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FACING THE CHALLENGES OF AGING ASSETS

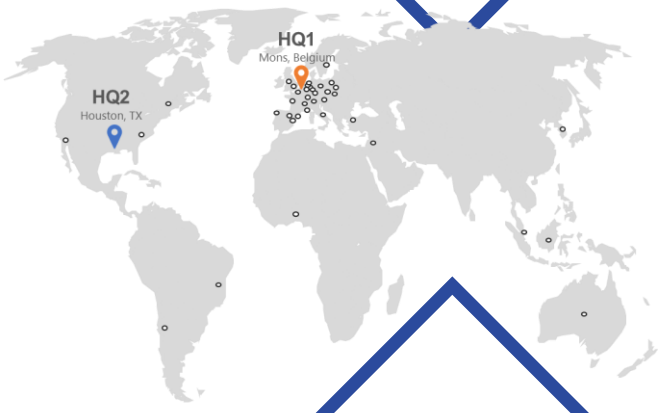
Tom Rombouts

ABOUT US

+25%
Year over Year Growth since 2004

26
Number offices, alliance partners and distributors

18
Countries we support



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WHAT WE DO

Industry 4.0
Offering a complete digital transformation roadmap. Hardware enabled, software as service delivery model

Calibration & Measurement
For industrial measurement instruments and certification of production equipment and clean rooms

Predictive Maintenance
Integrated technology applications for early detection of component failures. We help measure, analyze and recommend action

Reliability Centered Lubrication
Comprehensive service offering including implementation of lubrication plans, management, on-site storage and analysis of lubricants

Prescriptive Maintenance
Turn key asset life cycle management and process optimization support

Talent
Staff augmentation support by converting customer needs into well defined projects, executed by I-care Engineers

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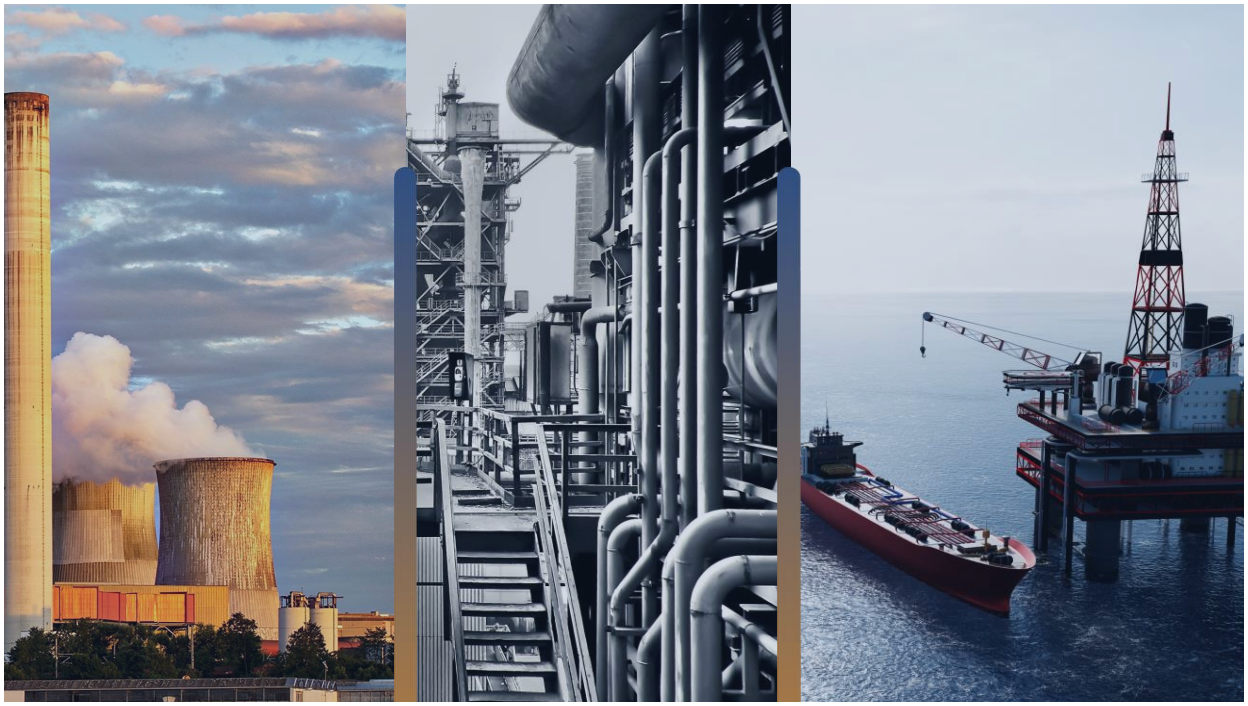
✓PROMOTE EQUALITY, DIVERSITY, AND INCLUSION
✓Work together to achieve more
✓Loyal, honest and have FUN

✓CARE ABOUT OUR PLANET
✓Industrial assets around the world consume less and pollute less with our services and solutions
✓Strategy is based on sustainable growth and innovation

✓REDUCE INDUSTRIAL BREAKDOWNS BY AS MUCH AS 95%
✓Increase site productivity by as much as 30%.
✓Nurture long-term relationships with our clients



AGEING MANAGEMENT

Material Degradation

- Material properties
- Operation conditions
- Environmental conditions
- Maintenance Practice

