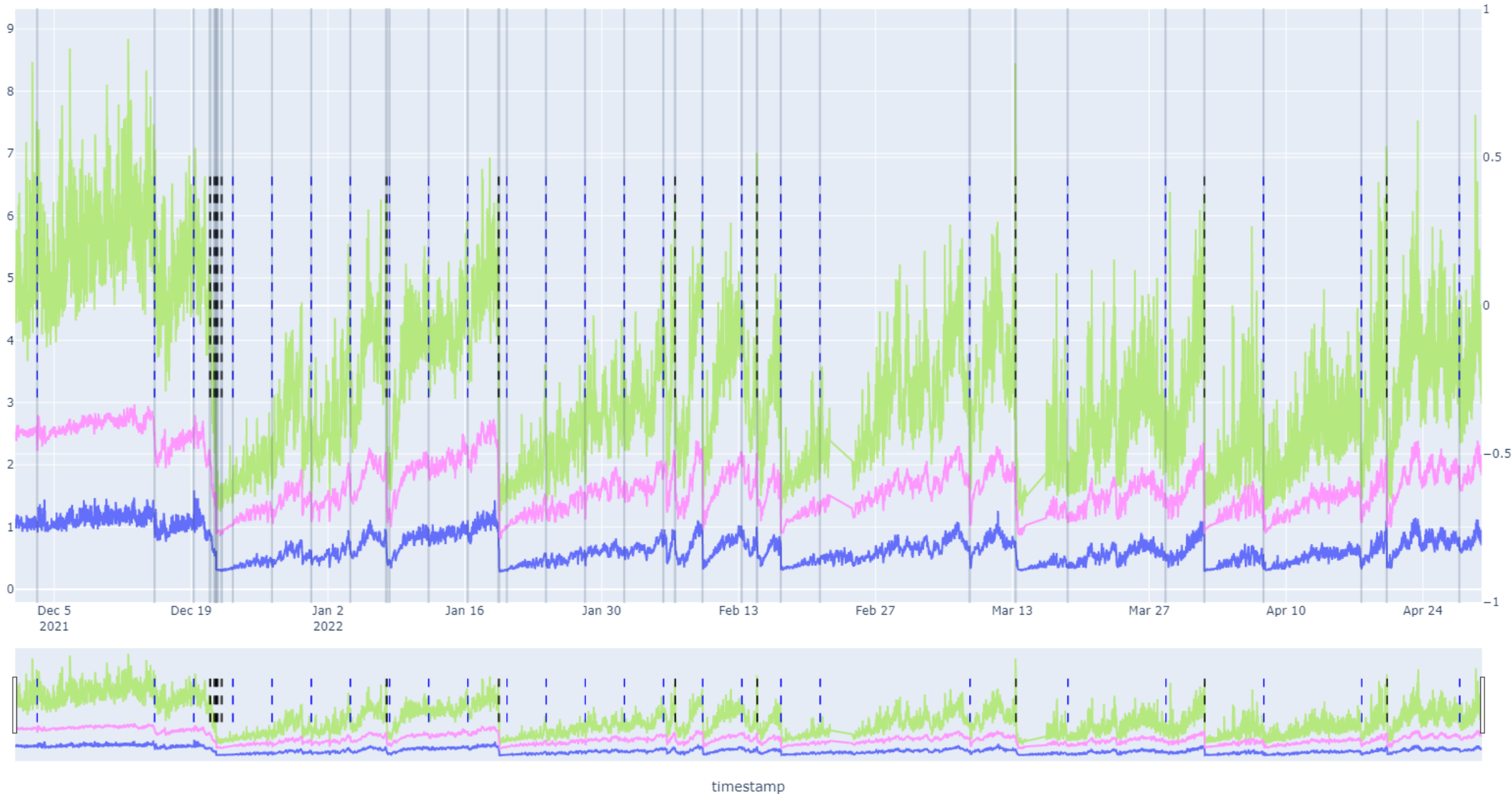
Introduction | Iterative approach for Data Science



