

The background features a collage of industrial scenes: blue electric motors, a large metal gear assembly, and a worker in a red safety jacket and white hard hat looking at a tablet. A white grid pattern is overlaid on the images.

FLUKE[®]

Reliability

Diagnostic Engine: Empowering Data Analytics

Webinar 2024

Meet the Speaker



Steven Hudson

Director, Professional Services (2018-Present)

- Remote Vibration Services
 - Automated Analytics
 - Reciprocating Compressor Analysis
 - Startup / Field Services
-
- Background:
 - 35 years in Predictive Maintenance
 - ISO Cat IV Vibration Analyst
 - Naval Nuclear Power (Submarines)
-
- Joined Azima DLI in 2010:
 - Chief Analyst
 - Technical Sales
 - Operations



Azima DLI Service History & Milestones



Founded

ExpertALERT™

First Expert Automated Software



Azima DLI is formed

WATCHMAN Reliability Portal™



A Fluke Reliability Company

Strategic Business Level Metrics



> 500,000 Annual Report Delivery

1966 1976 1980 1986 1990 1995 2000 2005 2012 2015 2017 2019 2023



Aircraft Carrier Contract



1st Triaxial Accelerometer



Online Diagnostic System



TRIO® Windows Based Data Collector

Cloud-enabled complete PdM Program Solution



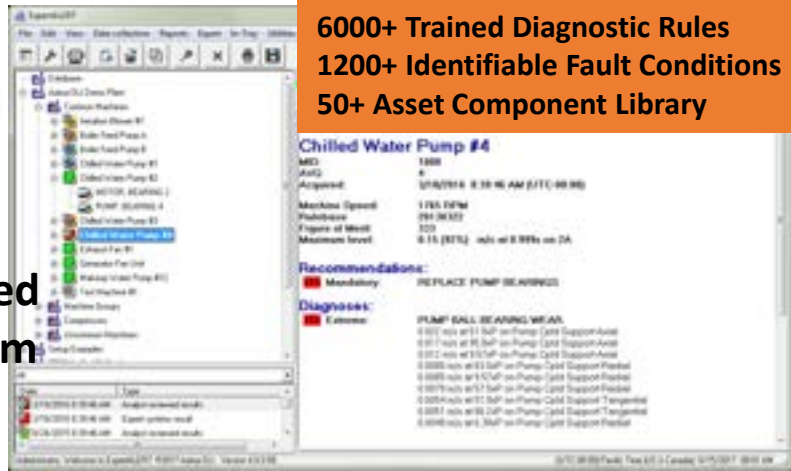
First Commercial Report Automation



Watchman™ System

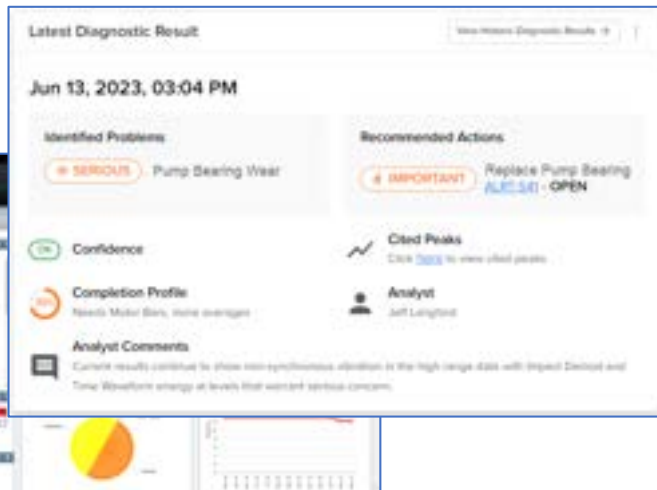


Expert Automated Diagnostic System



6000+ Trained Diagnostic Rules
1200+ Identifiable Fault Conditions
50+ Asset Component Library

Vibration AI



Watchman Portal™

Asset Data Lake

- 100,000** Unique Assets
- 150,000** Asset Components
- 3,000,000** Machine Tests
- 150,000** Component Specific Faults
- 100 Trillion** Individual Vibration Test Points approximately

Level 2, 3, 4 ISO Certified
50k Assets Monitored
560k Annual Machine Tests

Watchman Services



Vibration Data Sources



Program Management

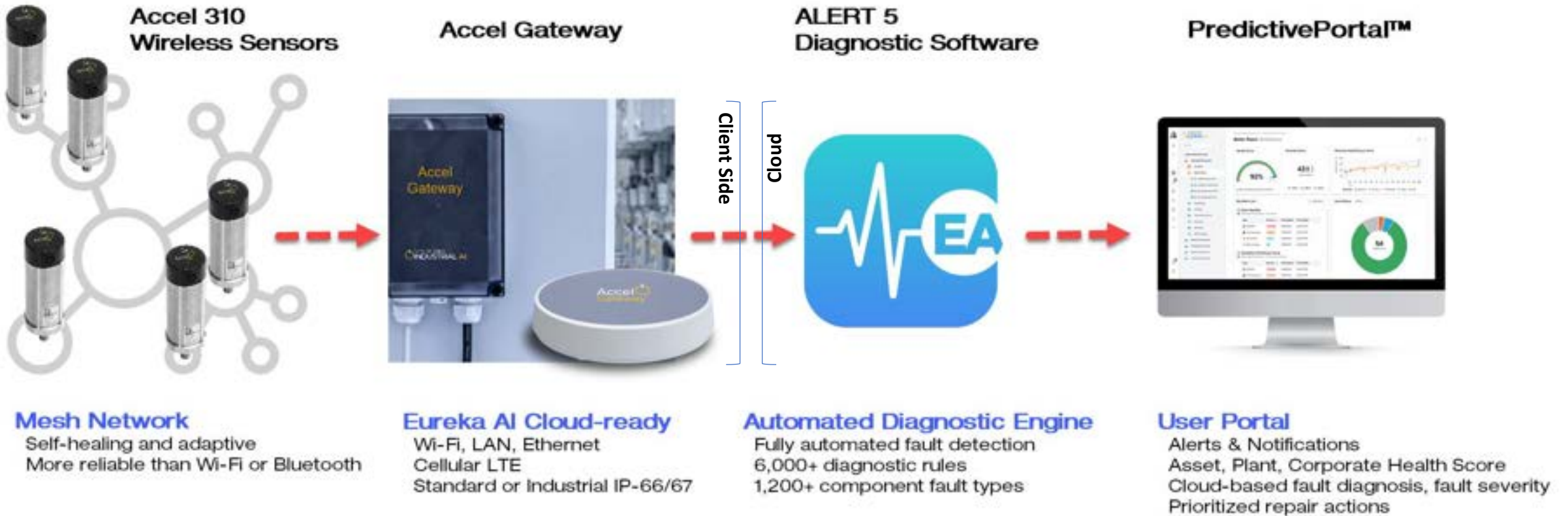


Evolution Reliability \neq Evolution Analysis

- More machines and more data with less analyst capacity
- More frequent data does not mean better analysis
- New machines are harder to diagnose
- Simplification at detriment of risk
- Harder to retain trained staff