Obsolescence

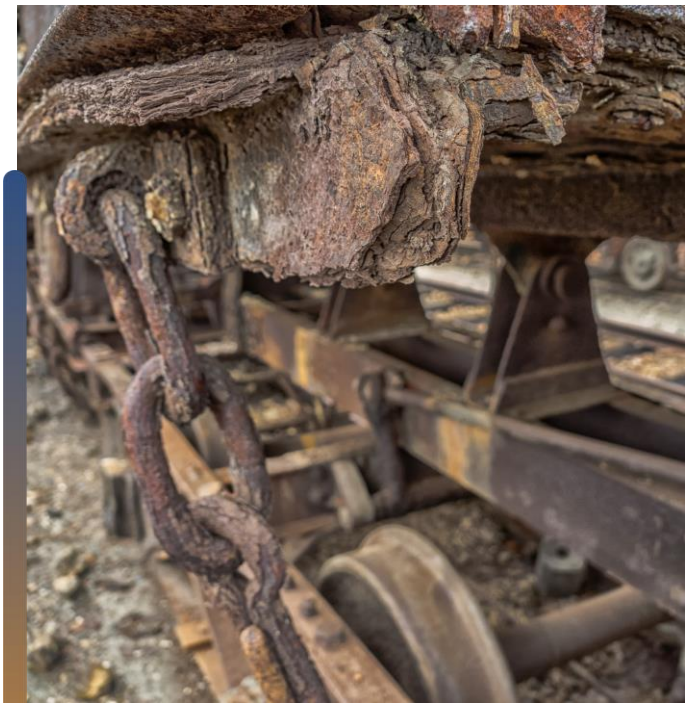
- Equipment "out of date
- New Needs
- New technology
- New requirements

Organizational issues

- Reorganization
- Ageing of personnel
- Transfer of knowledge

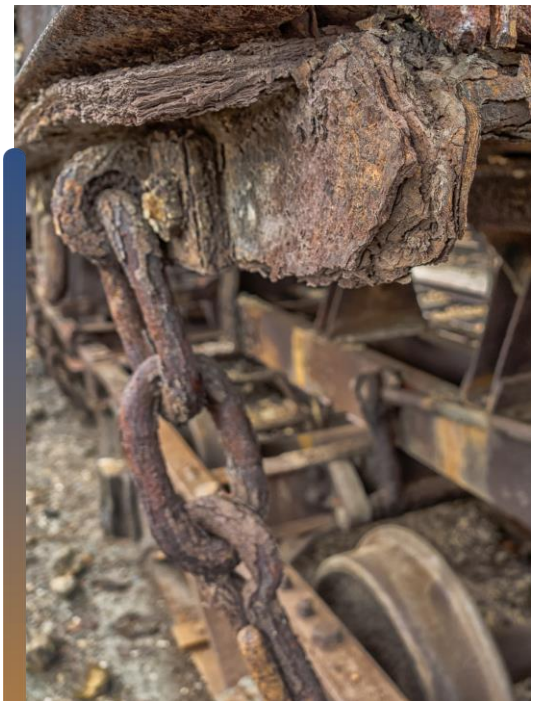
Source: *Maintenance Management of Aging Oil and Gas Facilities | WRITTEN BY | Riaz Khan, Ammeran B. Mad, Khairil Osman and Mohd Asyraf Abd Aziz*

Material & Asset Degradation



MATERIAL & ASSET DEGRADATION

1. MAINTENANCE STRATEGIES
2. RESILIENCE /rɪ'zɪlɪəns/
3. DETECT THE START OF DEGRADATION



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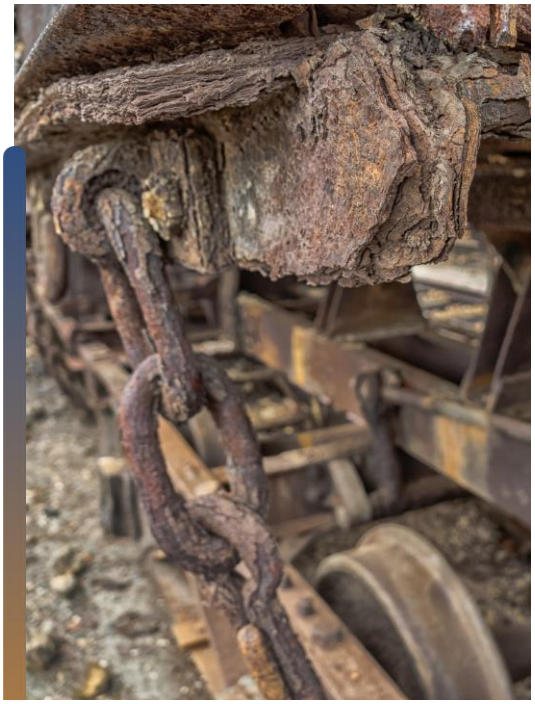

