Accurex™

Patended Automatic Machine Health Diagnosis of Rotating Machinery

SEMA-TEC

OneProd

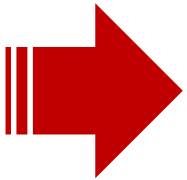
Brand of ACOEM

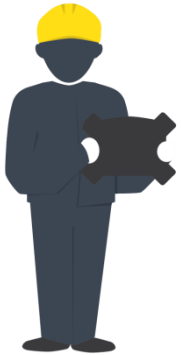
Financial crisis

Retirement

How staffed are production sites?

YESTERDAY





TODAY

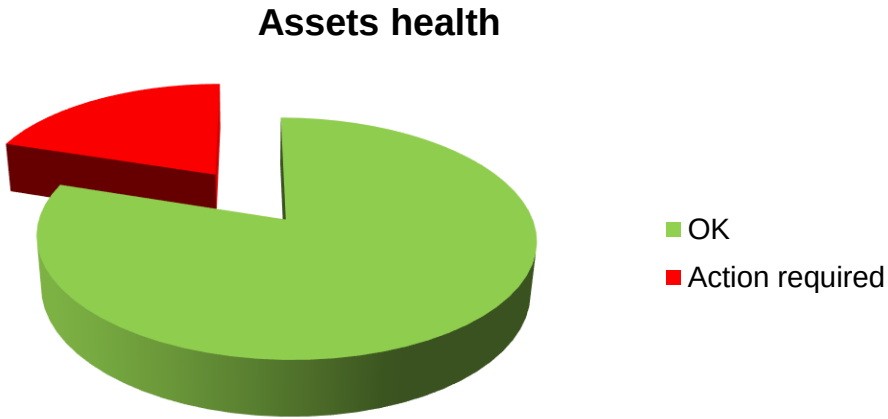
How can we improve the efficiency of a CM program?

- Help expert users to prioritize their work

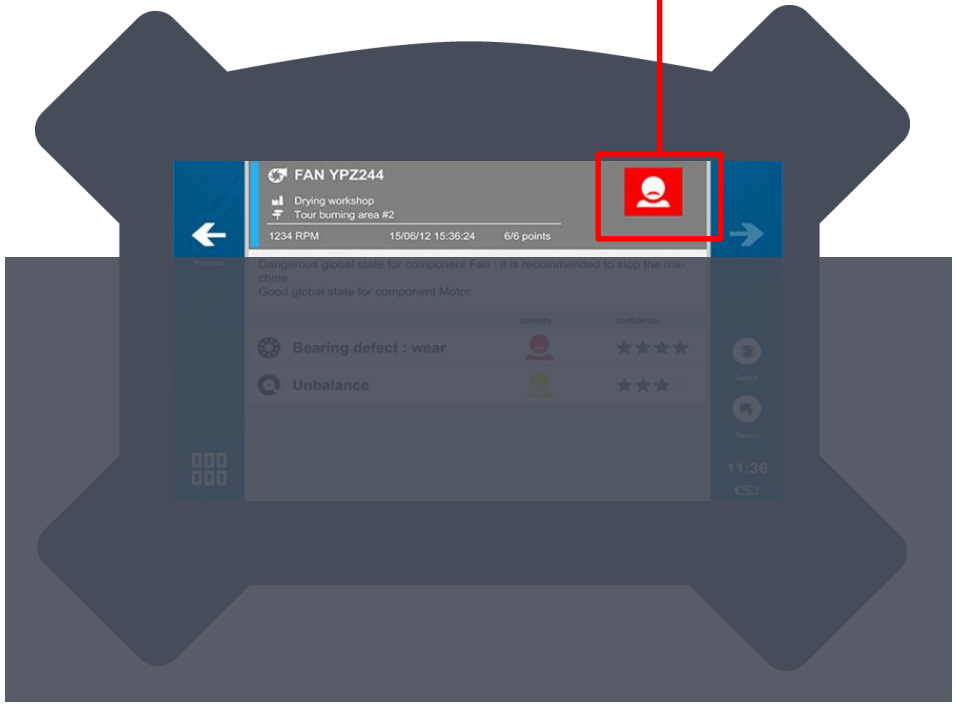
- Empower the rest of the staff:
  - Relieve the experts on less critical machines
  - Optimize the maintenance process
  - Easy check other machines

Help the Expert user

Focus on critical machines



1st level: Help the expert focus on critical machines



Machine Overall Health Status

Immediate action required

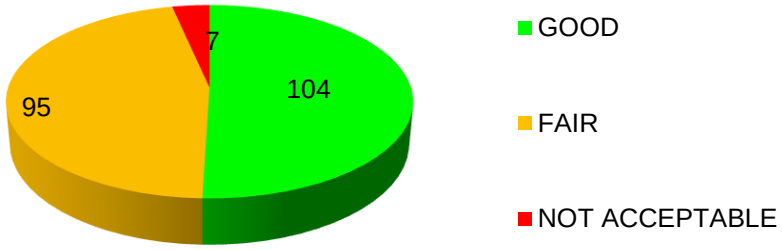
Shorten control periodicity

No action required

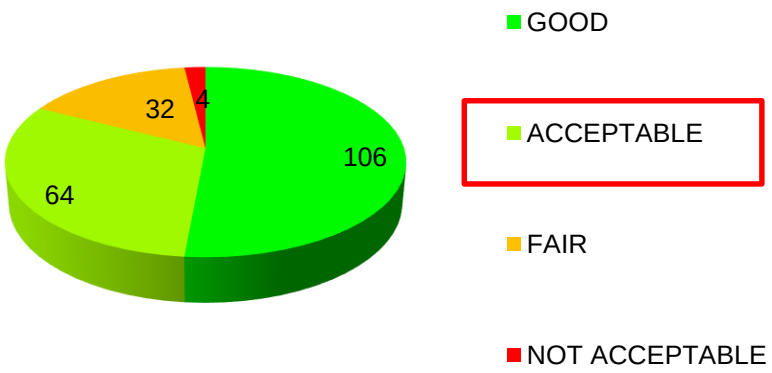
Example @Kimberly Clark (paper industry)

