FLUKE®
Reliability

Remote Condition Monitoring

Exploring Online, Offline, and Remote Services

Best Practices Webinar Series

Meet the Speakers

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Reliability Engineer, Certified ARP-E, Cat 3 Vibration, Level 1 Thermographer, Motion Amplification Level 1 Analyst

- What is Condition Monitoring?
- Who needs Condition Monitoring?
- Remote Condition Monitoring Offered at Fluke Reliability
- Case Histories

POLL QUESTION No. 1

Question?

What practices should be considered a priority before starting a condition monitoring program?

- A) Reliability Culture Change
- B) Centralized Maintenance Management System (CMMS)
- C) Asset Criticality Analysis (FMEA, FMECA)
- D) Skills, Training, and Proper Tools
- E) Answers B & D
- F) Answers A,B, C, & D

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What is Condition Monitoring?

Condition Monitoring is –

A process of monitoring a machine, by means of data analytics and our senses (sight, smell, listen, & feel), to determine if the machine's overall effectiveness is optimal for continuous operation, especially if the machine is critical.

Condition Monitoring

Condition Based Maintenance (CBM) is a technology that strives to identify incipient faults before they become critical which enables more accurate planning of the preventive maintenance.

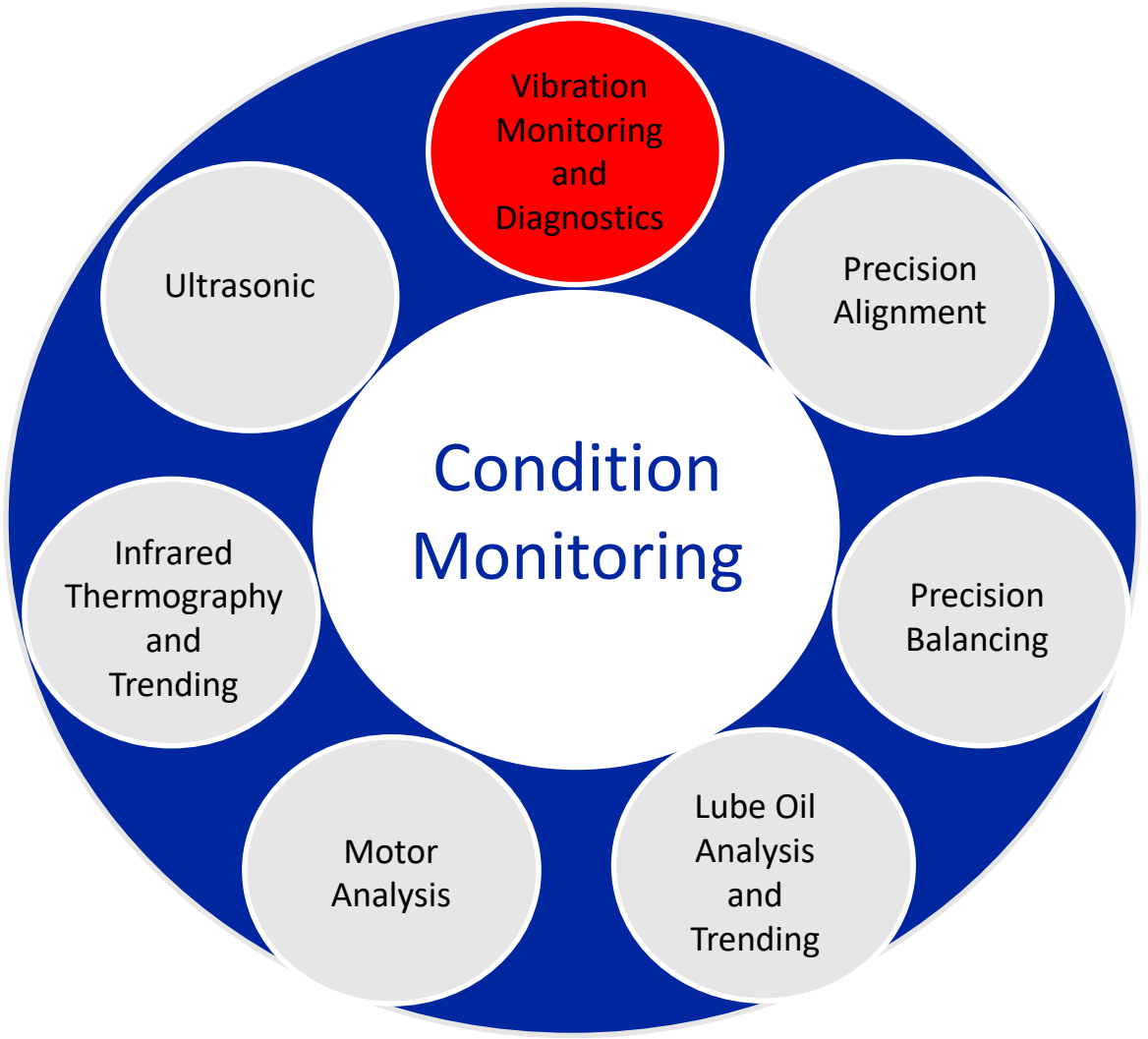
The purpose of a CBM Program is to improve:

- **System reliability and availability.**
- **Best programming of maintenance actions.**
- **Reduction of direct maintenance costs**

CBM is a set of maintenance actions based on real-time or near-real time assessment of equipment condition.

Condition which is obtained from monitoring various health indicative parameter and in which vibration is one of the most important parameter.

Condition Monitoring Technologies



Condition Monitoring Techniques

Offline – Periodic scheduled vibration, alignment, thermography, ultrasonic, and oil analysis inspections with developed routes using devices such as vibration analyzers, thermal imaging cameras, acoustic emissions, oil quality, and ultrasonic handheld devices.

Online – Wireless or wired sensors taking periodic measurements at prescribed times daily.

Continuous Monitoring – Dedicated systems which take data continuously at programmed intervals at up to 1 second data.

Which technique can be done remotely?

If you said ALL, you are Correct!

What data matters?

Vibration

Position

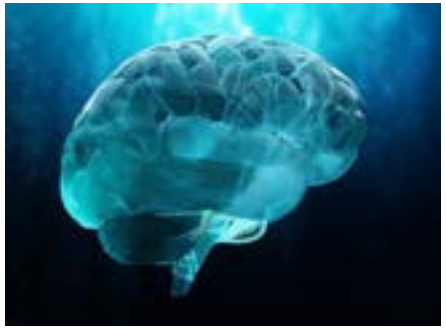
Temperature

Flow

Power

Hours

Pressure



Speed

Ultrasound

Oil Quality

Visual Inspection

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POLL QUESTION No. 2

Question?

What condition is responsible for 50% or more of machine failures in a plant?

- A) Unbalance
- B) Resonance
- C) Misalignment
- D) Cavitation

Who needs Condition Monitoring?