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I-mining

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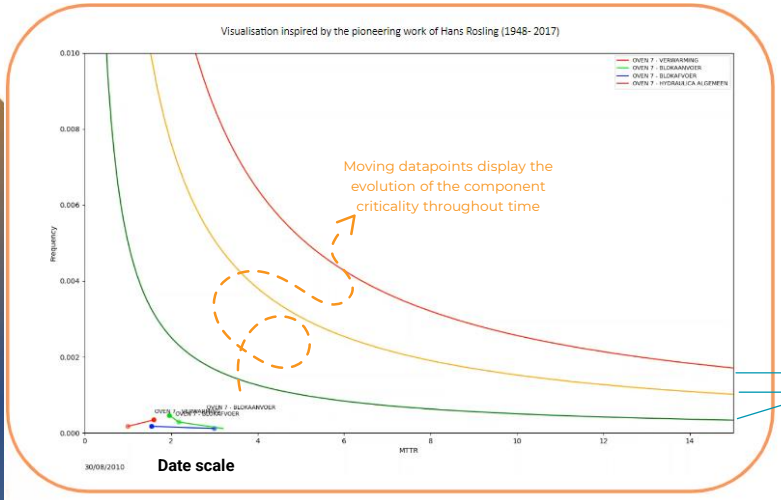

Analysis of 10 years CMMS data - 47.000 closed work orders – Business Case Identification based on equipment reliability data

Reference grid with equal criticality

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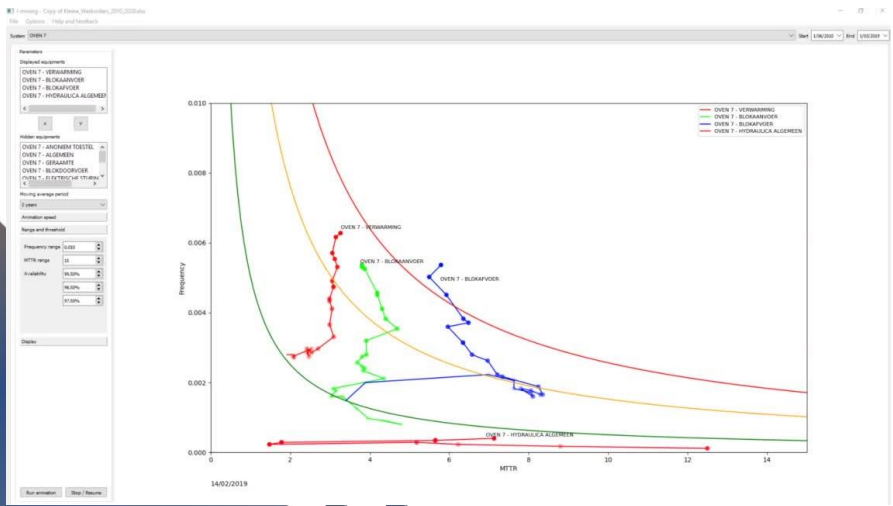
I-mining



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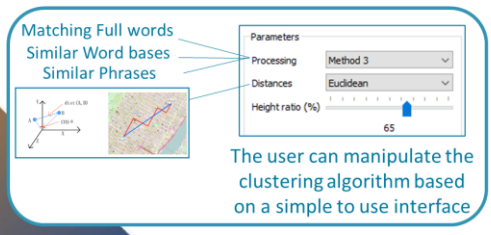
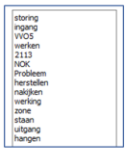
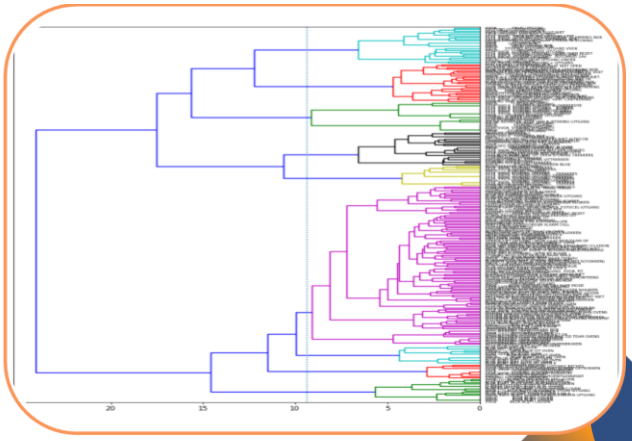


The user can manipulate the clustering algorithm based on a simple to use interface



Using a Blacklist, the user can highlight or ignore terms in the clustering process. This to increas the clustering relevance for further analysis



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In Depth Cluster Analysis

The user can select what cluster is most interesting for further analysis. This cluster can be picked from the pareto chart.

The technician feedback of the intervention is analyzed by an NLP algorithm, displaying the most relevant words in a Word cloud.

This visualization can be used for further Root cause analysis and triggering focused improvement projects.

MATERIAL & ASSET DEGRADATION

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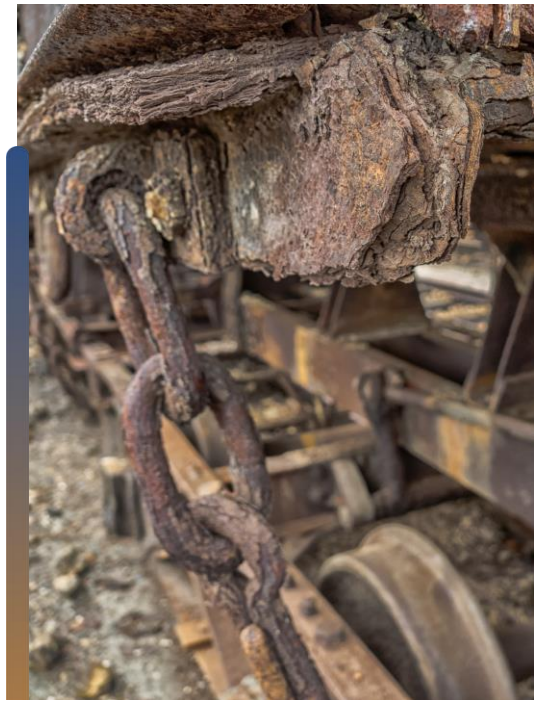