206 machines(pumps, fans…)
100% faults detected

Automatic diagnostic



Expert



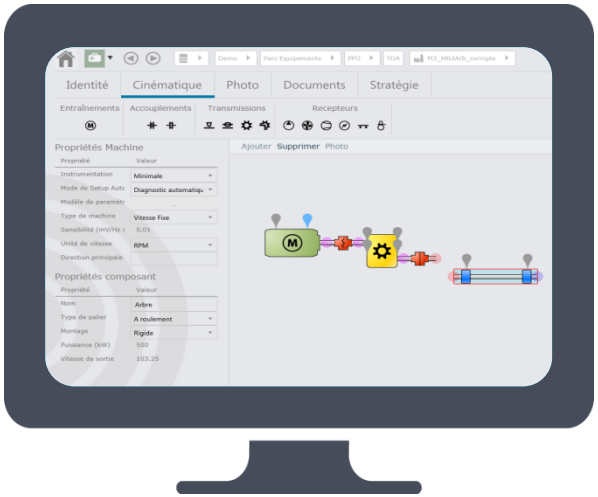
Empower the others

Help the rest of the staff to do something

- Assistance to diagnostic (<2 year experience)
- Take Immediate corrective actions on less critical machines without help of the expert – **Save time!**

- Take additional controls on suspicious machines between 2 periodic controls – **Save the machine!**
- Quick check-up on machines that are not part of the condition monitoring program **– Optimize maintenance**

1. Easy & reliable automatic setup

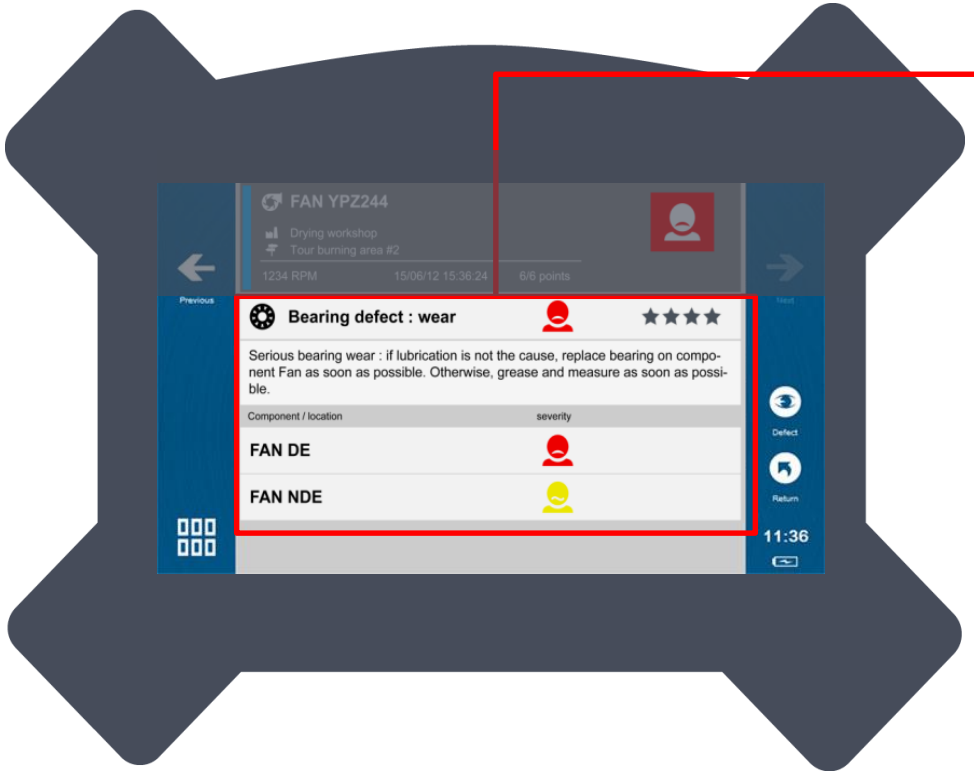


- Suitable for personnel of all skill levels:
  Description of the machine kinematics

2. Instantaneous result

- Result on the spot, embedded in a portable device: interact with the machine
- **Based on a single measurement**

3. Need of 2nd level of diagnosis to guide the user



Details and recommendations per location

Slight defect

Defect to be monitored

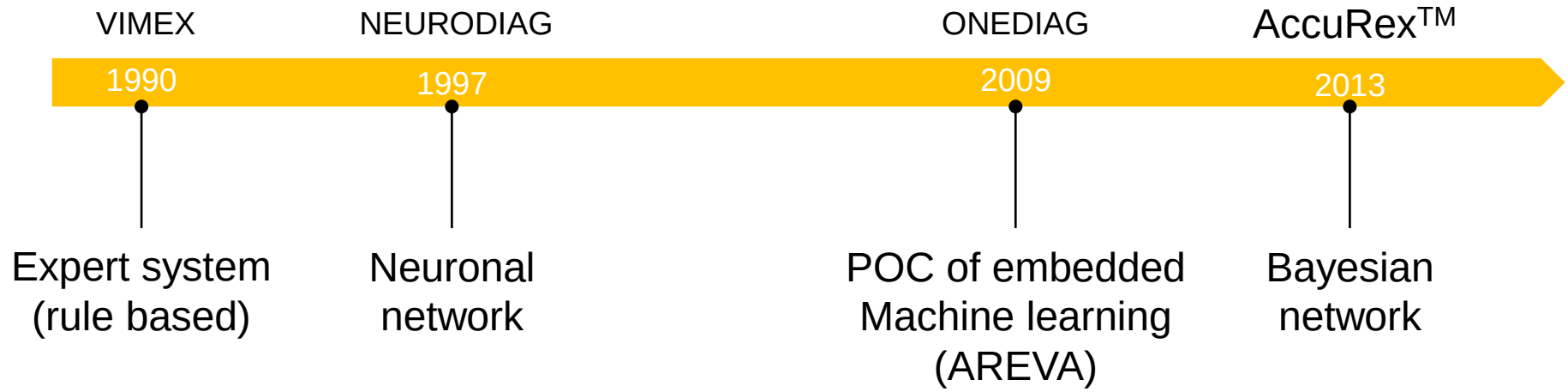
Defect to be corrected

4 – Need a system that can be trusted

- **Confidence level indicator**
  - Can it be converted into action ?
  - or just used as assistance to the diagnostic?