Wireless System Components

Watchman AIR™



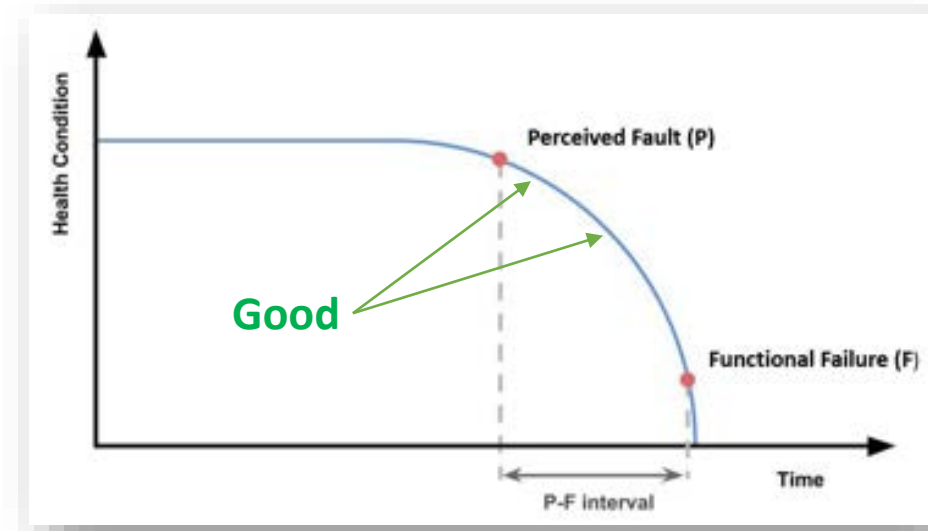
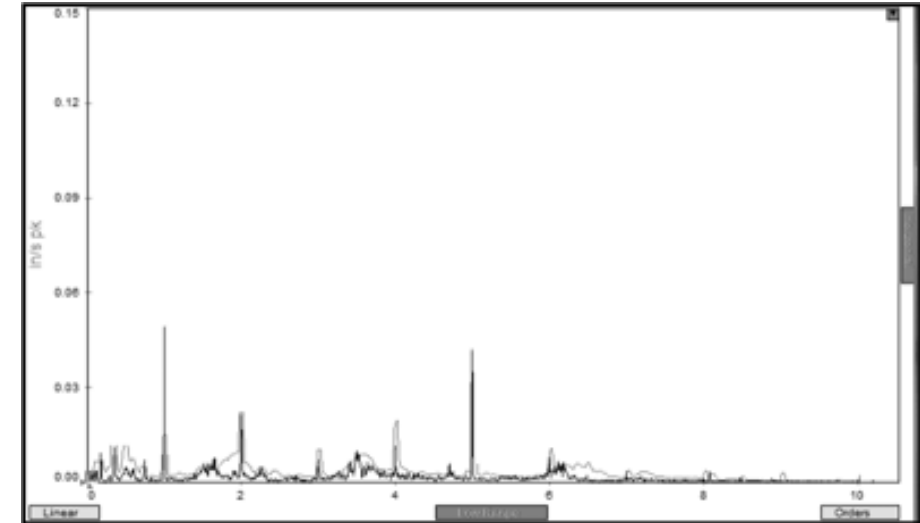
Wirepas® Mesh

WiFi, LAN Cellular

Action-Targeted Approach

Full Manual Analysis (Vibration Spectra)

- High value - Low volume
- Good Analyst = Good Assessment
- Substantial Resource Constraints
 - ~25 Machines reviewed per-day/Analyst
 - Data collection is additional time



Historical Process

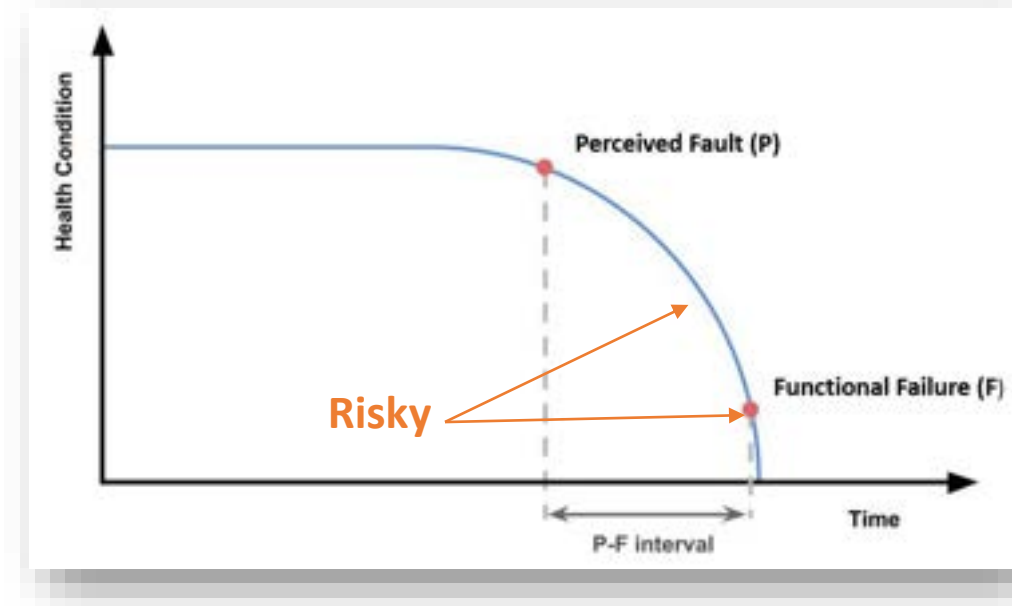
Rough-scale Approach

Overall Vibration Alarm

- Low Value - High Volume
- Not Diagnostic
 - No Actionable Results
 - Hand Raiser
- Often Late-stage/Reactive



Acceleration	0.10
OK	G
Velocity	0.35
Not Acceptable	in/s
Displacement	2.99
Not Acceptable	mil (RMS)

