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

FLUKE Reliability

Azima DLI Service History & Milestones

1966 — Founded

1976 — Aircraft Carrier Contract

1980 — 1st Triaxial Accelerometer

1986 — MSC

1990 — ExpertALERT™ First Expert Automated Software

1995 — Online Diagnostic System

2000 — Azima DLI is formed

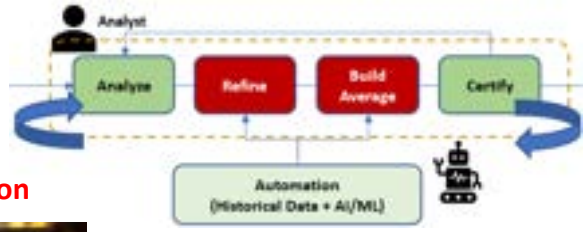
2005 — TRIO® Windows Based Data Collector

2012 — WATCHMAN Reliability Portal™

2015 — Cloud-enabled complete PdM Program Solution

2017 — Strategic Business Level Metrics

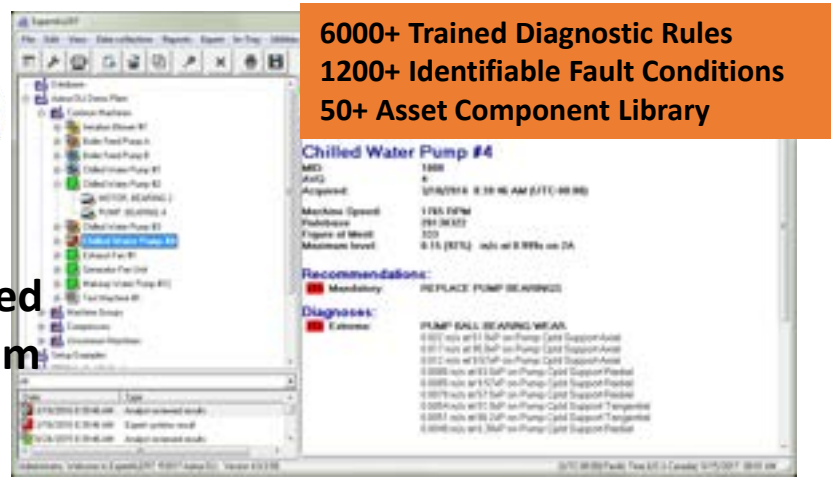
2019 — First Commercial Report Automation