Identified Technical Solution

ONEPROD Experience in Artificial intelligence systems

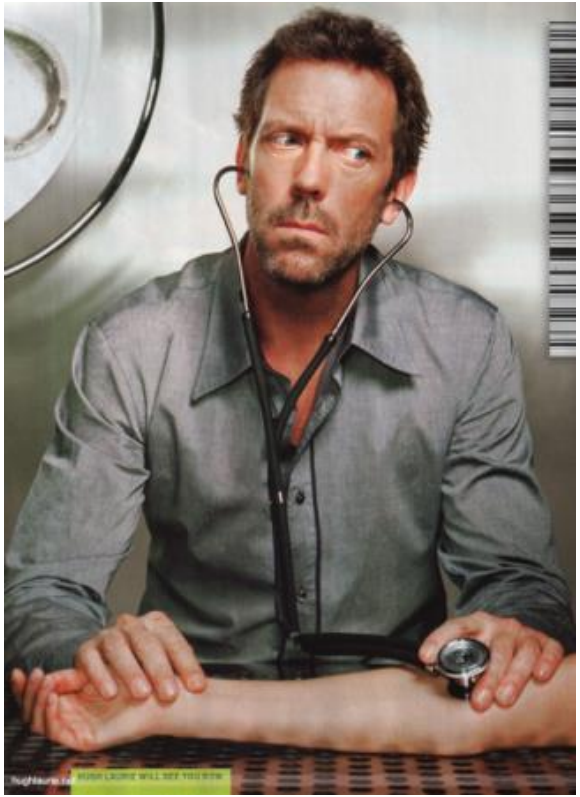


Knowledge: ISO10816 and vibration analysis experience

If the vibration level conforms to the ISO10816 and there are no shocks on the machine,

then this machine is healthy…

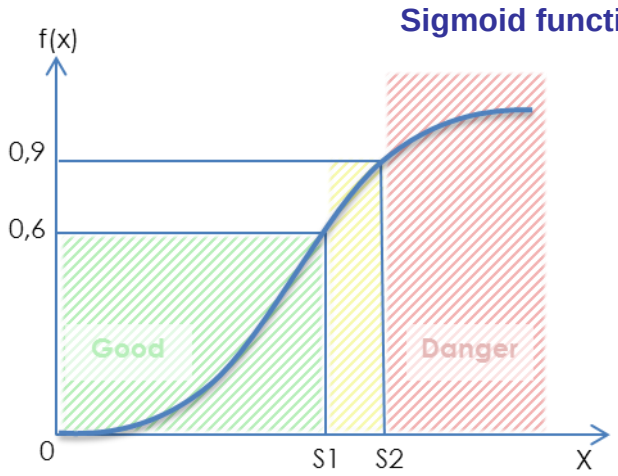
… if not: Scanning all symptoms on the machine



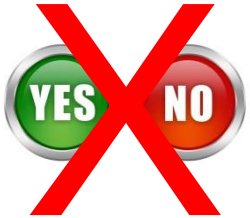
- Overall velocity vibration HIGH?
- Presence of shocks?
- Evolution compared to the previous measurement?
- *Bearing temperature HIGH?*
- …

Symptom probability evaluation: smooth results

Symptom Probability



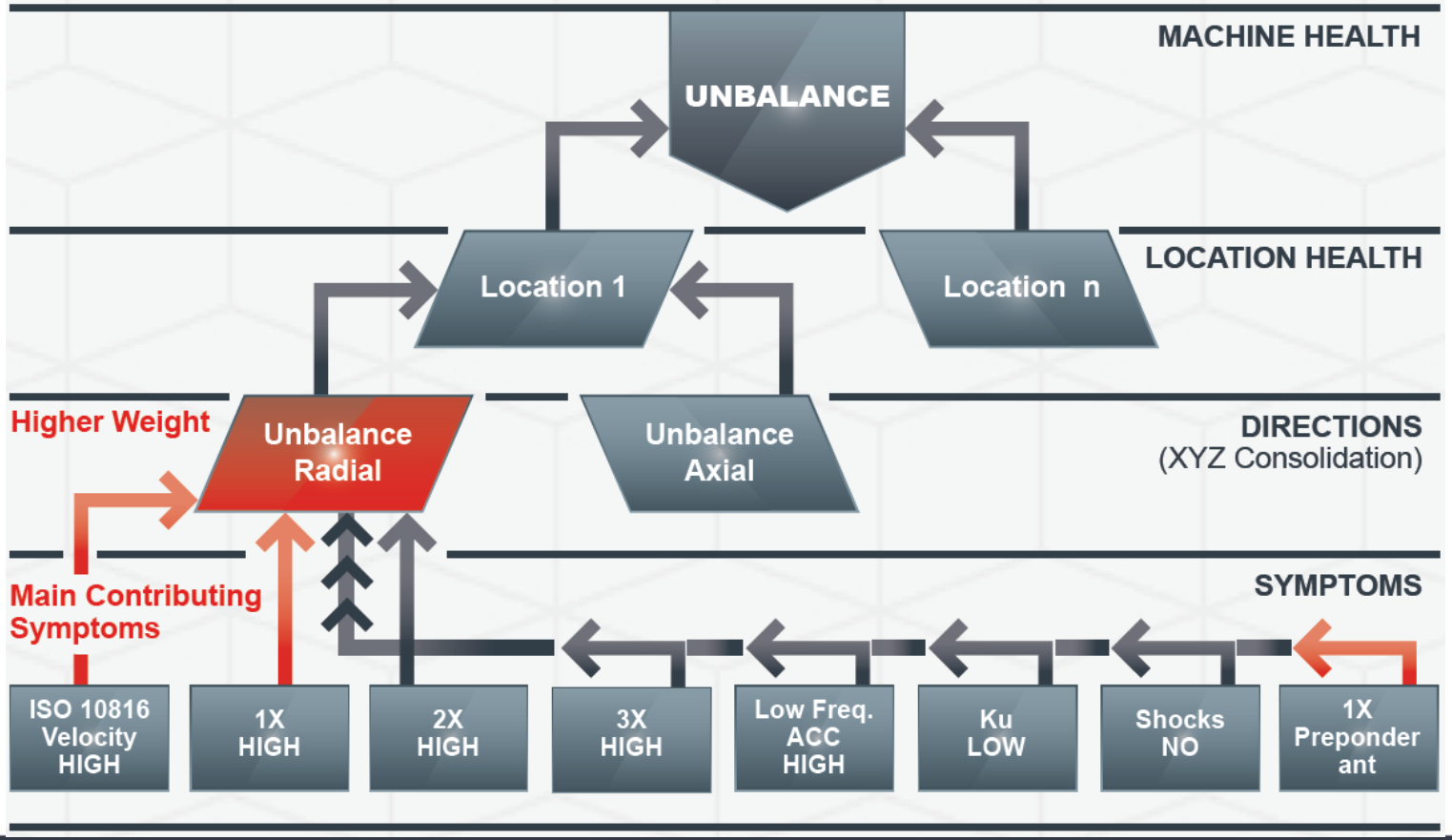
OVL VEL (mm/s)