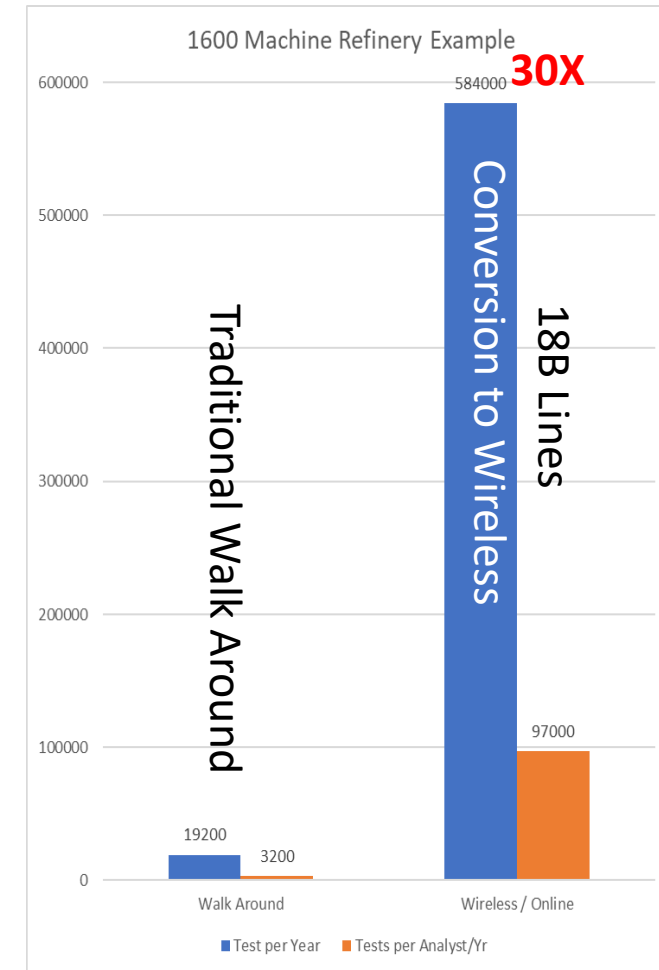


The Wireless Data Tsunami

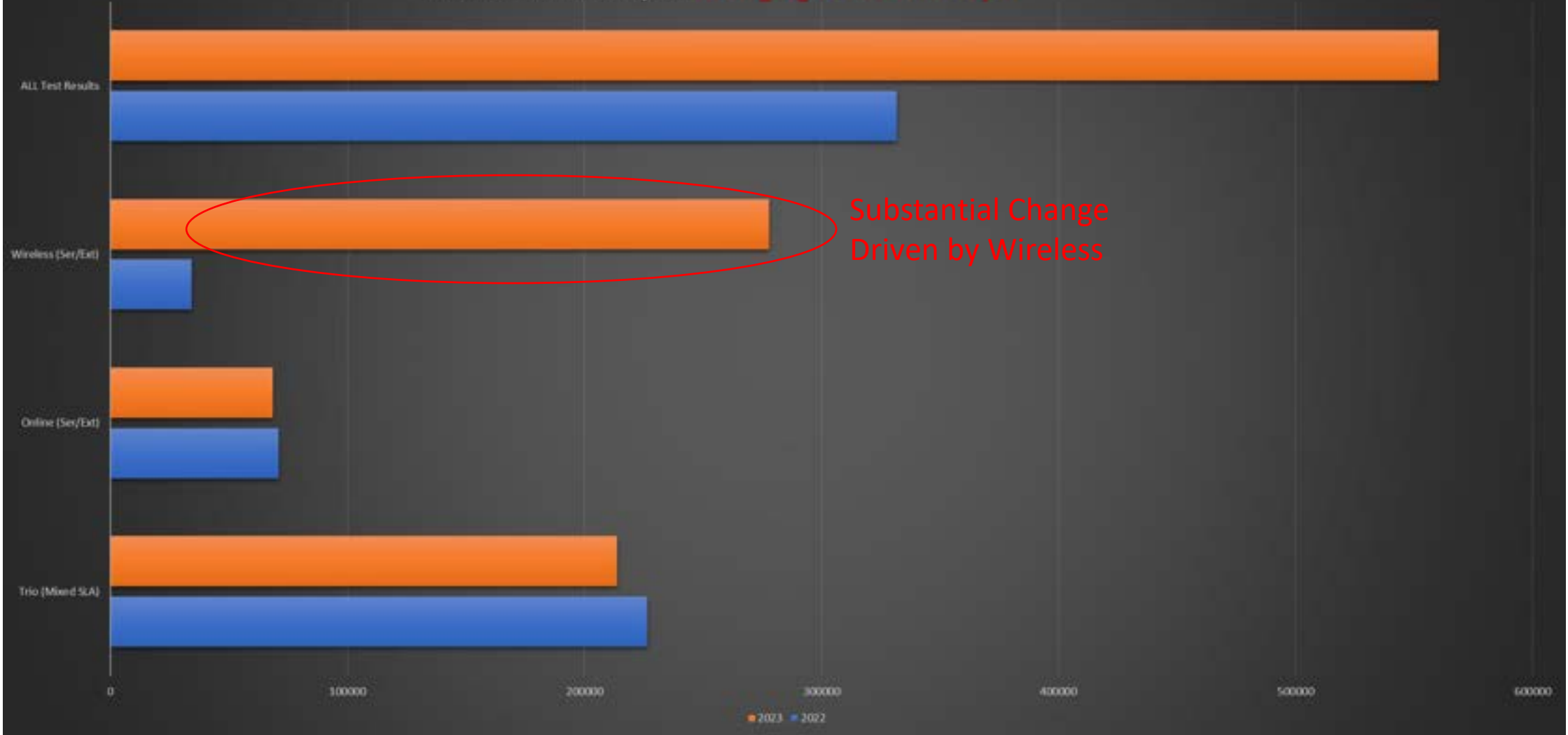
- **More Data ≠ Better Insights**
- ✓ Analysts Overrun
- ✓ Ineffective use of High Value Talent.
- ✓ Significant Resource Constraints
- ✓ 30-100x more data
- ✓ Overall Vibration Trend NOT enough

Need Better Approach

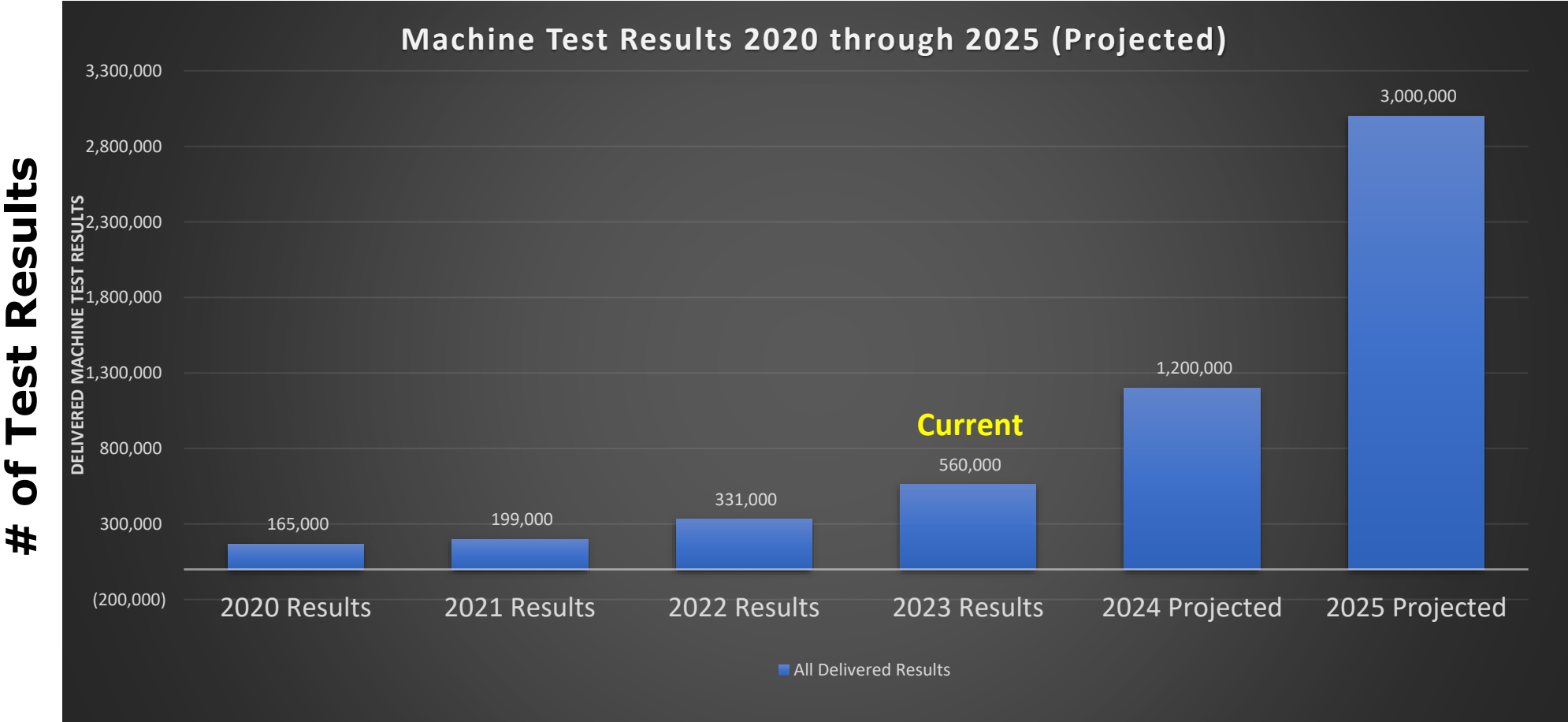
- Refocus Analyst on Actual Faults
- Automate Low Risk Results
- Escalate High Risk Results To Analyst



Year to Year Example: **Changing Data Landscape**



Azima History + Projections

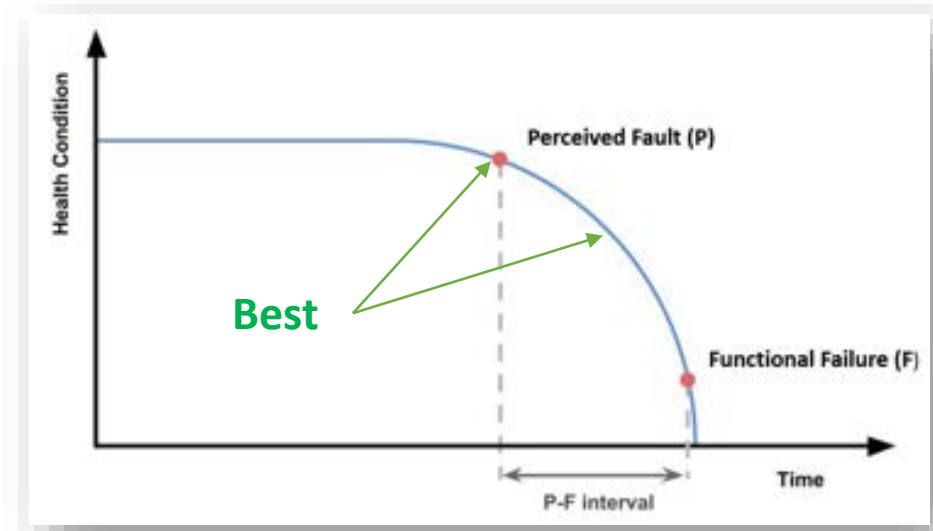
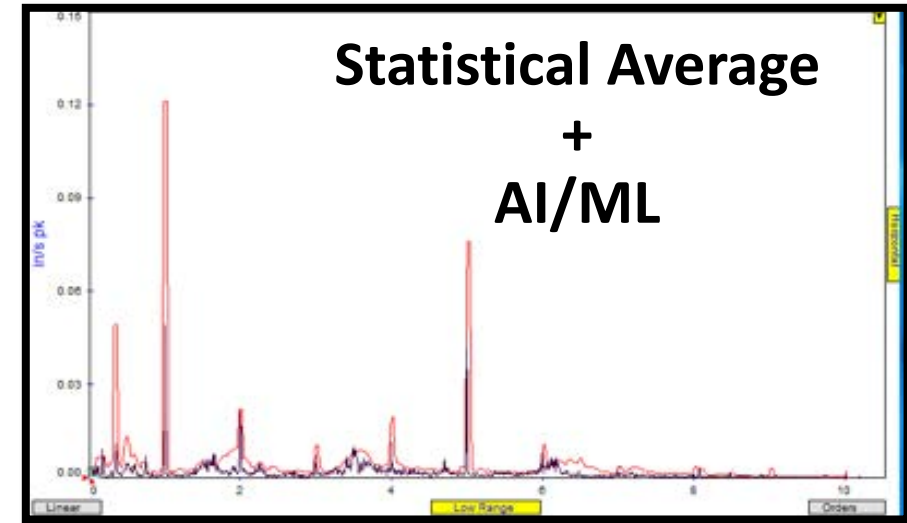