Data understanding



Visualize



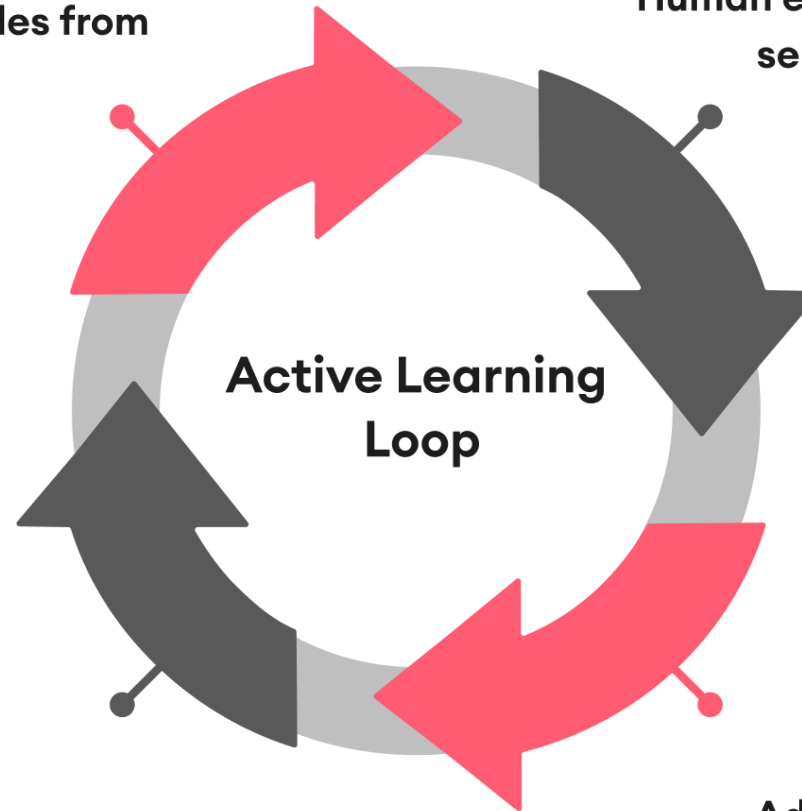
Active learning loop

QUERY

Use acquisition functions to select examples from unlabeled data

ANNOTATE

Human experts annotate selected examples



TRAIN

Train model on labeled training data

APPEND

Add newly labelled examples to training data

Case 37: Optimization of Bearing greasing interval (Micro)

Next

Prev

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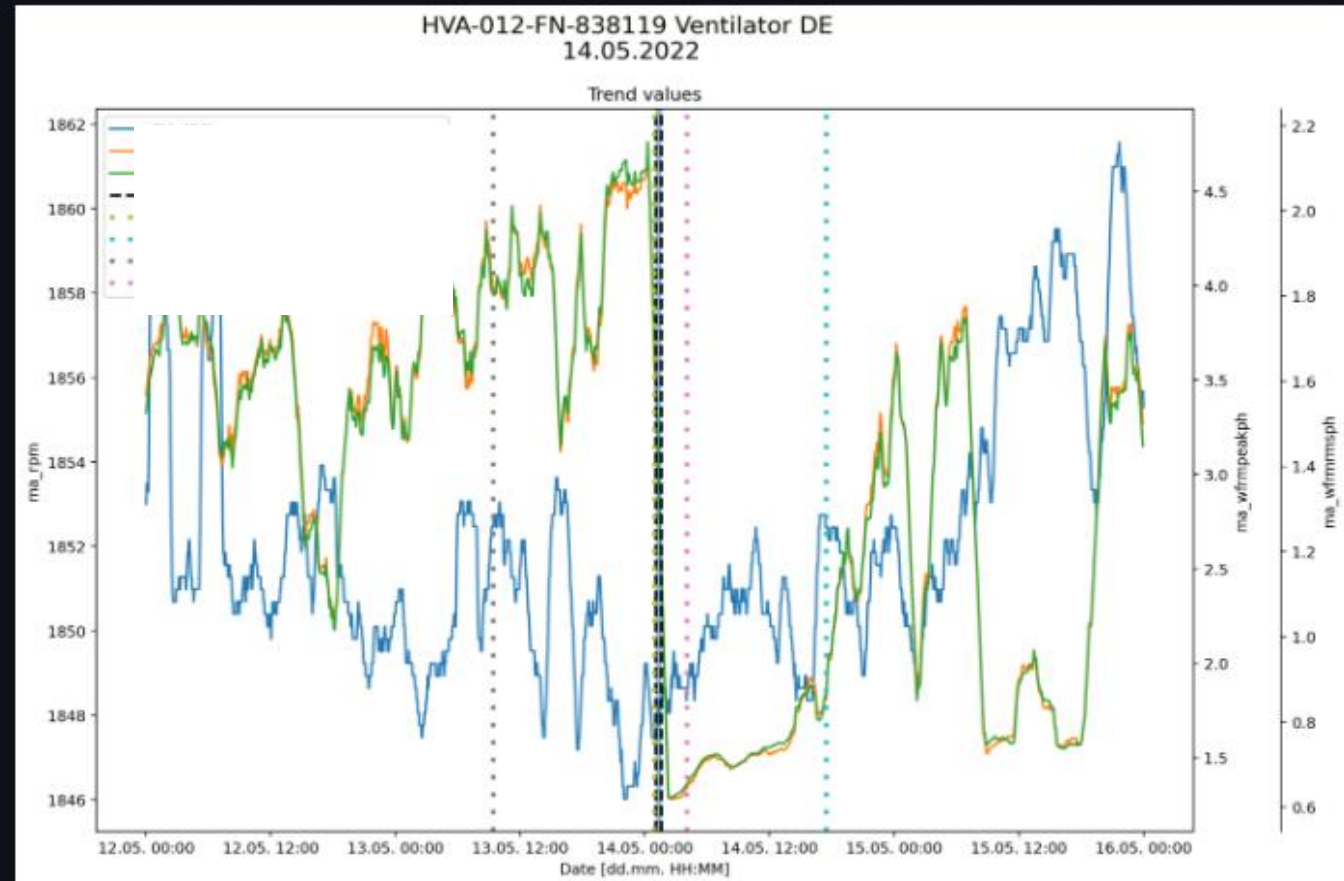
21

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+

Finish

- ☒ fault
- ☐ uncertain
- ☐ nofault



Lessons learned from the ML approach

- Iterative approach works
- Additional features identified
- Lubrication effect?
- Lubrication action “Complete”?
- Good basis for Optimization project





Want more information?
Visit our booth 241,
Drop us an e-mail
Or give us a call



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