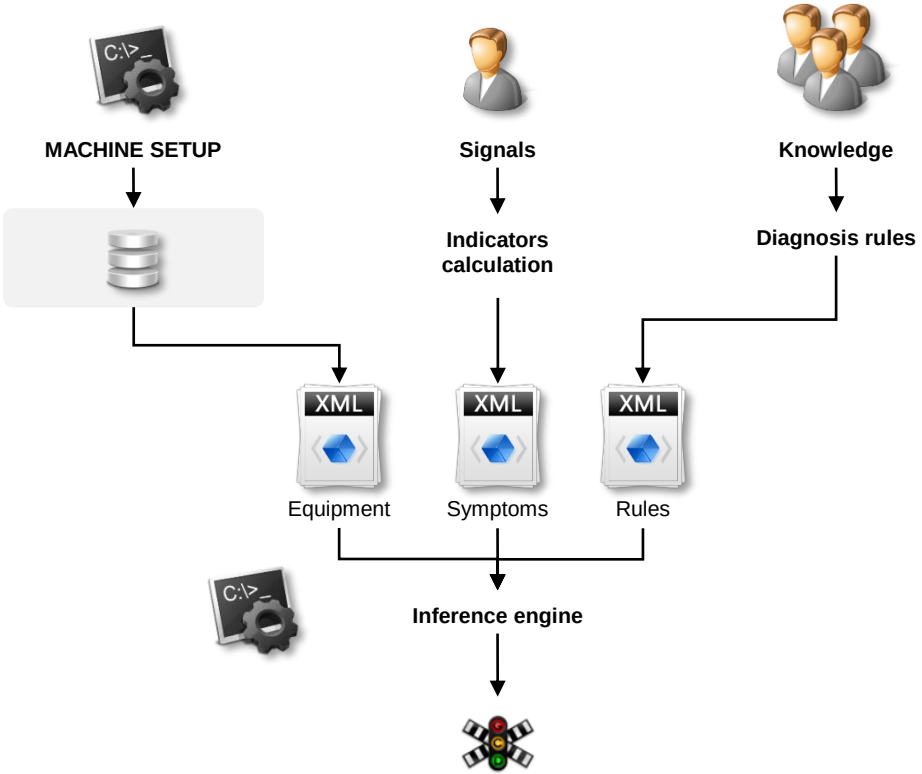
“This symptom is most likely present”

ISO10816 Alarm Thresholds

Example of defect



How it works


MACHINE SETUP
Signals
Knowledge
Indicators calculation
Diagnosis rules
XML
XML
XML
Equipment
Symptoms
Rules
Inference engine