By Year

Empowered Vibration Data Analytics

Diagnostic Engine + Manual Analysis

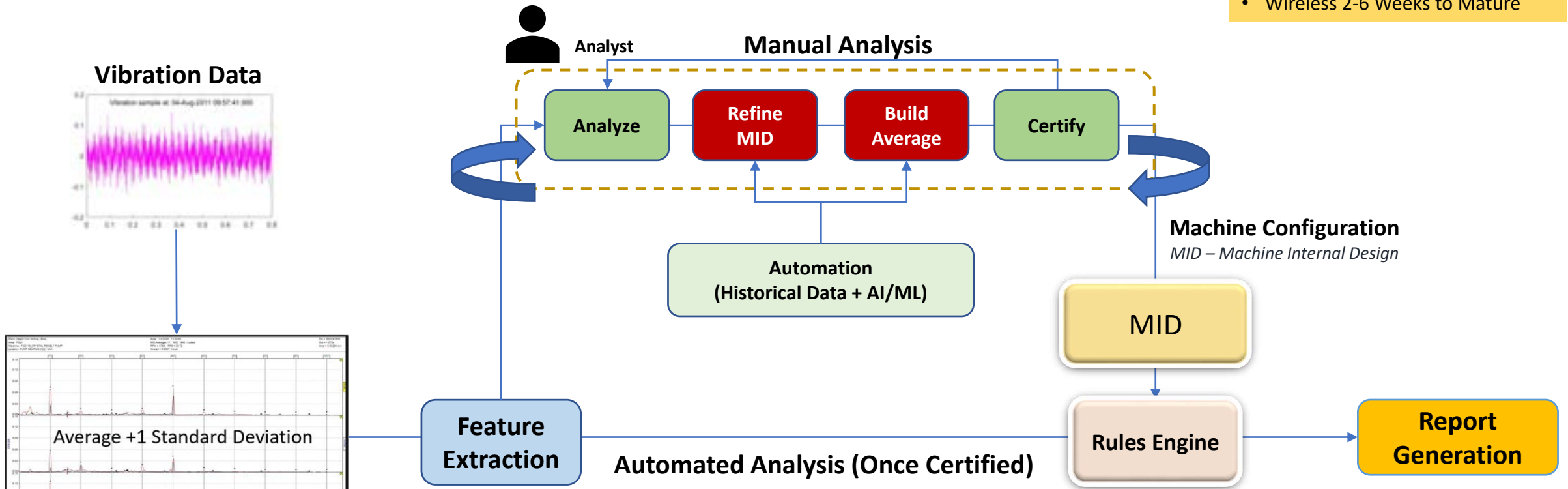
- High value – High Volume
- High Detailed Actionable Results
- Focus Analyst on Actual Faults
- Trusted Assessment
- Scalable



Diagnostic Recap

Diagnostic + Baseline/Grooming Process {Analyst + AI}

- Trio: 6 – 24 Months to Mature
- Wireless 2-6 Weeks to Mature



- 🔌 6,000 Diagnostic Rules
- 🔌 1,200 Fault Conditions
- 🔌 150,000+ Component specific faults
- 🔌 2 Million+ Historical Machine Tests

Types of Equipment (Partial List)

Individual or Coupled Combinations of Individual Components with or without transmissions

- AC Motor
- DC Motor
- VFD Motor
- Closed-coupled Motor
- Closed-coupled Turbine
- Gas Turbine
- Steam Turbine
- Two Stroke Diesel Engine
- Four Stroke Diesel Engine
- Flexible Coupling
- Magnetic Coupling
- Fluid Coupling
- Belts Drives
- Chain Drives
- Single-stage Gearbox
- Multi-stage Gearbox
- Marine Main Reduction Gear
- Gearbox Oil-pump / Aux Gear
- Machine Tool Spindle
- Turbo Charger
- Centrifugal Pump
- Propeller Pump
- Rotary Thread Pump
- Rotary Gear Pump
- Rotary Screw Pump
- Rotary Sliding Vane Pump
- Piston Pump
- Lobed Blower
- Single Stage Centrifugal Compressor
- Multi-stage Centrifugal Compressor
- Piston Compressor
- Screw Compressor
- Generator
- Generator With Exciter
- Single-stage Fan
- Multi-stage Fan
- Decanter
- Purifier With Clutch
- Purifier With Belt
- Shaft, Proximity Probes
- Horizontal / Vertical Shafting

EADS Capabilities

Automated
Diagnostic Rules:

- **6000+**

Individual
Fault Conditions:

- **1200+**

Industrial
Machine Types:

- **~50 (all common)**

Evolution of Diagnostic Engine

Top 3

- Precise Application / Implementation
- Template + Baseline Build / Certify
- Workflow Management / Service Level



Precise Application / Implementation

- **Plant Walk Down**
- **Review Machine List**
- **Record Machine Profile**
- **Ensure Machine Application Fit**
 - **Operating Conditions**
 - Example: Intermittent (Stop/Start)
 - **Speed Range**
 - Slow Speed Limits

Machine List

Must Have	Must Have	Must Have	Must Have	Must Have	Must Have	Must Have	Must Have
							Yes/No
<u>PLANT</u>	<u>Area</u>	<u>EQUIPMENT SAP/CMMS #</u>	<u>MACHINE Number and NAME</u>	<u>HP</u>	<u>RPM In</u>	<u>RPM Out</u>	<u>VFD</u>
Steel	CDFS	250-40.1	5 Press Pump		1800	1800	No
Steel	CDFS	250-40.1	5 Press Motor	900	1190	1190	No
Steel	CDFS	250-40.3	5 Press Pump		1800	1800	No
Steel	CDFS	250-40.3	5 Press Motor	900	1190	1190	No
Steel	CDFS	250-40.5	5 Press Pump		1800	1800	No
Steel	CDFS	250-40.5	5 Press Motor	900	1190	1190	No
Steel	CDFS	216-40.4	5 Press Pump		1800	1800	No
Steel	CDFS	216-40.4	5 Press Motor	900	1190	1190	No
Steel	CDFS	216-40.2	5 Press Pump		1800	1800	No
Steel	CDFS	216-40.2	5 Press Motor	900	1190	1190	No
Steel	CDFS	Boost Pump Motor	5 Press Motor	50	1190	1190	No
Steel	CDFS	Circulation Pump Motor	5 Press Motor	15	3525	3525	No
Steel	CDFS	Pilot Motor	5 Press Motor	100	1190	1190	No
Steel	CDFS	Wepuko Pump 112.1	5 press Pump		3475	3475	No
Steel	CDFS	Wepuko Pump 112.1	5 press Motor	900	1190	1190	No
Steel	CDFS	Wepuko Pump 112.2	5 press Pump		3475	3475	No
Steel	CDFS	Wepuko Pump 112.2	5 Press Motor	900	1190	1190	No
Steel	CDFS	Table Booster Pump	5 Press Motor	7.5	1165	1165	No
Steel	CDFS	Pilot Pump	5 Press Motor	25	3475	3475	No
Steel	CDFS	Wepuko Pump 4	8216 Press Pump		1800`	1800	No
Steel	CDFS	Wepuko Pump 4	8216 Press Motor	400	1190	1190	No
Steel	CDFS	Wepuko Pump 5	8216 Press Pump		1800	1800	No
Steel	CDFS	Wepuko Pump 5	8216 Press Motor	400	1190	1190	No