Factors to Consider

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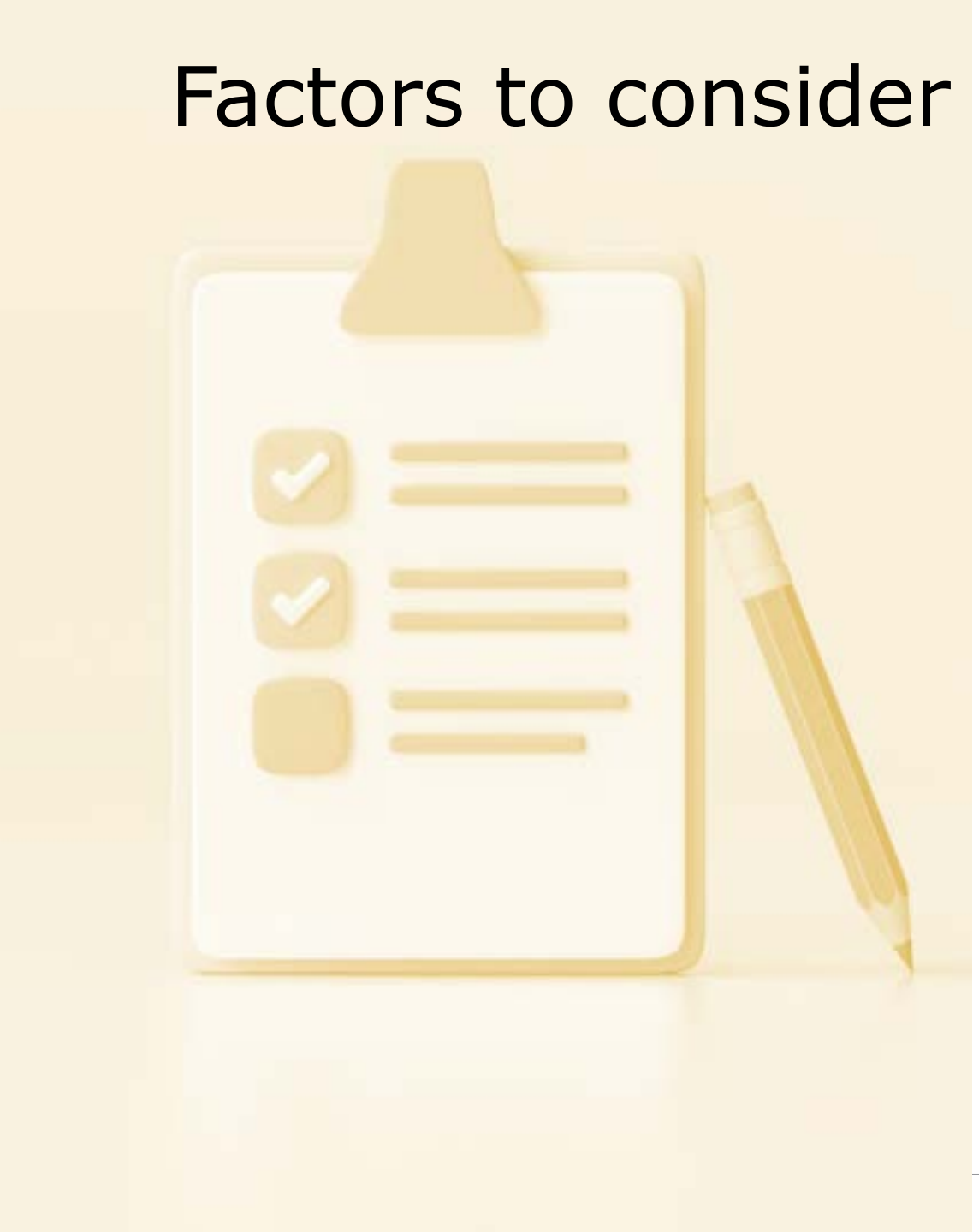
Factors to consider for Condition Monitoring



1. Safety (#1 concern)
2. Likelihood of failure
3. Detectability of failure
4. Occurrence of failure
5. Asset Criticality
6. Maintenance Strategy
7. Skills & Training

1. Safety

- #1 factor when considering condition monitoring or performing asset criticality analysis.

- If a machine failure can cause injuries or fatalities, having not only condition monitoring; interlocks, guarding, and implementing controls are also necessary.

2. Likelihood of failure

Failure

What is the definition of failure in terms of reliability?

The availability of an asset to perform it's intended function based on specified conditions.

Examples of functional failure:

- Fan not providing enough CFM?
- Pump not creating enough flow?
- Bearing/Seal/Coupling Failure

Anything Post secondary?

Post Secondary Functional Failures

- Environment Hazards – Can cause harm to the environment i.e., chemical tank leaking
- Safety issues (Remember #1) – cooling tower water process
- Production processes – Suction rolls in paper mill

3. Detectability

Can the failure be detected?

- Is the asset easy to get to? Can the failure be seen?
- What is the likelihood the diagnosis is correct? What technology is necessary?

4. Occurrence of Failure

Important metrics to know!