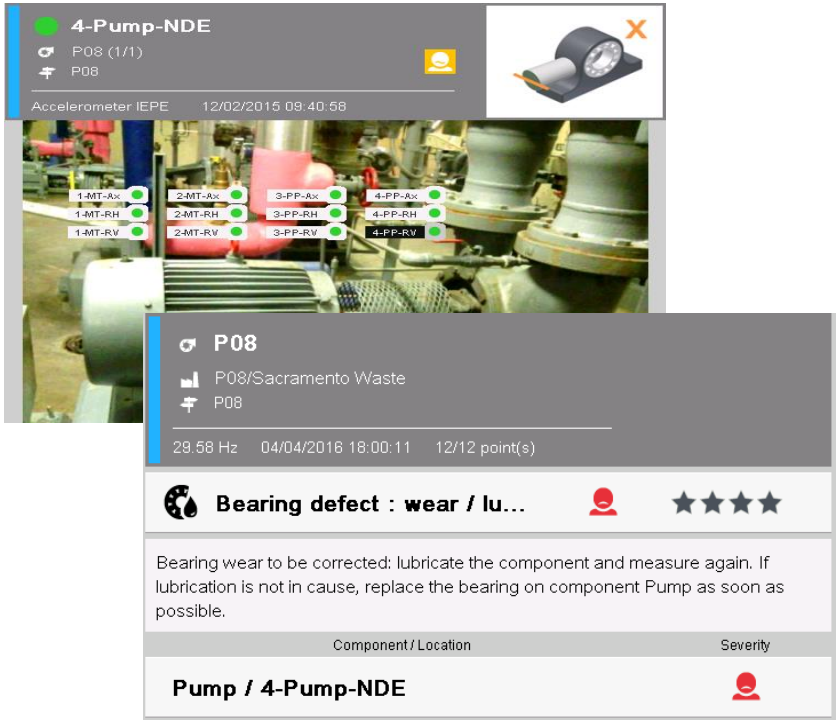
Examples of results

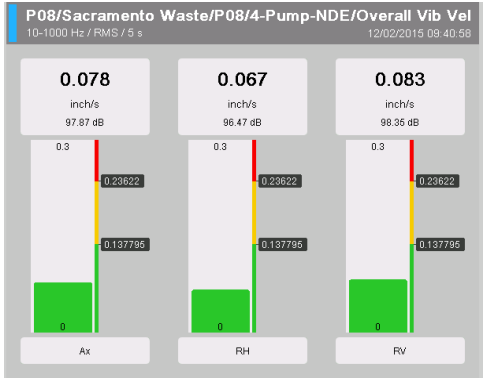
Sacramento waste water treatment (USA)

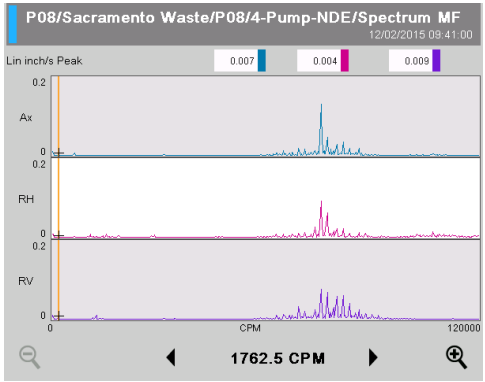
- A 15 HP motor driven pump was making an excessive amount of noise.

- the basic vibration bearing meter was not identifying that there was an issue…

Fault instantly confirmed at the first control

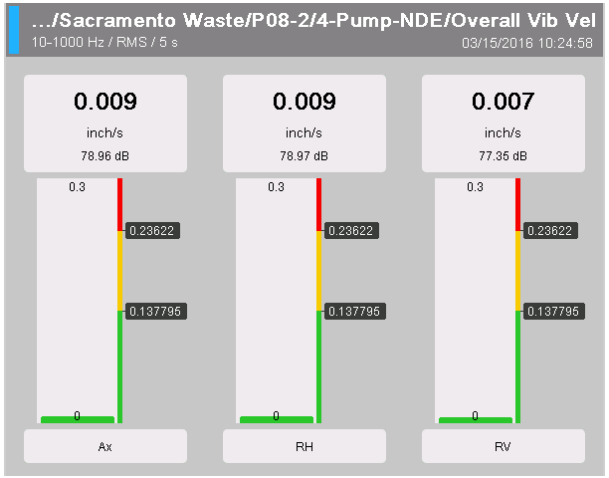


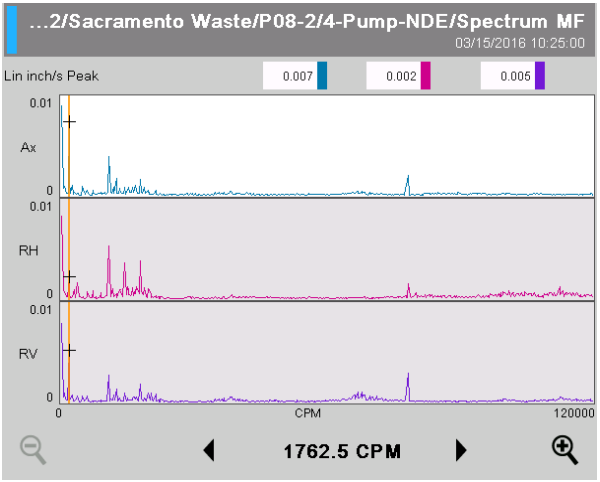


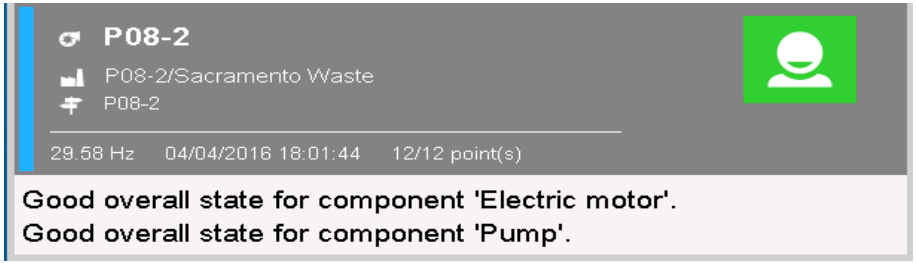


Bearing defect confirmed

OK After repair







Blower - Misalignment detected and confirmed

The Falcon SMART was used recently to test (3) Gardner-Denver blowers at the Yadkinville, NC Wastewater Treatment facility.

The Falcon reported that one of these blowers had a misalignment problem.

Expertise Report

Filter: Equipment name (+) \ Tree order (+)

Location	Yadkin County WTP\
Designation	...
Equipment	G-D Blower
Designation	...
Abbreviation	GDB1
Serial No	
Model	
Periodicity (d)	Normal 60 Alarm 15

Fixed speed

Previous Advice | Condition | Rotation Speed

Date: 01/04/2015 13:18:35
Condition: DfCnd
FAIR
Health is not acceptable for a long time service.

Speed: 59.6 Hz / 3577 rpm
Author: sriddle
Instrument sn: - 10461
Sensor:
Connector:

Diagnosis & Recommendation

Parameters sheet

Diagnosis

Overall state still acceptable for the component 'Electric motor'.
Good overall state for component 'Pump'.