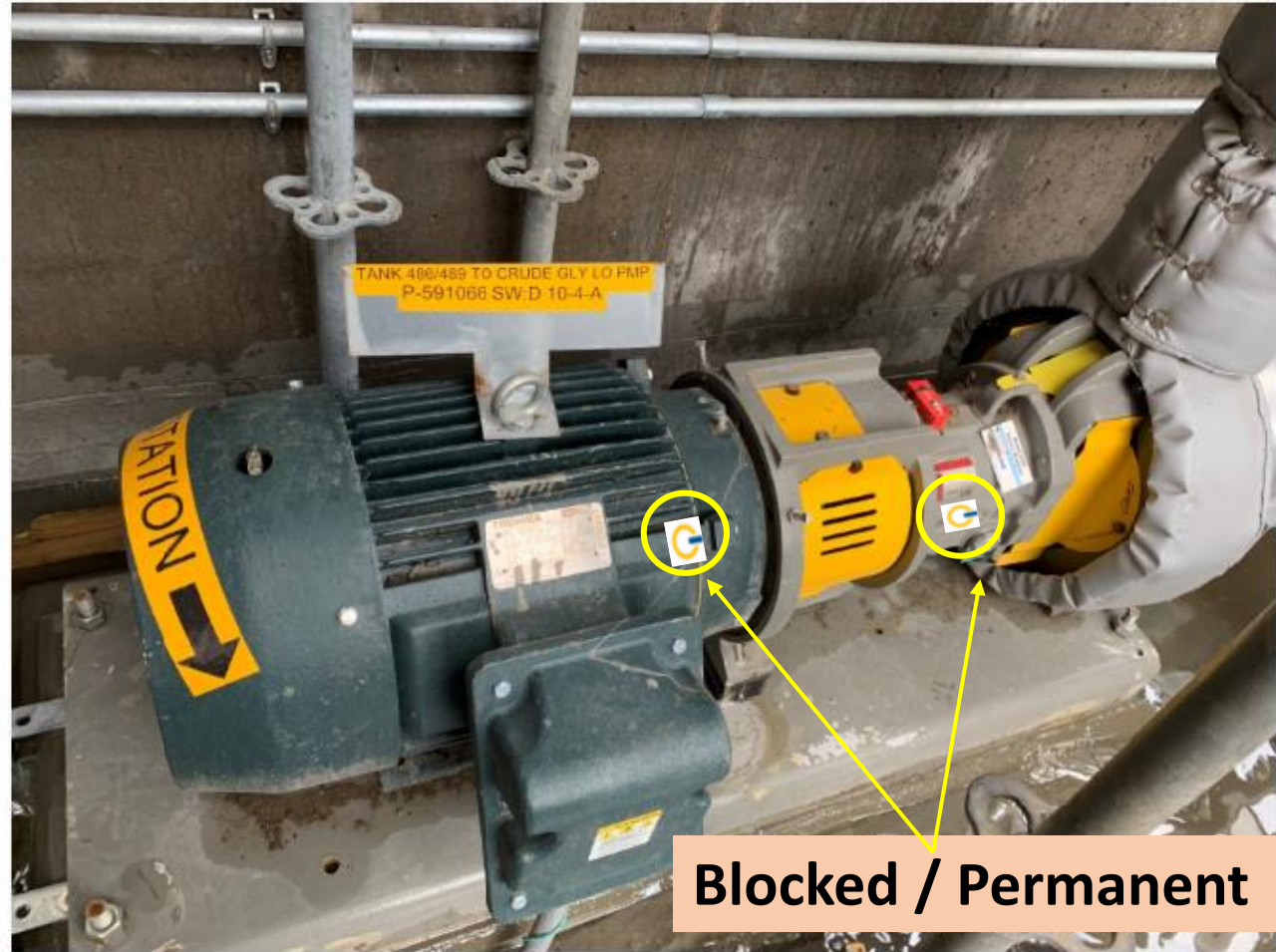
Implementation Walkdown. Photos, Vtags



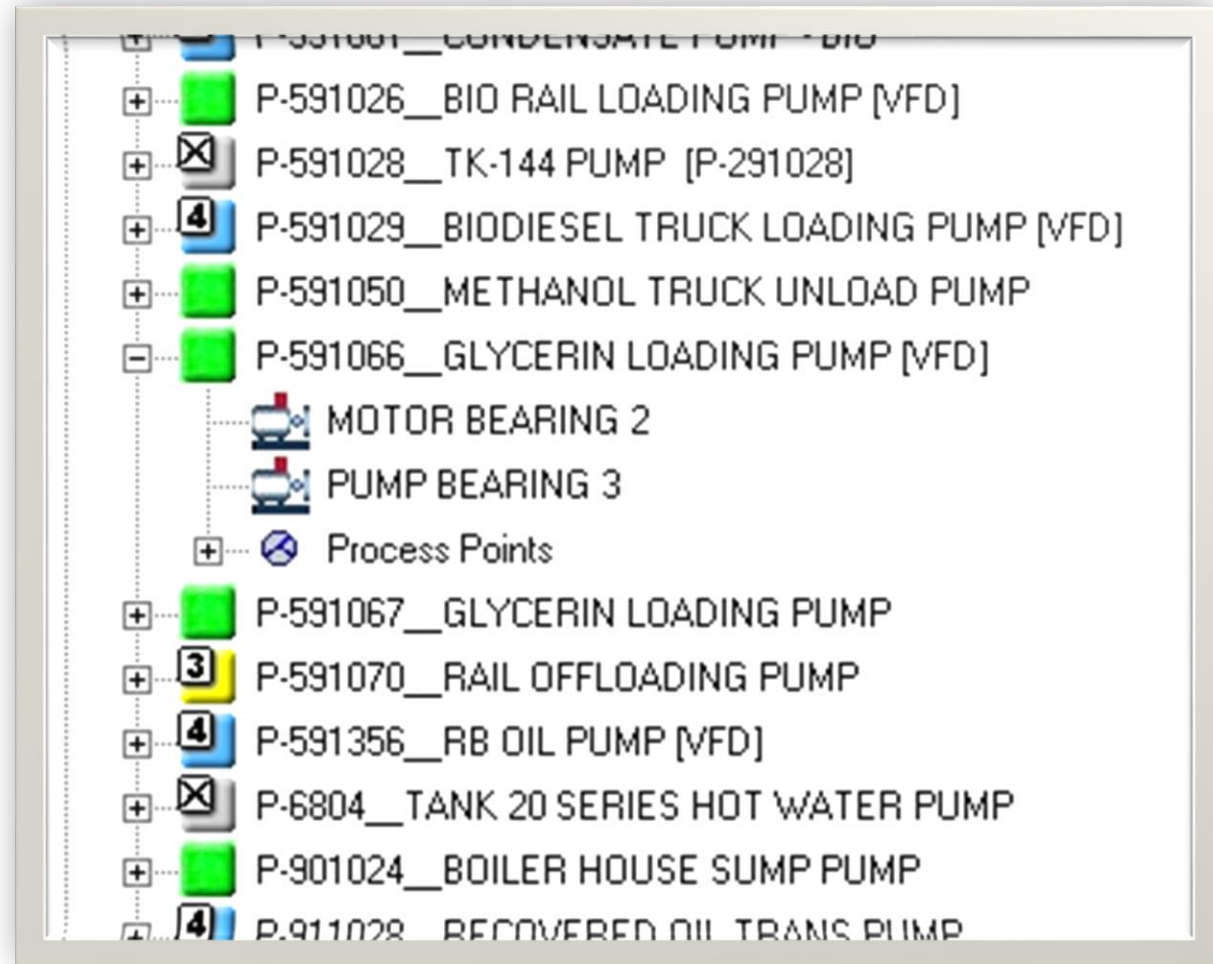
Plant / Area				Machine Name				Asset ID				Photo ID					
HORIZ	OVERHUNG	M INCL	M DEL	CPL	Machine Type	Pump	Fan	Comp	Cent	Screen	Recip	Mower	Conc	Log	Crab	Scrub	Other
	Y / N	1	2	Rigid	3	4	5	6	7	8	Rigid	9	10	11	12		
MANUF.	G.E.	Pump #4		Flux	MTR	Pump #6					Flux						
HP	700			None							None						
DRIVER				Chain							Chain						
RPM	1190	var	var	- belt	var	var	var				Belt						
DR Motor	Frontic:			Brg:			Photo ID										
DRN Motor	Type:			Model:			Photo ID										
Wireless Sensor #1:	85B20F5G				WNT: Pump #1 Bay												
Wireless Sensor #2:	CBA27527				WNT: Pump #2 Bay												
Wireless Sensor #3:	C916C333				WNT: MTR #3 Bay												
Wireless Sensor #4:	A5C6C8				WNT: d.i.d												
Wireless Sensor #5:	CE7757																
Wireless Sensor #6:																	