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Peak in wear-out (WaaS)

MATERIAL & ASSET DEGRADATION

DETECTABILITY USING VIBRATION:
BASED ON 11.469 DESIGN FAILURE MODES

- ALL FAILURE MODES — 21,32%
- "Age related" Failure modes — 28,26%

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MATERIAL & ASSET DEGRADATION

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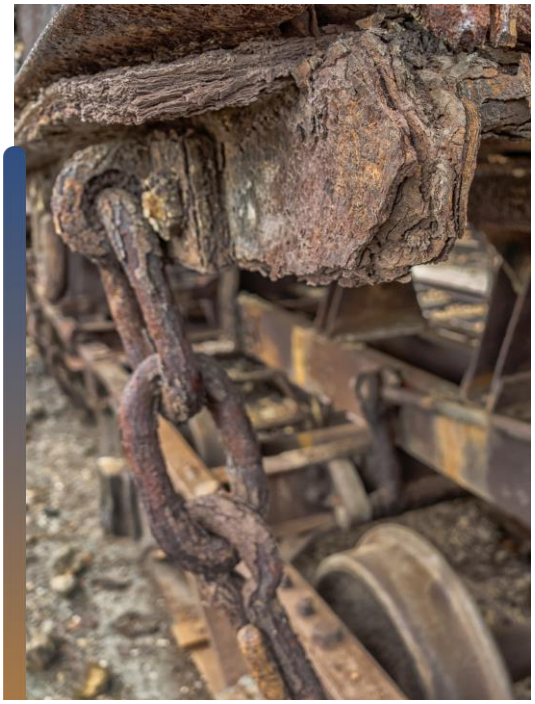

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Equipment Obsolescence

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Equipment Obsolescence

- Revamping + Energy efficiency
- Proactive Maintenance
- Stock management

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Data Oriented Failure Analysis (DoFa)

DOFA Worksheet example

Asset	Assembly	sPart	sFailure	Delta P	Flow	RPM	Speed	Power	Moisture	Temperature	Level	Particle count	Weight
Sifter	Bearing	BRG-BEARING SEALED (EMEA)	Abrasion							TIA_26000			
Sifter	Bearing	BRG-BEARING SEALED (EMEA)	Adhesion							TIA_26000			
Sifter	Bearing	BRG-BEARING SEALED (EMEA)	Corrosion-Pitting							TIA_26000			
Sifter	Bearing	BRG-BEARING SEALED (EMEA)	Fatigue										
Sifter	Bearing	BRG-BEARING SEALED (EMEA)	Fretting							TIA_26000			
Sifter	Screen	SCREEN (EMEA)	Fails To Remove Particulate		Operator/Productflow		SY_26000	EI_26000					WI_20101
Sifter	Screen	SCREEN (EMEA)	Restricted Flow		Operator/Productflow		SY_26000	EI_26000		TIA_26000			WI_20101
Sifter	Seal (air purge)	SEALPLAN API32 (EMEA)	Improper Flow		Operator/Productflow								
Sifter	Seal (air purge)	SEALPLAN API32 (EMEA)	Leakage		Operator/Productflow					TIA_26000			
Sifter	Vibro motor	VIBRO MOTOR	Corrosion		Operator/Productflow								
Sifter	Vibro motor	VIBRO MOTOR	Wear		Operator/Productflow								
Sifter	Motor-AC	BRG-BEARING OIL (EMEA)	Abrasion							TIA_26000			
Sifter	Motor-AC	BRG-BEARING OIL (EMEA)	Adhesion							TIA_26000			
Sifter	Motor-AC	BRG-BEARING OIL (EMEA)	Corrosion-Pitting							TIA_26000			
Sifter	Motor-AC	BRG-BEARING OIL (EMEA)	Fatigue										
Sifter	Motor-AC	BRG-BEARING OIL (EMEA)	Fretting							TIA_26000			
Sifter	Motor-AC	MOTOR ELECTRIC - HOUSING (EMEA)	Distorted										
Sifter	Motor-AC	MOTOR ELECTRIC - ROTOR (EMEA)	Defective Rotor Bar				SY_26000	EI_26000					
Sifter	Motor-AC	MOTOR ELECTRIC - ROTOR (EMEA)	Imbalance				SY_26000	EI_26000					
Sifter	Motor-AC	MOTOR ELECTRIC - WINDINGS (EMEA)	Insulation Failure										
Sifter	Motor-AC	MOTOR ELECTRIC - WINDINGS (EMEA)	Open				SY_26000	EI_26000					
Sifter	Motor-AC	MOTOR ELECTRIC - WINDINGS (EMEA)	Over Heat				SY_26000	EI_26000		TIA_26000			
Sifter	Fan-Centrifugal (Squirrel Cage)	SHAFT (EMEA)	Worn										
Sifter	Fan-Centrifugal (Squirrel Cage)	SHAFT (EMEA)	Bent										
Sifter	Fan-Centrifugal (Squirrel Cage)	SHAFT (EMEA)	Corrosion										
Sifter	Fan-Centrifugal (Squirrel Cage)	SHAFT (EMEA)	Embrittlement										
Sifter	Fan-Centrifugal (Squirrel Cage)	SHAFT (EMEA)	Fatigue										
Sifter	Power Transmission-Belt Drive	COUPLING - BELT (EMEA)	Glazed (Slipping)										
Sifter	Power Transmission-Belt Drive	COUPLING - BELT (EMEA)	Wear				SY_26000	EI_26000		TIA_26000			WI_20101
Sifter	Power Transmission-Belt Drive	COUPLING - BELT SHEAVE/PULLEY (EMEA)	Worn				SY_26000	EI_26000		TIA_26000			WI_20101
Sifter	Power Transmission-Belt Drive	COUPLING - BELT SHEAVE/PULLEY (EMEA)	Key Broke/Missing				SY_26000	EI_26000					WI_20101