*Misalignment to be corrected Confidence=****

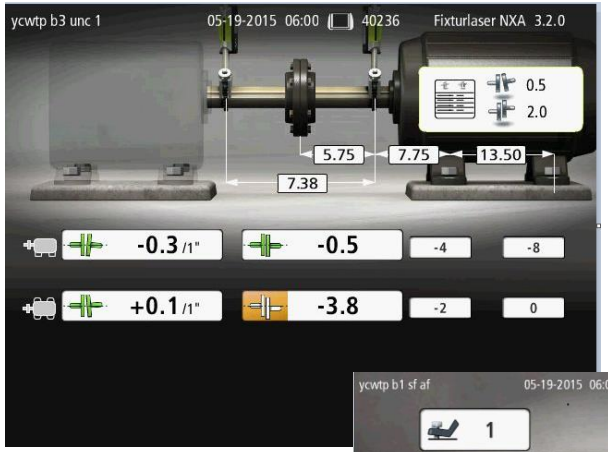
*Structural resonance to be watched Confidence=***

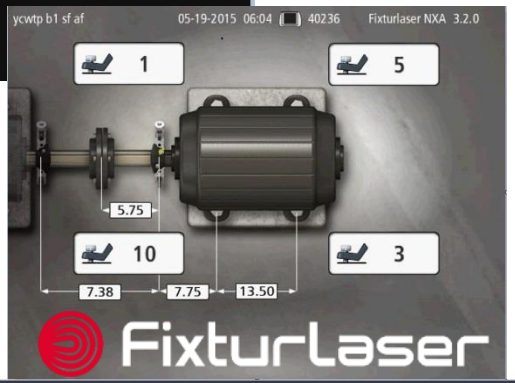
*Unbalance to be watched Confidence=****

Recommendations

Misalignment to be corrected as soon as possible.
Location "Motor-DE" slight
Location "Motor-NDE" to be corrected
Structural resonance that amplifies vibration imbalance at rotational frequency.
Slight structural resonance that amplifies vibration imbalance at rotational frequency.
Location "Motor-NDE" to be watched
Unbalance to be watched. A correction is conceivable during a planned shutdown.
Slight Unbalance: component Pump might require closer monitoring.
Location "Motor-DE" to be watched

IP1.jpg





OK after alignment

This soft foot was corrected, and the machine aligned to within VibrAlign specifications.

VIBRALIGN

VIBRALIGN

Issue A page 1 / 1

OneProd
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Expertise Report

Filter: Equipment name (+) \ Tree order (+)

Location	Yadkin County WTP\Blower Building\
Designation	
Equipment	G-D Blower
Designation	
Abbreviation	B3
Serial No	
Model	
Periodicity (d)	*Normal* 60 *Alarm* 15

Fixed speed

Previous Advice		*Condition*	*Rotation Speed*	
15/05/2015 09:06:59	FAIR	DfCnd	59.6 Hz	3577 rpm

Date	EXCELLENT	*Speed*	59.6 Hz / 3577 rpm
05/06/2015 08:57:50	*Health is excellent (no default, low vibration levels).*	*Author*	sriddle
Condition		*Instrument sn*	- 10461
DfCnd		*Sensor*	
		Connector	

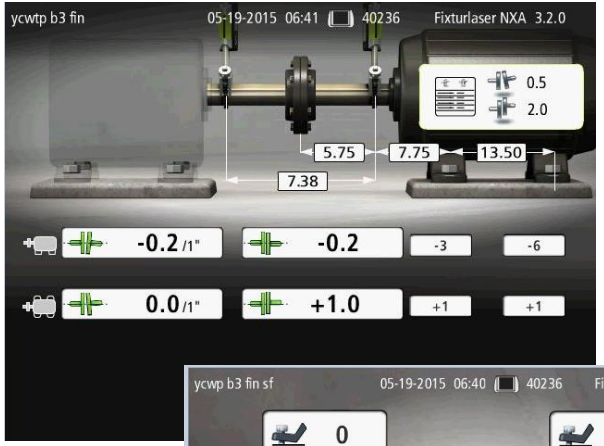
Diagnosis & Recommendation | *Parameters sheet*

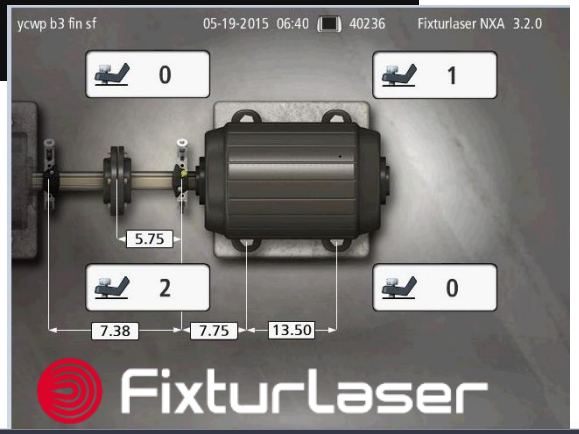
Diagnosis

Good overall state for component 'Electric motor'.
Good overall state for component 'Pump'.