Example Machine Setup



Centrifugal Pump



Template + Baseline Build / Certify

Diagnostic ML/AI Template Consist of:

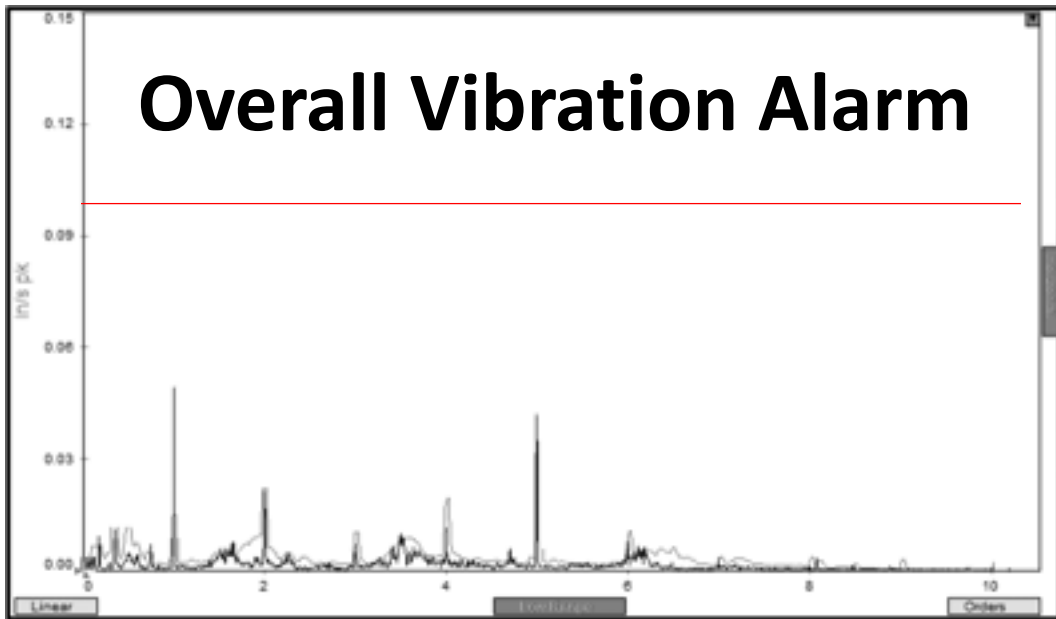
- Machine Profile – Components
- Known Fault Frequencies
- Statistical Average Spectrum
- Correct Machine Running Speed

• Additional Processes

- MID – Completion Score
- Certify Template
- Secure Baseline / Management of Change MOC

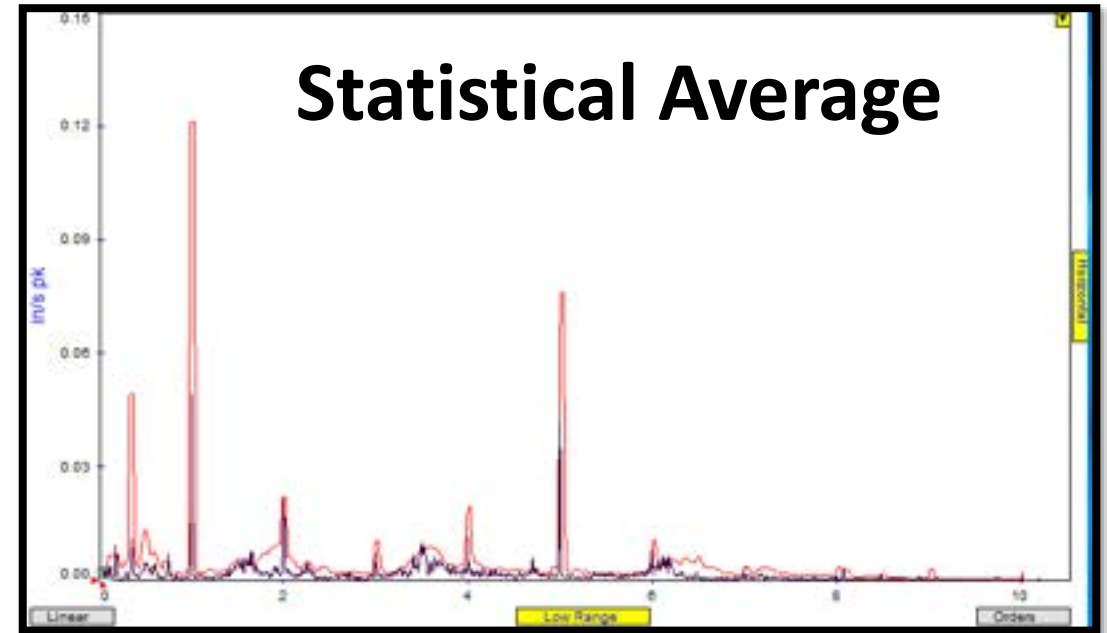
What is a Statistical Average

Others



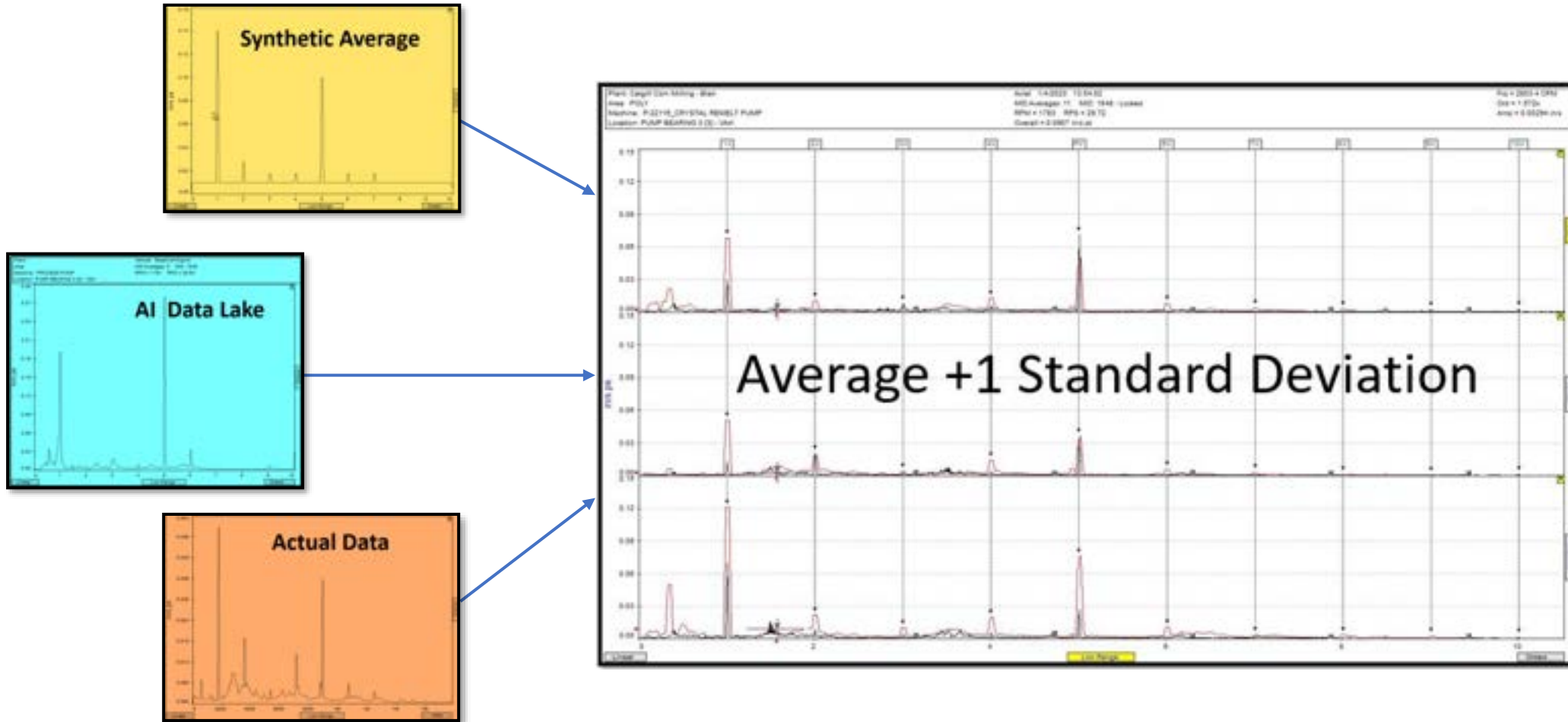
VS

AzimaDLI Screening



8000+ Line - Screening Criterion (per machine)