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Data Oriented Failure Analysis (DoFa)

DOFA Worksheet example

Here, the equipment, its components / Parts and the total number of relevant failure modes are listed.

Here is indicated how many failure modes are detectable with "classical" process monitoring and the detectability with online vibration monitoring.

This table shows which additional monitoring techniques are relevant to monitor the uncovered failure modes

Asset	Main assembly	No. dominant failure modes	Detectable online			Possible additional (advanced) techniques			
			"classic" process monitoring	Monitoring Including vib. Analysis	Delta	Delta	Power consumption	ESA	RPM
Cake Crusher	Bearing	5	3	5	0	0			
Cake Crusher	Screen	2	0	0	2	0	2		
Cake Crusher	Hammer	3	0	0	3	0	3		
Cake Crusher	Motor-AC	11	7	8	3	0		3	
Cake Crusher	Power Transmission-Belt Drive (Eddy	4	3	3	1	0			1
Total		25	13	16	9	0			
		Remaining Risk	48,0%	36,0%		0,0%			

Comparing these "remaining risk factors" shows the value of investing in online vibration monitoring for this equipment

Comparing these "remaining risk factors" shows the value of investing in Process data monitoring for this equipment

Green: proposed and sensor(data) assumed to be available.
Orange: proposed and assumed that sensor still needs to be installed.

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Executive Summary (Example)

As initiation of the Digitisation project, the DOFA methodology is applied on the selected equipment of the [Example- process]. More information of the methodology and the output for each individual equipment can be found in the following slidedeck. In short, the results of the DOFA sessions are summarized in the table below.

	Residual risks after incrementally implementing monitoring technologies below:		
Asset	**"classic" process monitoring**	**Monitoring Including vib. Analysis**	**additional (advanced) techniques**
Example pump P0-1000	75,6%	42,2%	17,8%
Eample pump Location 1	73,3%	42,2%	17,8%
Example conditioning Tank	83,9%	54,8%	29,0%
Example Loading pump(s)	66,0%	35,8%	15,1%
Exmaple press	88,8%	72,9%	17,8%
Example Cake Crusher	48,0%	36,0%	0,0%
Average risk	72,6%	47,3%	16,2%

Here we can generally observe the remaining risk being reduced while investing in detectability.
First the investment in online vibration technology reduces a average residual risk from 73% to 47%. Additional advanced techniques under the form of dedicated sensors or anomaly detection algorithms have the potential to further reduce the risk to 16%. These numbers are dependant of the choice what will be developed and/or implemented.?At the end of this slidedeck, you can find a proposed roadmap for next steps.
To spread the workload and speed up development, the proposal is made:

Given the existing high rate of adoption of online vibration monitoring in [Location], to reduce the risk by developing and implementing additional advanced detection techniques. Especially for the [Asset] where residual risk remains high.. Logically, additional vibration sensors can be deployed where the DOFA output shows its value. Additionally, in [Location 1], integration of process data into the vibration analysis platform can increase detectability for complex equipment. To increase the detection in [Location 2] by implementing online vibration monitoring, later followed by a roll-out of the development made for [Location 1].