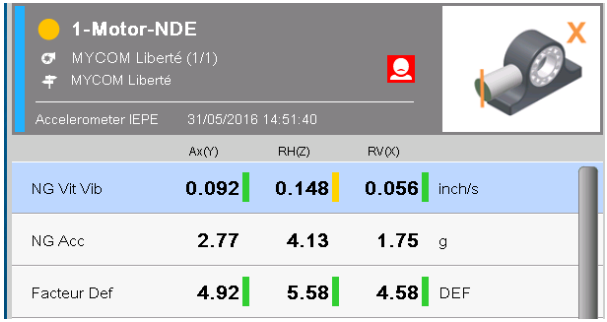
Recommendations

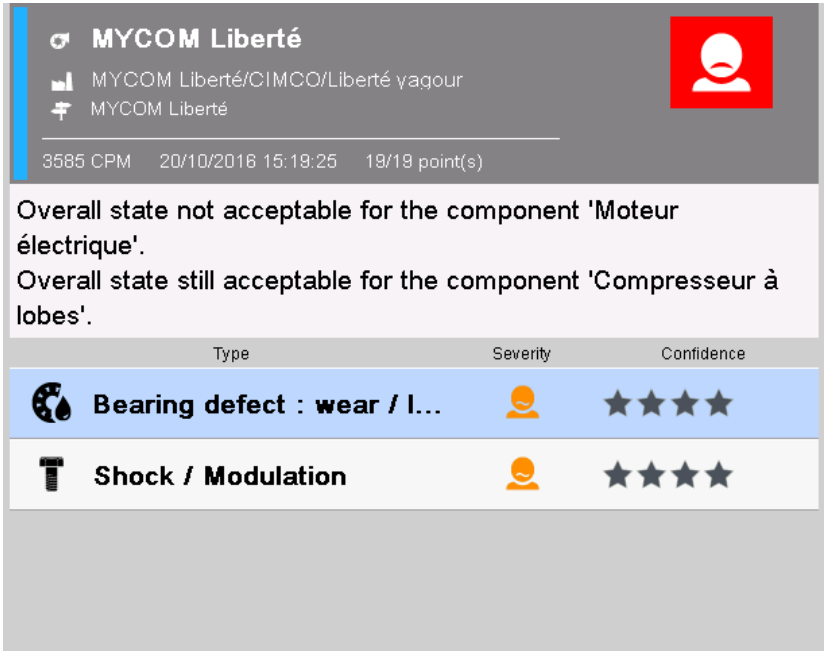
No action required



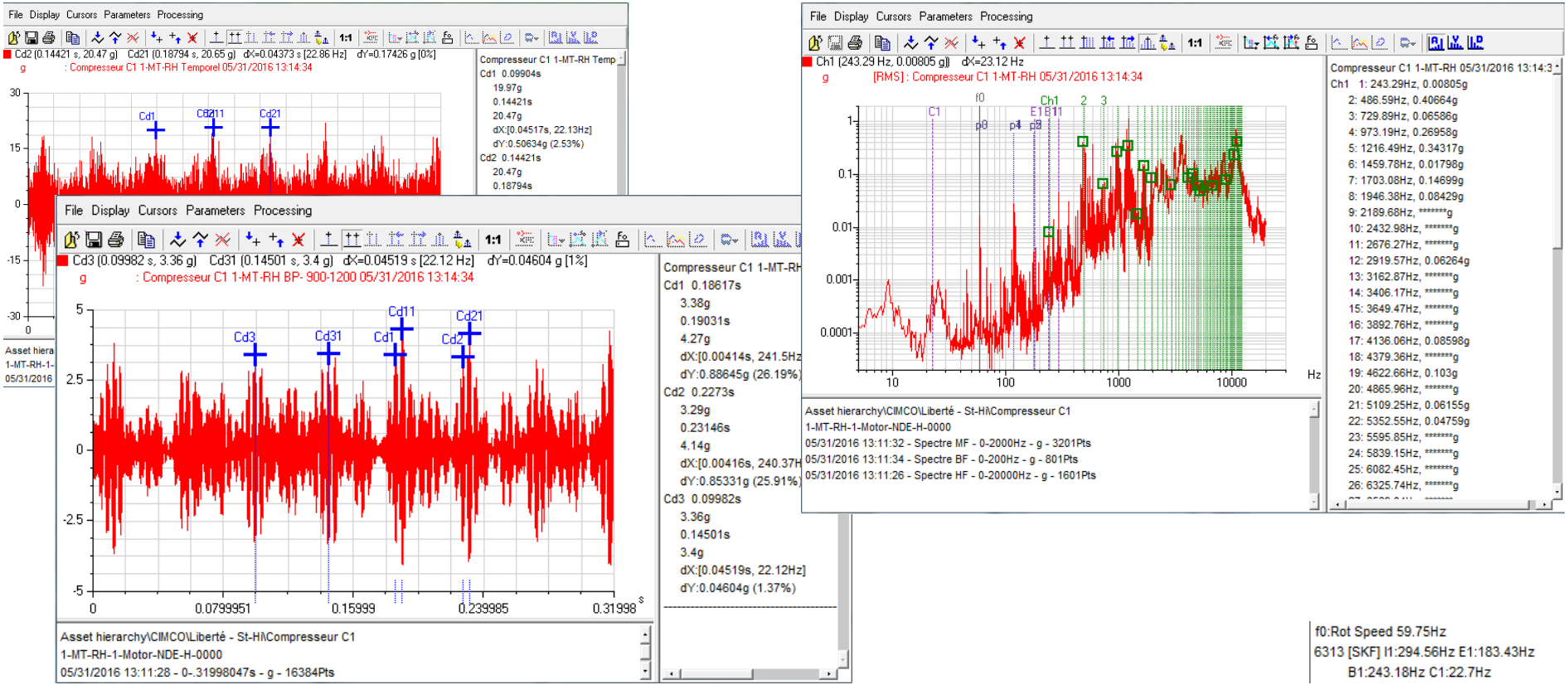


Screw Compressor – Liberté - CANADA

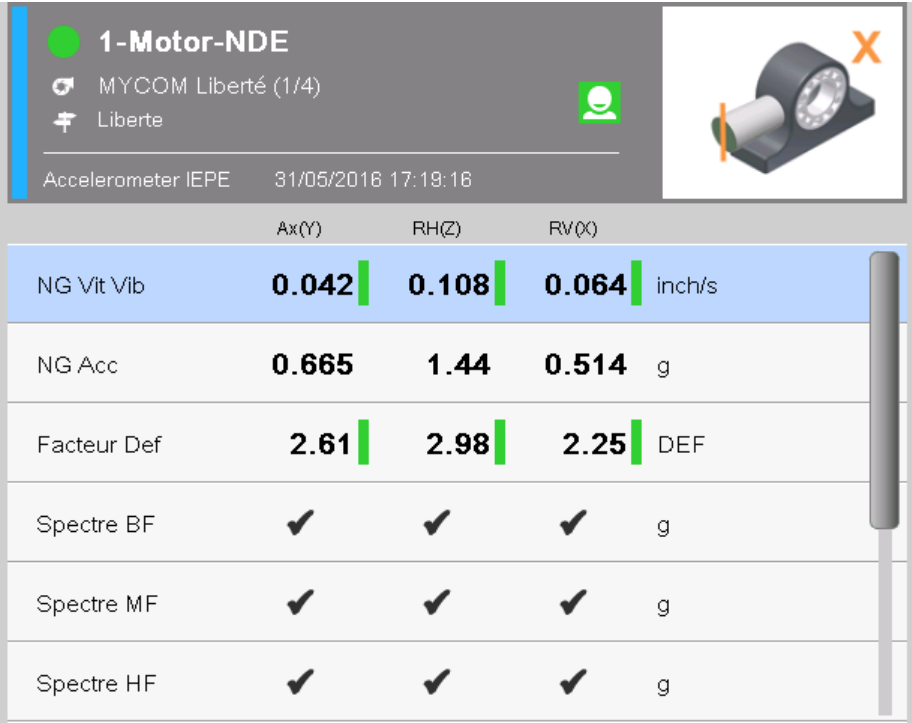




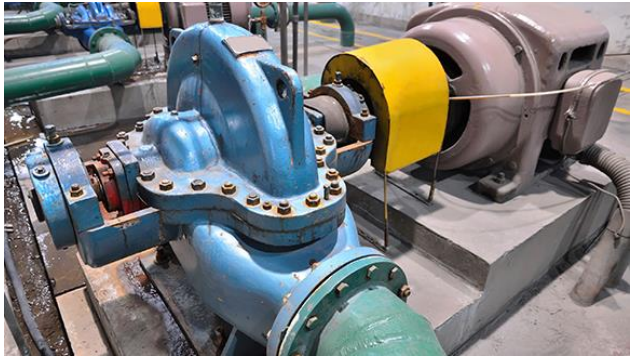
Screw Compressor – Liberté – Confirmed by the expert



Ok – after bearing change

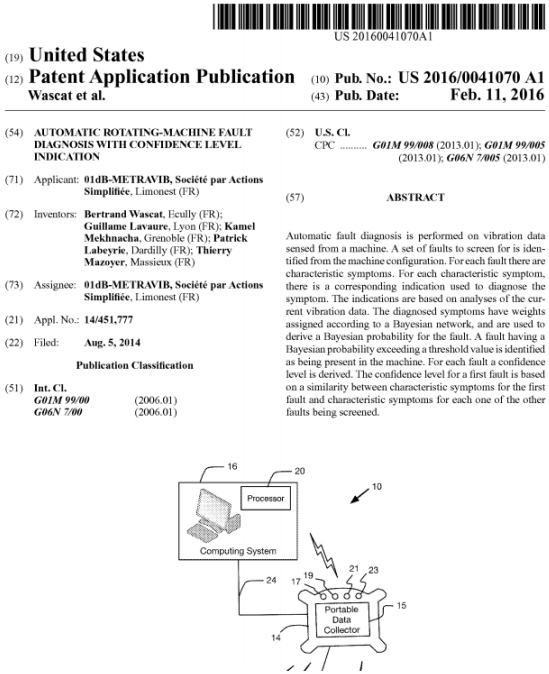


Know the limits!



- **Most common machines (about 80%)**
  - Electric motors, Pumps, Fans, Compressors (Centrifuge, Lobed), Gearboxes, Rollers
  - **Speed limit**
    - >120 RPM (ISO10816)
    - Difficult automatic identification of the rotation speed for low speed machines (field testing results: < 300RPM, Level 1 OK 100%, Level 2 not always available)
- **Most common defects (about 80%)**
  - Unbalance, Misalignment, Bearing and lubrication, Mounting, clearance, friction, Gear defects, Cavitation

Patent publication on the confidence level



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(19) **United States**

(12) **Patent Application Publication**

Wascat et al.

(10) **Pub. No.: US 2016/0041070 A1**

(43) **Pub. Date: Feb. 11, 2016**

(54) **AUTOMATIC ROTATING-MACHINE FAULT DIAGNOSIS WITH CONFIDENCE LEVEL INDICATION**

(71) Applicant: **01dB-METRAVIB, Société par Actions Simplifiée**, Limonest (FR)

(72) Inventors: **Bertrand Wascat**, Ecully (FR); **Guillame Lavaure**, Lyon (FR); **Kamel Mekhnacha**, Grenoble (FR); **Patrick Labeyrie**, Dardilly (FR); **Thierry Mazoyer**, Massieux (FR)