- Mean Time Between Failure (MTBF).
- Mean Time To Repair (MTTR).
- How Critical is the Asset?
- Is the Asset a Repairable or Non-Repairable? (Budgetary Concerns)

5. Asset Criticality

Asset Criticality is defined as the process of assigning assets a criticality rating based on their potential risk. Since it can't truly be quantified, risk, in this case, is thought of as all the possible risks associated with failure and the effects that failure can have on safety, the system and operation.

Areas of Concern during Asset Criticality Analysis include:

Customer Impact
Single Point of Failure Impact
Strategic Plan Impact
Utilization Impact
Asset Reliability Impact
Critical Spares Impact
Maintainability Impact
Safety Impact

Does your company have one?

6. Maintenance Strategy

- **Reactive Maintenance**
- **Preventive Maintenance**
- **Predictive – Condition Based Maintenance**
  - Maintenance and repair depend on machine condition / health
- **Proactive – Maintenance**
  - Detect and Improve/Prevent
    - Balancing
    - Alignment
    - Structural changes/improvements

7. Skills and Training

A culture change within the organization requires people to have the skills to improve Reliability, simply meaning, to get buy-in from management and personnel, to continuously improve uptime, employees must be taught "the way". The skills required are the following:

- Reliability Engineering
- ISO Vibration Certification Levels 1-3
- Maintenance Lubrication Certification
- Ultrasonic Technician Certification
- Thermography Certification Levels 1 - 3
- Product and Software Training
- CMMS Utilization Training
- Organizational Plant Reliability Policies (Reliability Culture Change)

Proactive maintenance requires dedicated resources!

Does your company have dedicated resources?

What technology?

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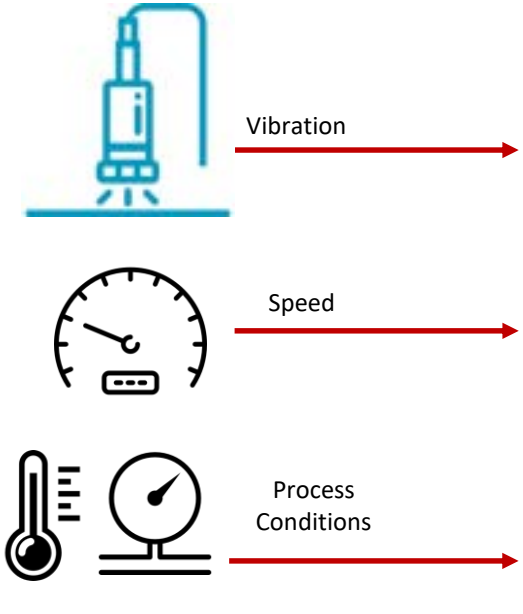
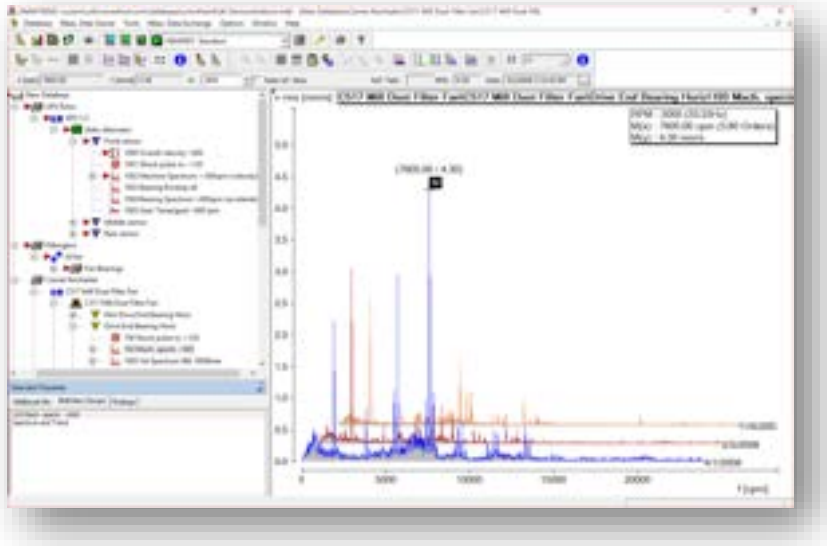
Technology Techniques