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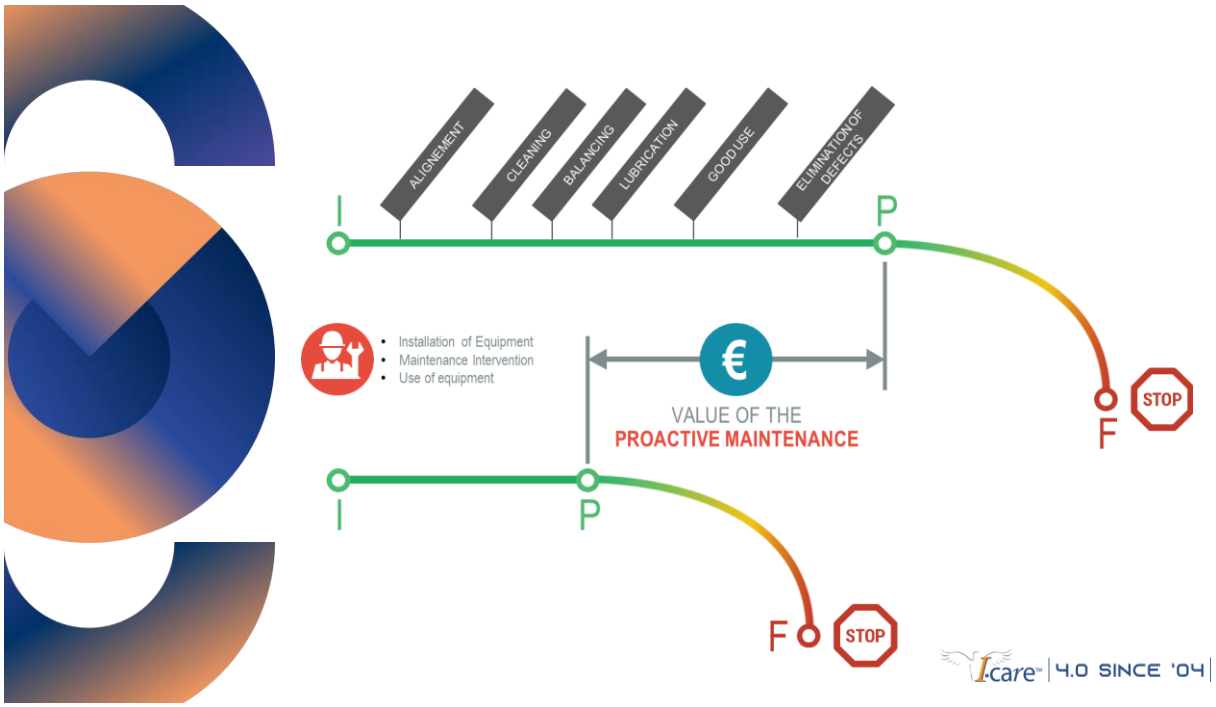
Equipment Obsolescence

- Revamping + Energy efficiency
- **Proactive Maintenance**
- Stock management



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Equipment Obsolescence

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Organizational issues

ORGANIZATIONAL ISSUES

- Lack of resources / Reduce workload
- First time right :
  - Invest in quality
  - Train

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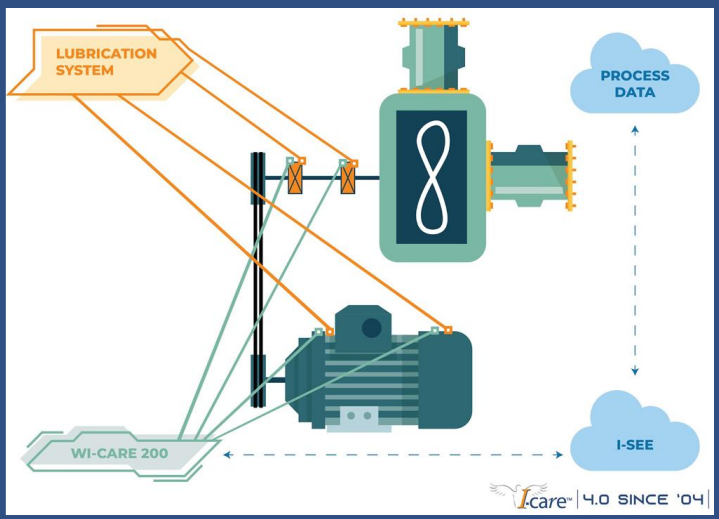
Pattern recognition



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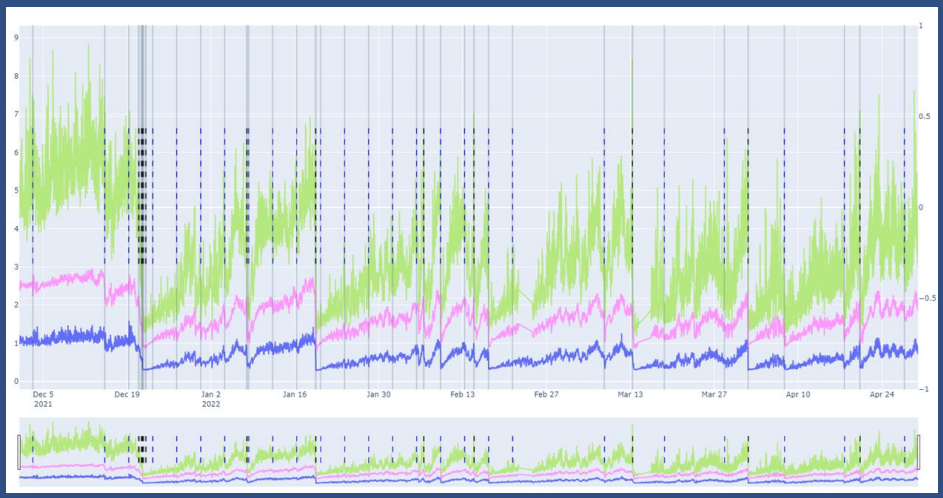