Robust Statistical Average

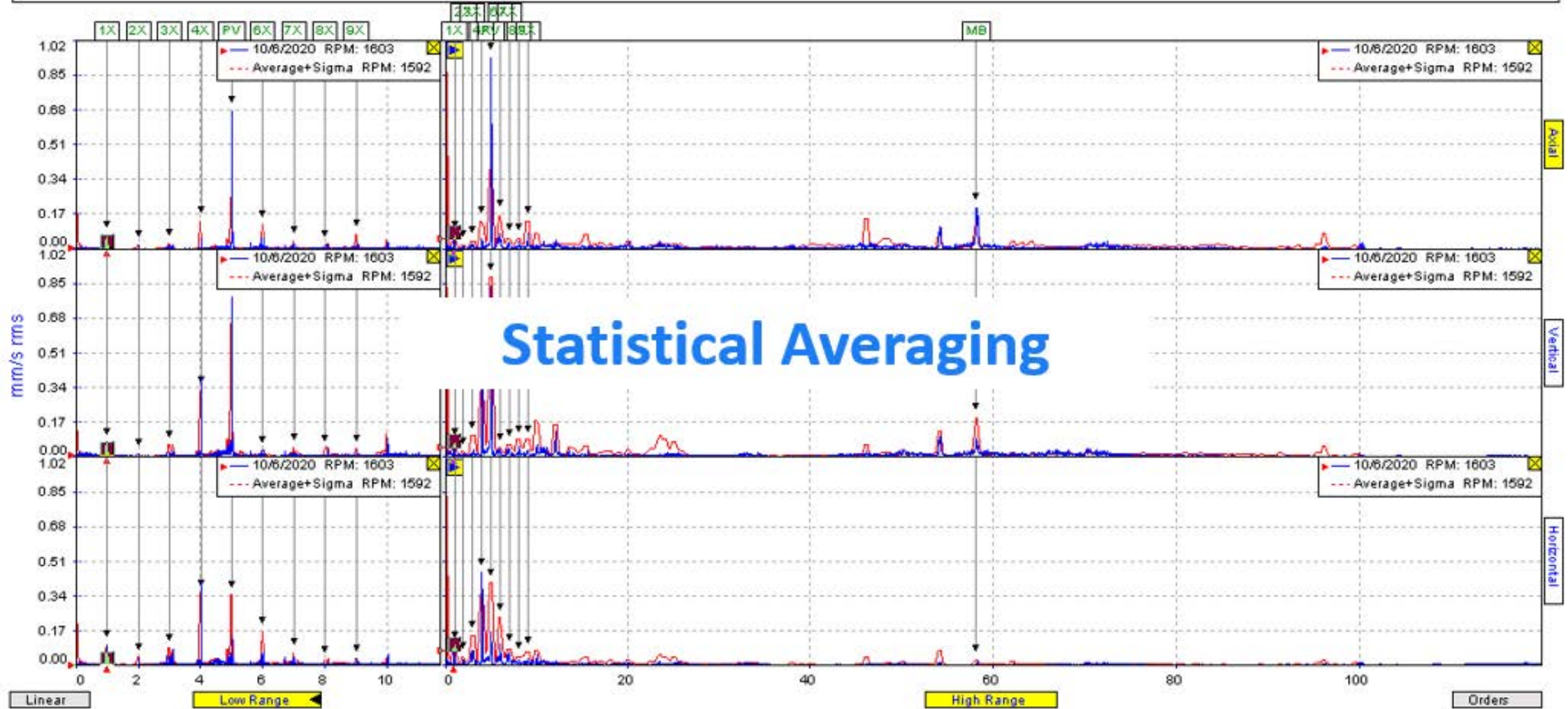


Statistical Average - Each Axis, Each Range, And Each Location of any Machine/Template
Result = 8000+ Line Screening Criterion per Machine

Plant:
 Area:
 Machine: P-06221_MICROFILT FD TANK PMP HUSKER 1 [VFD]
 Location: MOTOR BEARING 2 [2] - HAV

Acqal 10/6/2020 17:18:19
 MID Averages: 3 MID: 2772
 RPM = 1603 RPS = 26.71
 Overall = 0.918 mm/s rms

Frq = 1583.9 CPM
 Ord = 0.988x
 Amp = 0.00179 mm/s



Workflow Management / Service Level

- **Dedicated Workflow Tool**
- **Delivery Process Driven By Severity**
 - Low Priority Results Automated
 - High Priority Results (Fault)
 - Diagnostic Engine + Human Analyst

Assignment Summary



Virtual Diagnostic Center 16.6.4

[Dashboards](#)

[List Views](#)

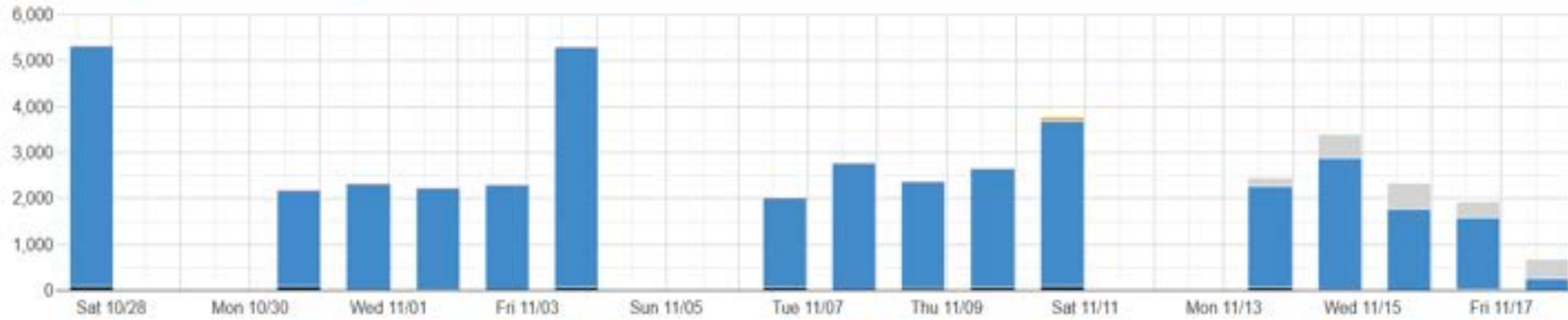
[Admin](#)

Tech Services Inbox

 My View (Shows only your primary DSL's and batches assigned to you)

Machine Tests vs Due Date

■ Do Not Review | ■ Complete | ■ Not Complete | ■ Overdue | ■ Due Today



Watchman Core Service Level Metrics

Completion Rate (%)

100.0

100.0 last 90 days

On-Time Turnaround (%)

100.0

99.9 last 90 days

Extreme Peer Review Rate (%)

100.0

100.0 last 90 days

Serious Peer Review Rate (%)

100.0

100.0 last 90 days

Analyst Name

NR

HOL

EXT

SER

QC

462

13

22

213

14

44

156

18

24

10

1

2

121

6

13

105

4

9

23

2

81

28

2

2

143

6

15

29

4

11

18

1

317

10

52

97

5

8

21

1

69

Additional Process

- **Persistence**
 - Automate Persistent (Continuous) Fault Reporting
- **Confidence Scoring**
- **Profile Completion Scoring**
- **Automated Fault Code finder**

Confidence Level & Completion Score

Latest Diagnostic Result

Feb 02, 2023, 06:55 AM

Identified Problems

 **SERIOUS**

Motor Shaft Looseness

Recommended Actions

 **IMPORTANT**

Check Motor Bearings For Improper Fit
[ALRT-22996](#) - **OPEN**

 OK

Confidence

No warnings for this diagnostic result.