2023 — > 500,000 Annual Report Delivery

Watchman™ System

Expert Automated Diagnostic System



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

Vibration AI

Asset Data Lake

100,000
Unique Assets

150,000
Asset Components

3,000,000
Machine Tests

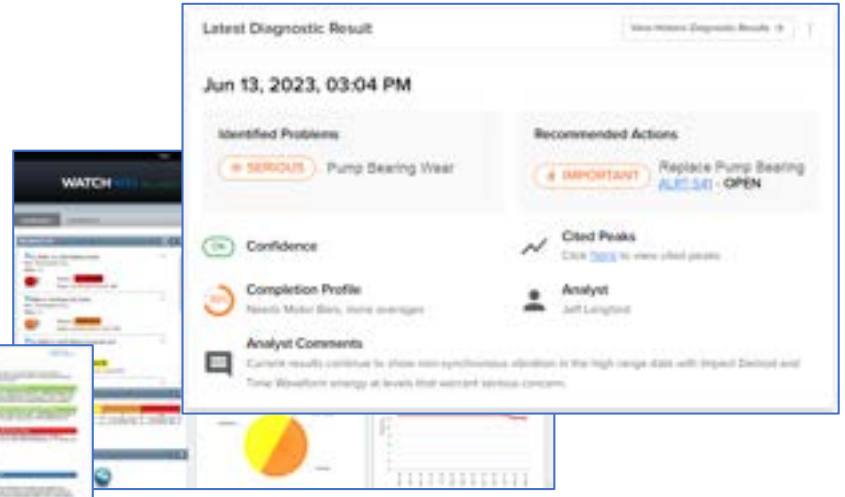
150,000
Component Specific Faults

100 Trillion
Individual Vibration Test Points

approximately

Vibration Data Sources

Program Management



Watchman Portal™

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

Watchman Services

Vibration Institute

MOBIUS INSTITUTE

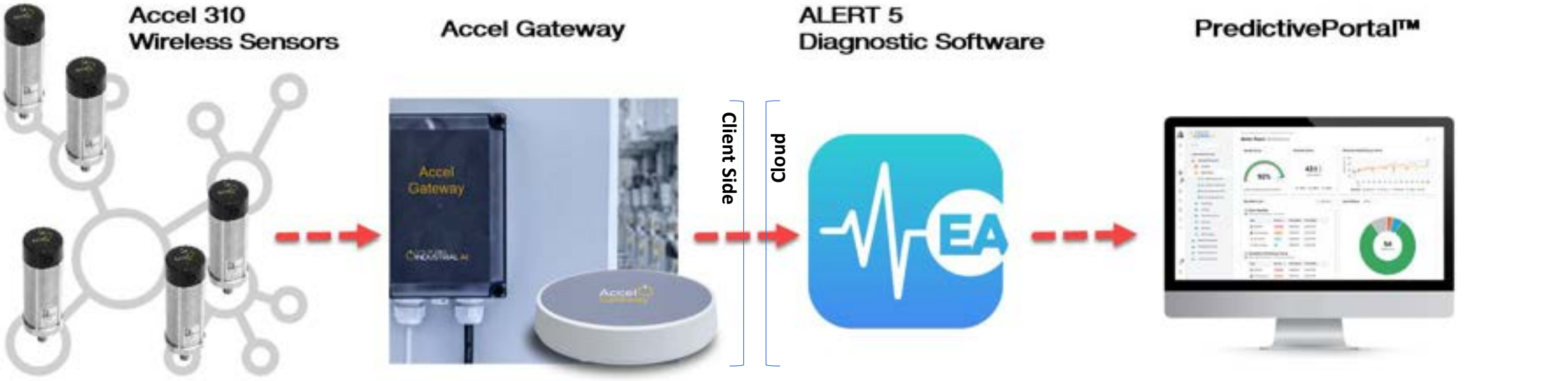
FLUKE Reliability

Evolution Reliability ≠ 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™



Mesh Network
Self-healing and adaptive
More reliable than Wi-Fi or Bluetooth

Eureka AI Cloud-ready
Wi-Fi, LAN, Ethernet
Cellular LTE
Standard or Industrial IP-66/67

Automated Diagnostic Engine
Fully automated fault detection
6,000+ diagnostic rules
1,200+ component fault types

User Portal
Alerts & Notifications
Asset, Plant, Corporate Health Score
Cloud-based fault diagnosis, fault severity
Prioritized repair actions