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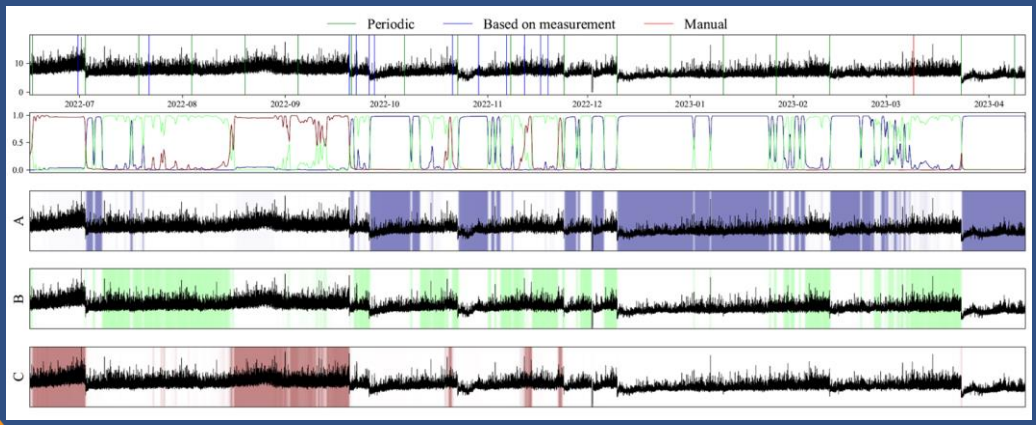

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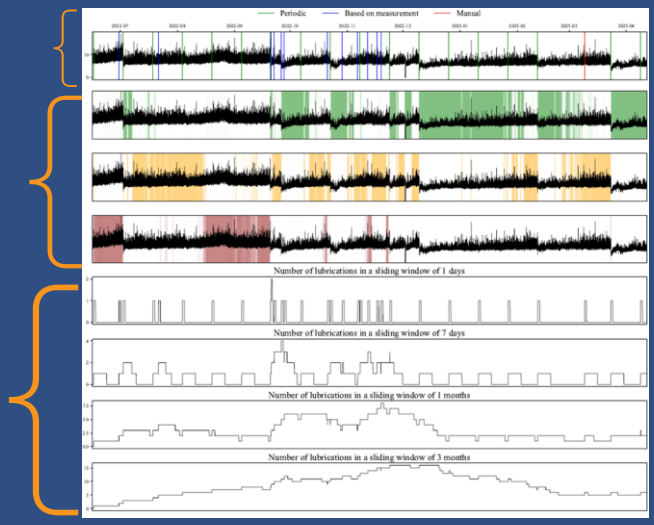
Lube Optimization

Vibration based Lubrication State monitoring

Good State
Medior State
Bad State

Lubrication Quantity
Accumulative in different
rolling time windows



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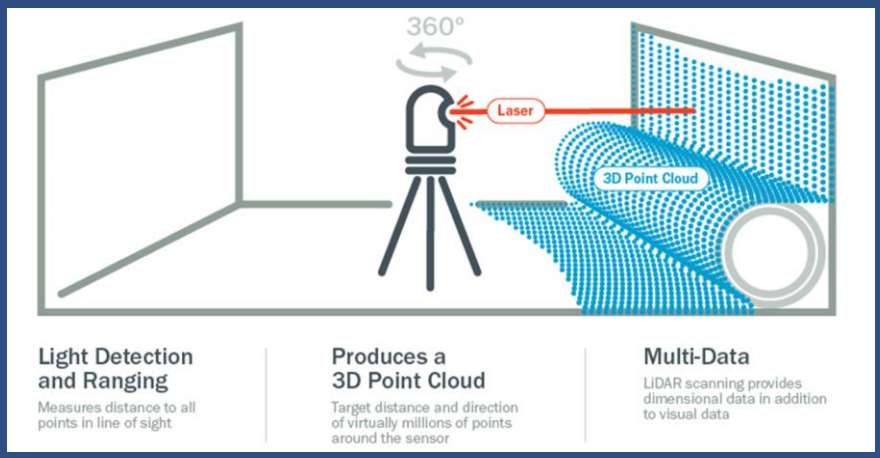
LIDAR



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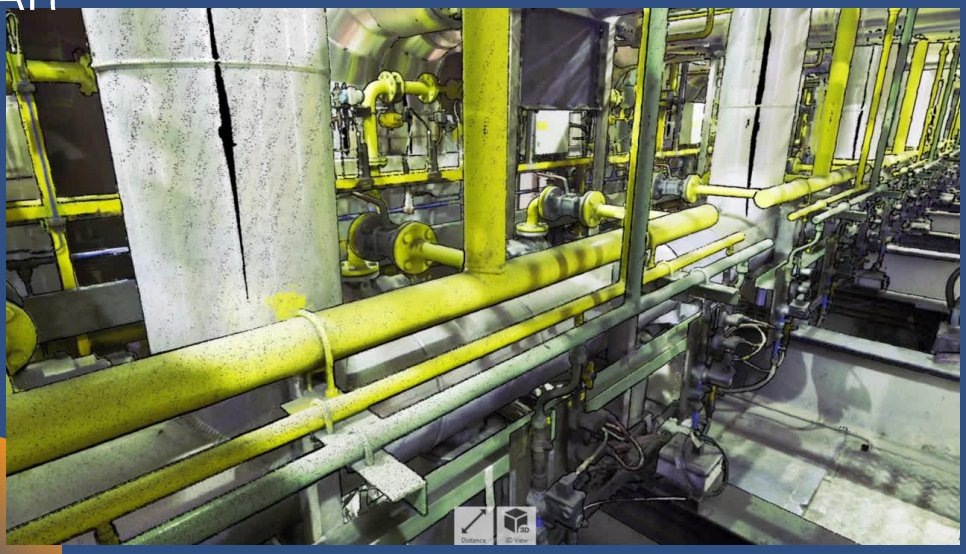