- Offline
- Online
- Continuous

Offline Systems

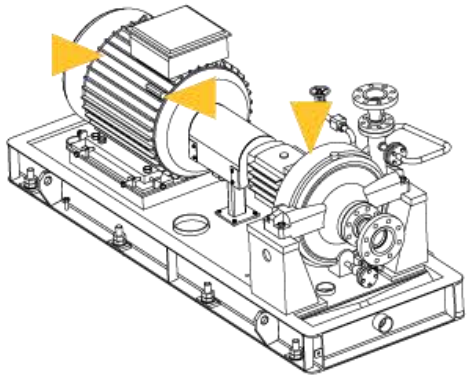
Route-Based or Advanced Analytics Data Collection





Wireless Online System

How wireless systems work



Data is transmitted by a short-range wireless technology standard from the sensors to gateway

Gateway sends data to the cloud through Wi-Fi or ethernet connection

Data can be viewed through web application or cell phone

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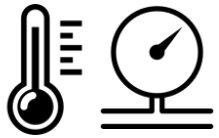
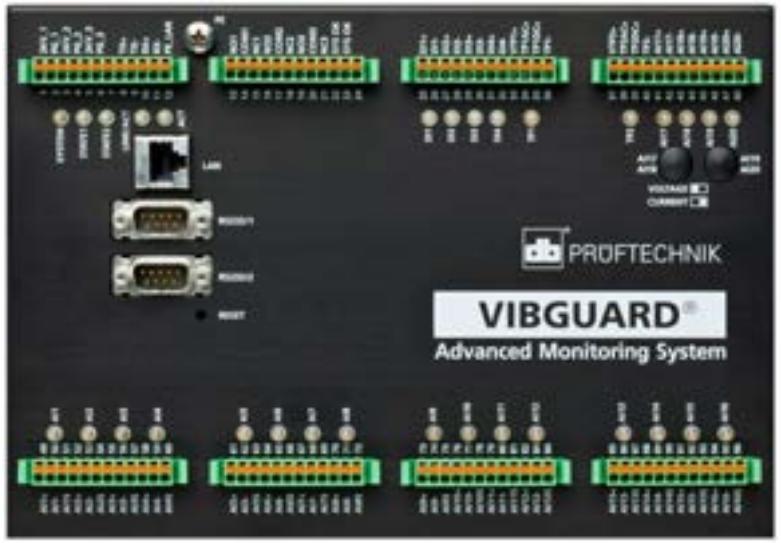
Continuous Systems