(73) Assignee: **01dB-METRAVIB, Société par Actions Simplifiée**, Limonest (FR)

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G01M 99/00 (2006.01)
G06N 7/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G01M 99/008*** (2013.01); ***G01M 99/005*** (2013.01); ***G06N 7/005*** (2013.01)

(57) **ABSTRACT**

Automatic fault diagnosis is performed on vibration data sensed from a machine. A set of faults to screen for is identified from the machine configuration. For each fault there are characteristic symptoms. For each characteristic symptom, there is a corresponding indication used to diagnose the symptom. The indications are based on analyses of the current vibration data. The diagnosed symptoms have weights assigned according to a Bayesian network, and are used to derive a Bayesian probability for the fault. A fault having a Bayesian probability exceeding a threshold value is identified as being present in the machine. For each fault a confidence level is derived. The confidence level for a first fault is based on a similarity between characteristic symptoms for the first fault and characteristic symptoms for each one of the other faults being screened.

Publication n°: 20160041070

[Automatic Rotating-Machine Fault Diagnosis With Confidence Level Indication]

Local representative

Represents OneProd in Sweden!

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- **Tekniska Verken, Linköping**
- **SSAB**
- **SKF**
- **Strukton Rail**
- **BMUTek**
- **Södra Woods, Mönsterås**
- **Bergkvist I Insjön**
- **Volvo cars**
- **And others…**