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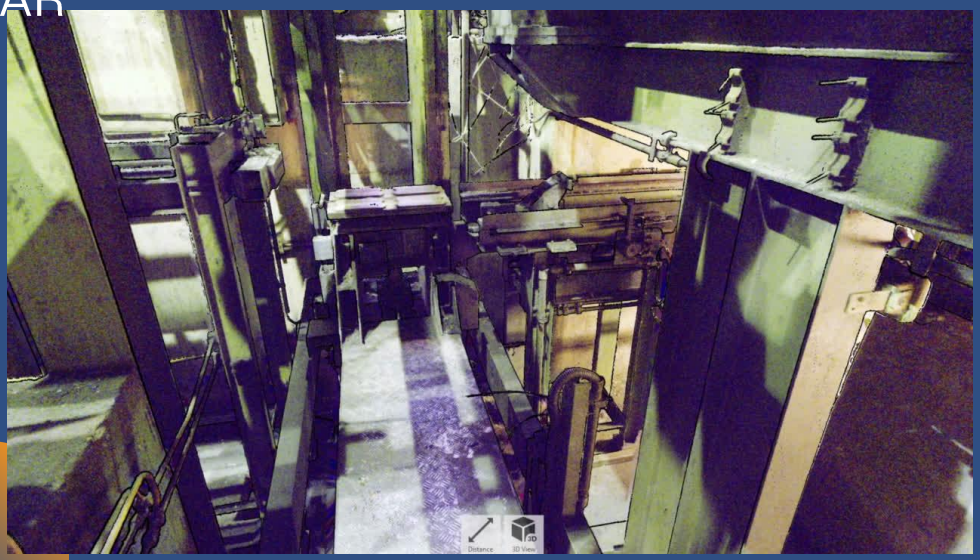

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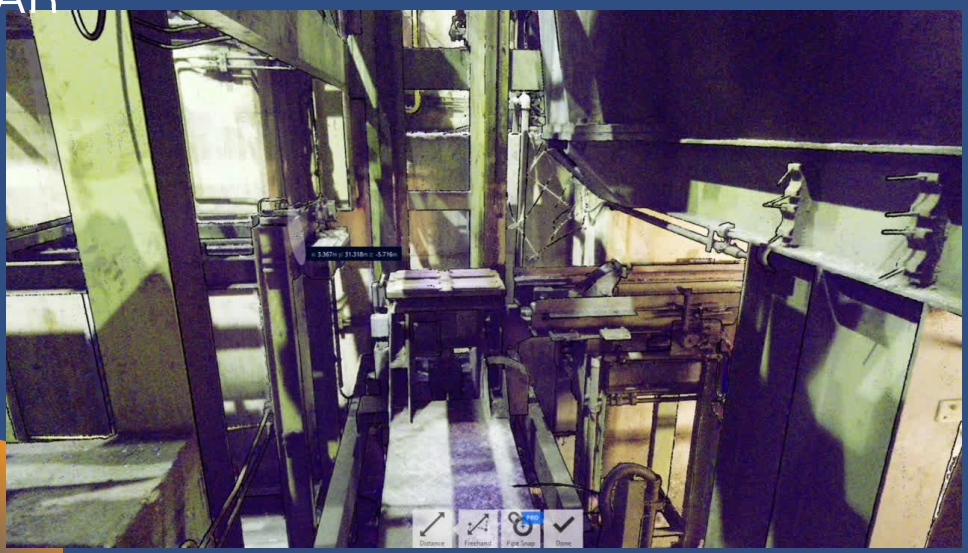

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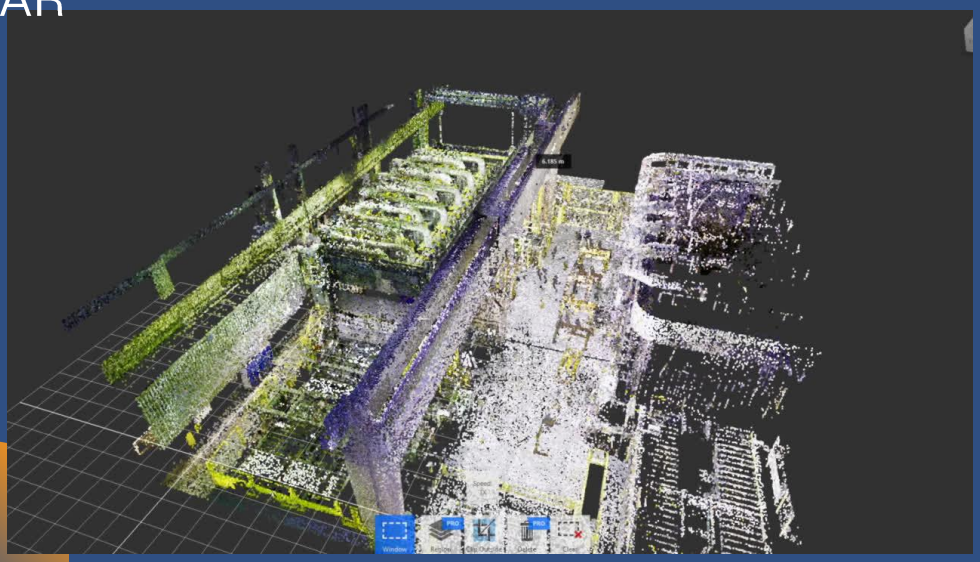

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Want more information?
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