 65%

Completion Profile

Needs Motor Bars, more averages



Cited Peaks

Click [here](#) to view cited peaks



Analyst

Manjunath

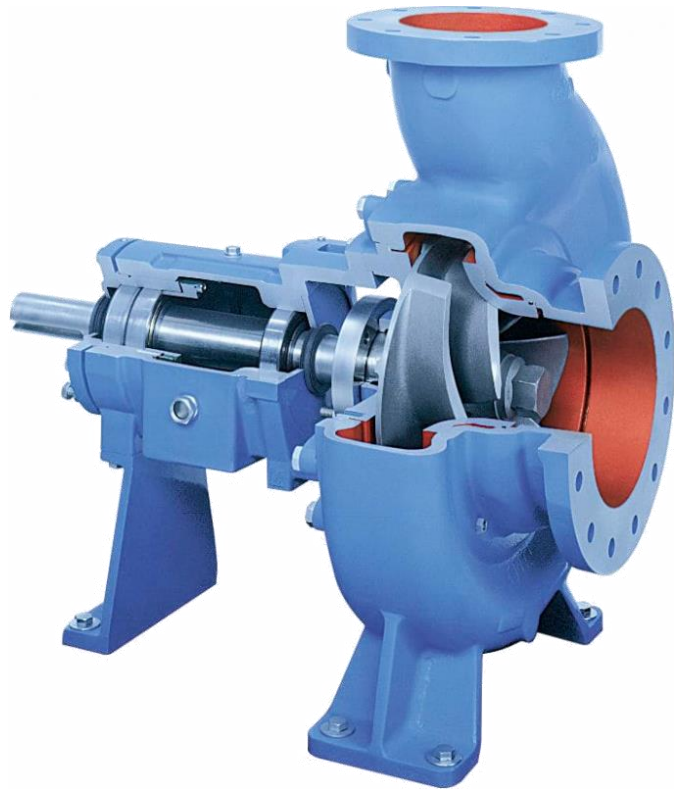


Analyst Comments

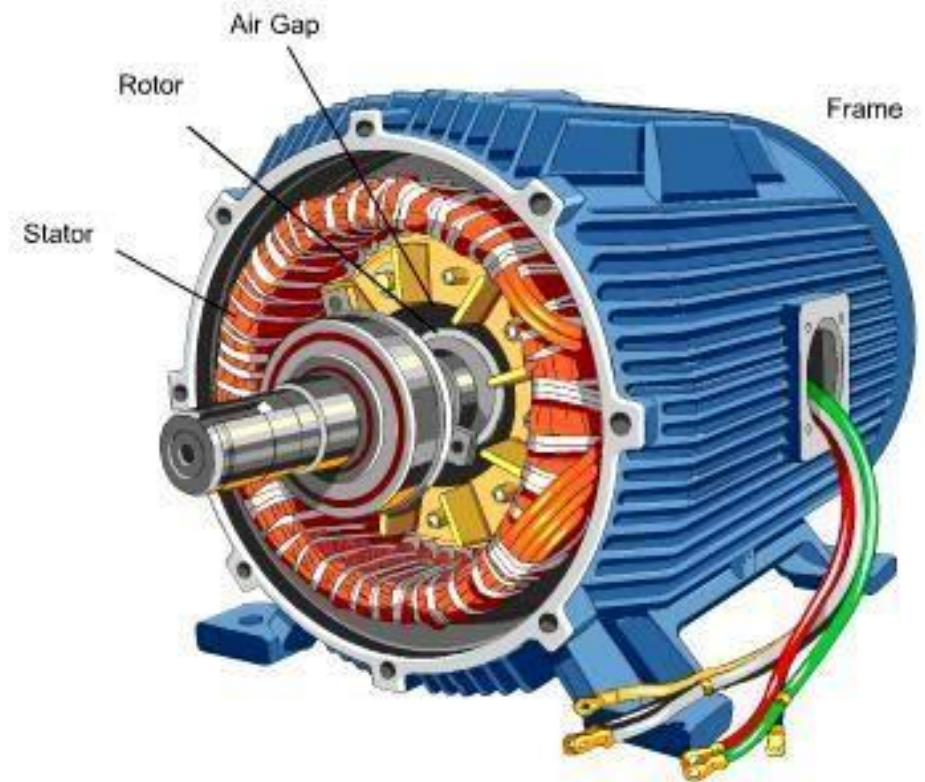
Fault has increased in severity since last month's reading, prompting an escalation to Important recommended action.

Vibration AI: Automated Fault Codes Examples

Identifies number of pump vanes



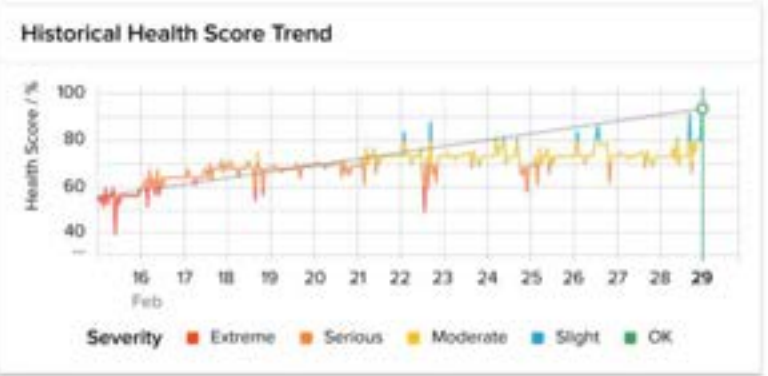
Identifies number of motor rotor bars





Boiler Room Dashboard

- Search...
- Globex Manufacturing
 - Glendale Production
 - Dry Area
 - Boiler Room
 - #1 Boiler Feed Pum...
 - #2 Boiler Feed Pump
 - Air Compressor #1 P...
 - Air Compressor #2 ...
 - Dry Mixing
 - Facilities
 - Production House
 - Recovery
 - Wet Area
 - Wet Pressing
 - Medford Production
 - Redding Production
 - Salinas Production
 - Tacoma Production



My Watch List Add Asset

⚠ **Dryer Gearbox** ✕

Glendale Production / Dry Area

Type	Severity ↓	Date Added	Time Added
Vibration	EXTREME	10/18/2012	4:02:00 PM
Thermography	SERIOUS	10/18/2012	4:02:00 PM
Oil Analysis	SLIGHT	10/18/2012	4:02:00 PM
Motor Testing	OK	10/18/2012	4:02:00 PM

⚠ **Oscillation Felt Shower Pump** ✕

Glendale Production / Production House

Type	Severity ↓	Date Added	Time Added
Vibration	EXTREME	10/18/2012	4:02:00 PM
Thermography	SERIOUS	10/18/2012	4:02:00 PM



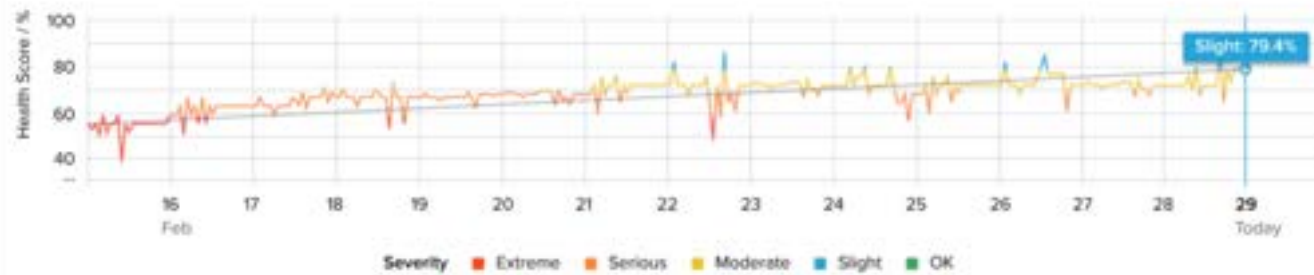


Globex Manufacturing Health Score

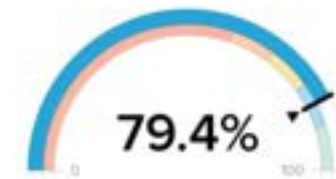
Showing data for: Default: Last 14 days

Historical Health Score Trend

Some description should be here. Some description should be here.



Health Score



▲ +4 Compared to previous period

Feb 29 2020, 11:00 PM 79.4%

Some description could be here. Some description could be here.

Health Score Impact Factors



Component	Impact	Component Health	Weight
Vibration Health	-10.0%	40%	2
Lube Oil Health	-5.0%	85%	4
Process Health	-4.8%	81%	3
Bearing Health	-0.5%	97%	2
Anomaly Score	-0.3%	96%	1



FLUKE®

Reliability

THANK YOU!

Ensuring the success of your connected reliability program is essential for the management team. Many companies today are facing vibration data overload, where the excessive amount of vibration data exceeds analytic capacity in today's wireless sensor world. Azima DLI manages over 500,000 machine tests per year and uses algorithms, metrics, and processes to sustain those programs. The webinar will discuss changes in vibration AI/machine learning, workflow, and culture necessary to help drive your success.