Vibration

Speed



Process Conditions



Speed, Vibration, Process Conditions…

Omnitrend Center

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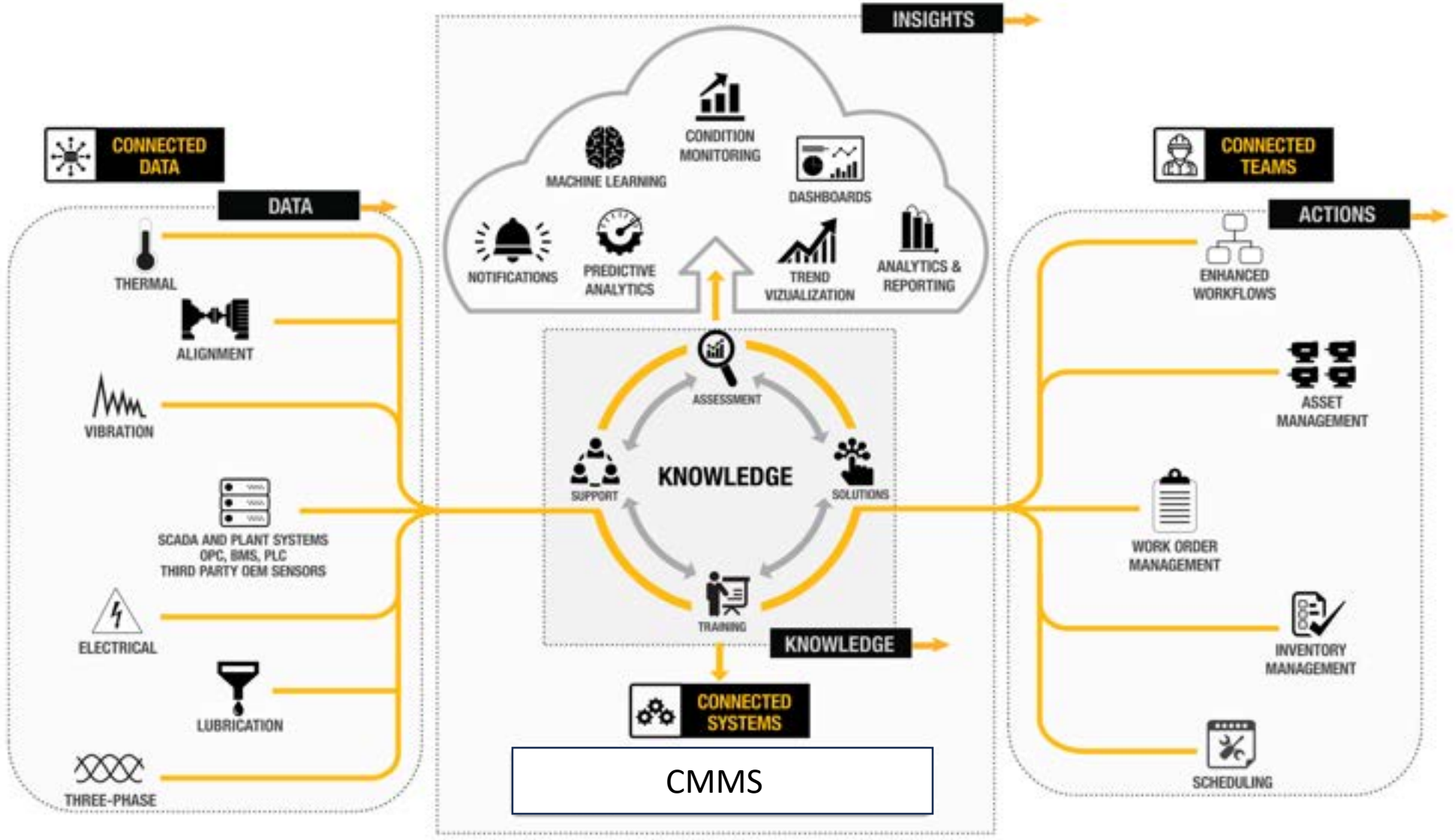
Welcome to the digital age of technology!



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Important Need to Know

Hardware/Software Capabilities

Questions to ask:

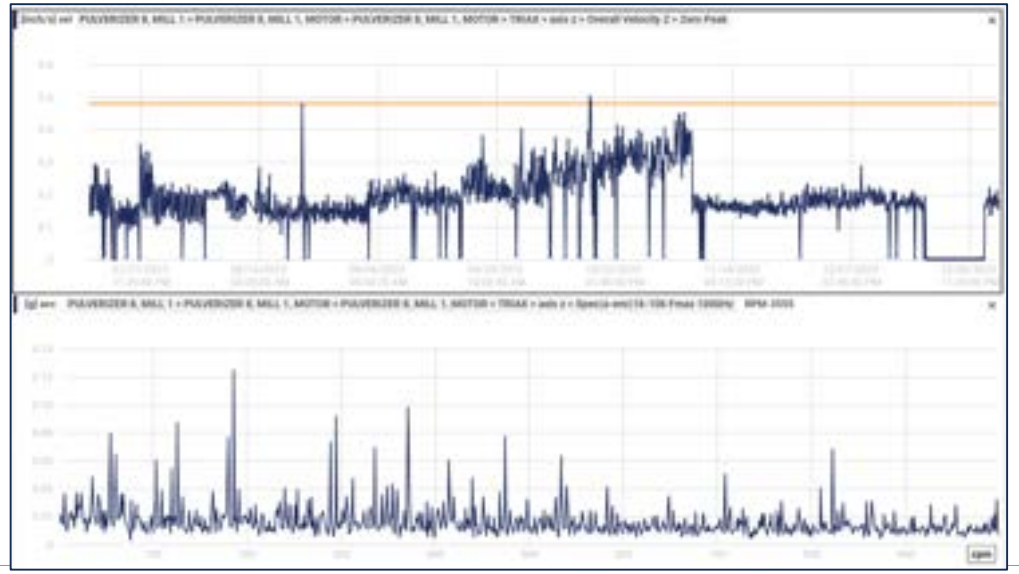
1. Frequency sensor range and analysis features
2. Environmental Rating
3. Sensor Capability (Vibration and/or Temperature/Piezo or MEMS}
4. Does the software offer early detection i.e.. Enveloping?
5. How many directions does the sensor measure vibration…Triaxial?
6. Is machine learning and alarm specifications built into the software?
7. Mounting technique
8. Power Consumption

Freq Range/Analysis
Features/Capabilities

Environmental

Power

Data Measurement and Transmission	
Measurement interval (Overalls)	Configurable, default is every 30 minutes, minimum is every 10 minutes, and maximum is every 2 hours
Measurement interval (Time waveform)	Configurable for every 3, 6, or 12 hours
Range	
Frequency range	2 Hz – 10,000 Hz Z (2 Hz – 1,000 Hz X, Y)
Amplitude range	z-axis: +/- 50g; x- and y-axis: +/- 16g
Sampling frequency	218.5 – 62.5 kHz: +/- 3dB
Temperature	
Measurement range	-20°C to 85°C (-4°F to 185°F)
Storage range	-20°C to 85°C (-4°F to 185°F)
Mechanical	
Size	(D x H) 68mm x 53.4mm
Weight	199.5g (145g without batteries)
Ingress protection class	IP67
Shock Limit	5000 g peak
Power	6 x 3.6V 1/2 AA Li-SOCl 2 battery Battery lifetime: Up to 5 years based on cadence of scheduled measurements
AD Conversion	24 bit
Wireless communication (sensor to gateway)	
Radio Frequency	2.4 GHz ISM band according to IEEE 802.15.1
Range (line of sight)	Up to 100 meters, depending on environment



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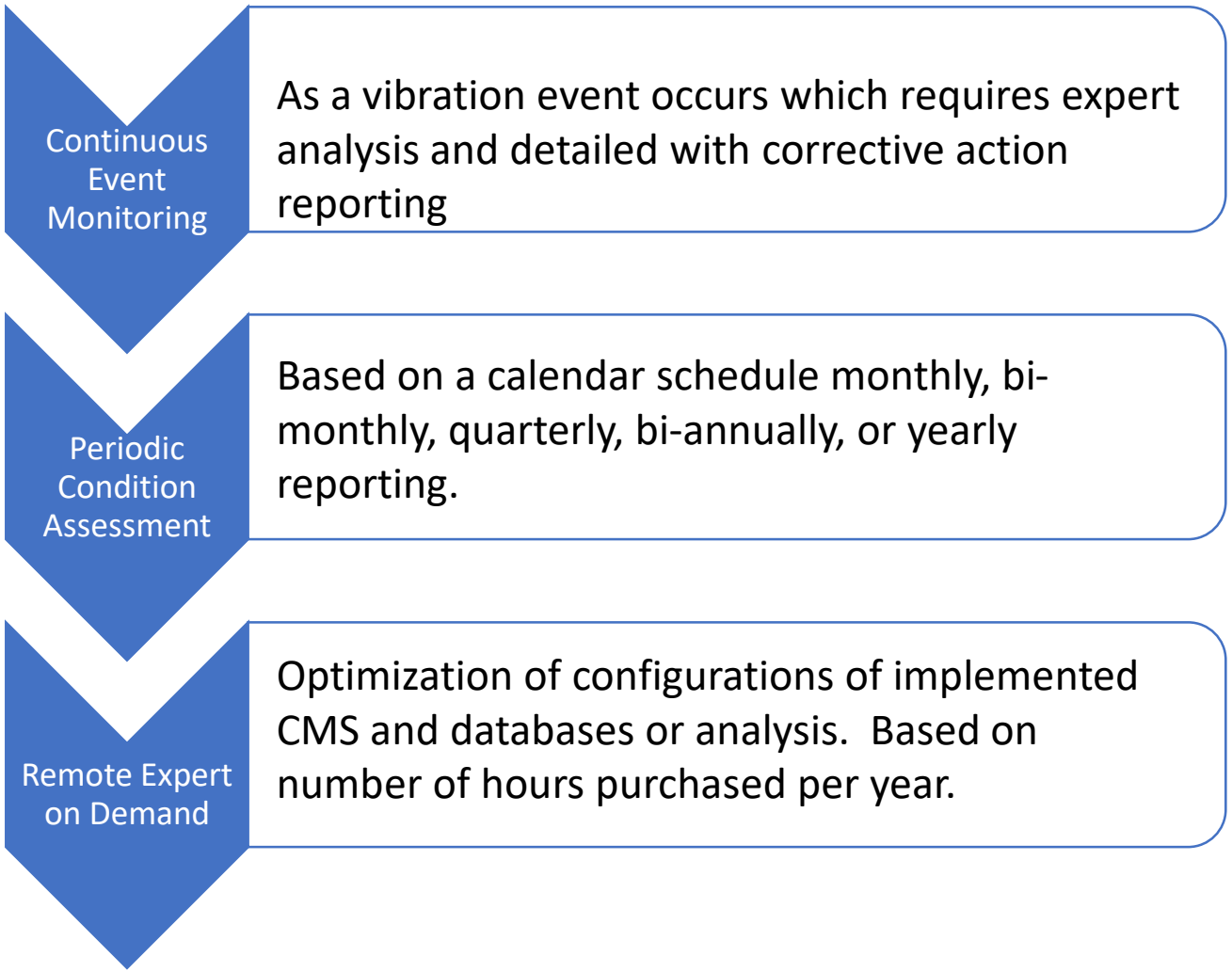
Remote Condition Monitoring

Approach

Recurring Remote Condition Monitoring Service



Questions

QUESTIONS?

Thank you!

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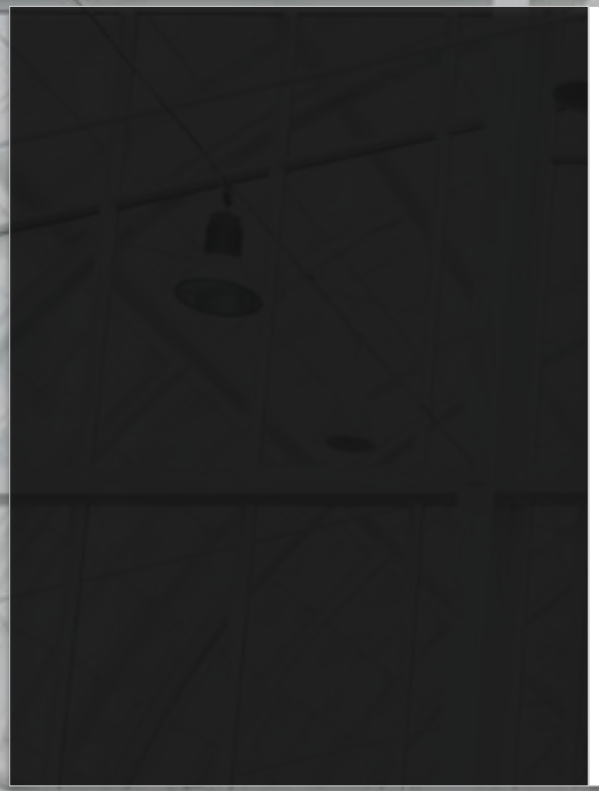

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THANK YOU!