Wirepas® Mesh

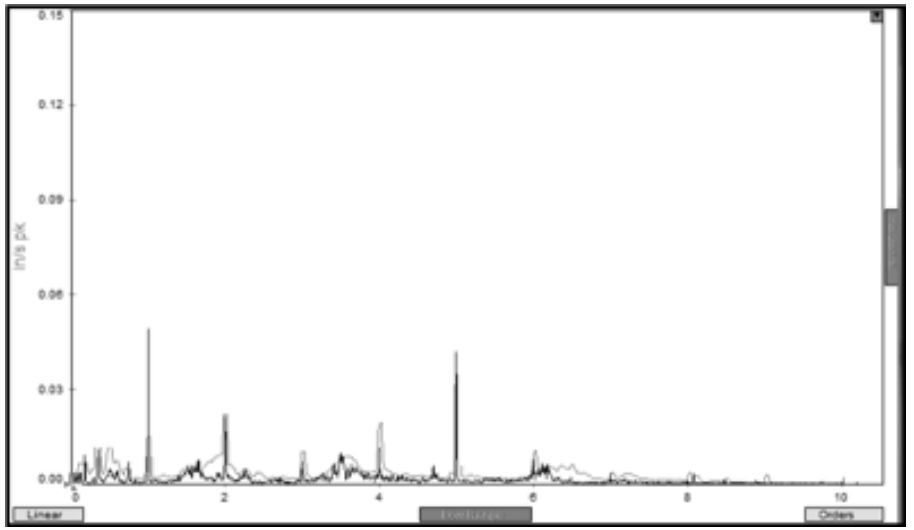
WiFi, LAN Cellular

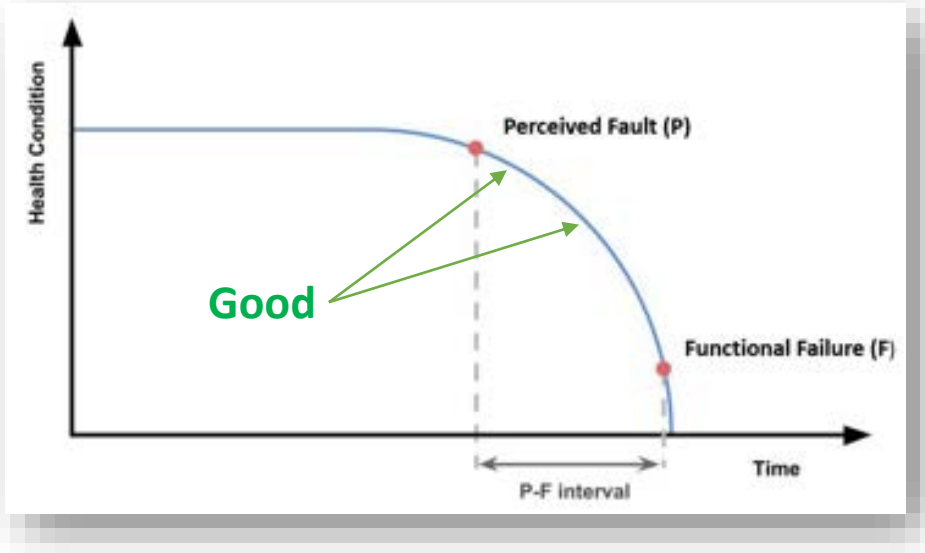
6

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



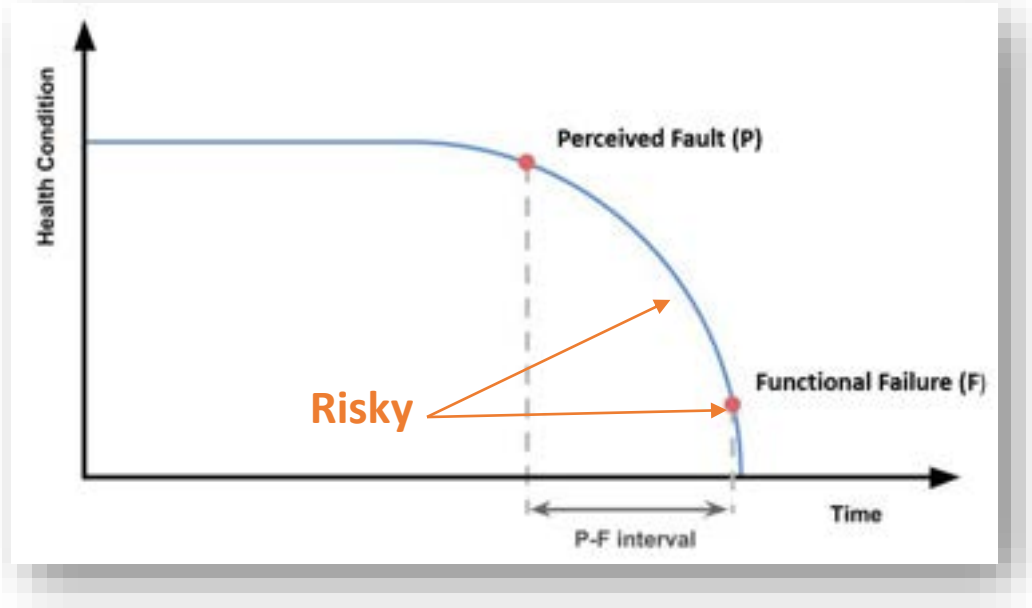


Historical Process

Rough-scale Approach

Overall Vibration Alarm

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



The Wireless Data Tsunami

- **More Data ≠ Better Insights**

✓Analysts Overrun

✓Ineffective use of High Value Talent.

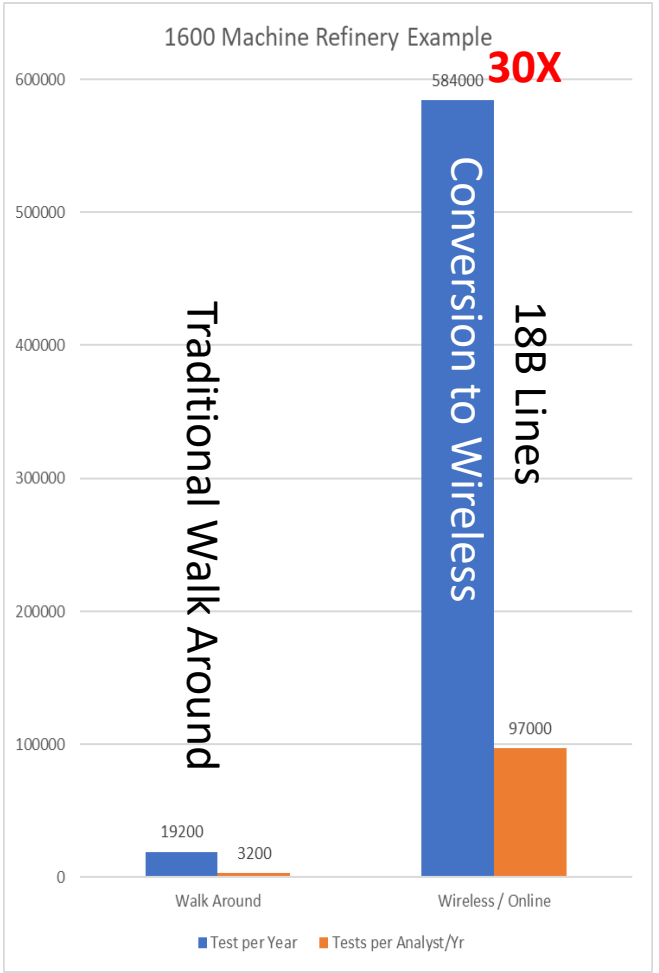
✓Significant Resource Constraints

✓30-100x more data

✓Overall Vibration Trend NOT enough

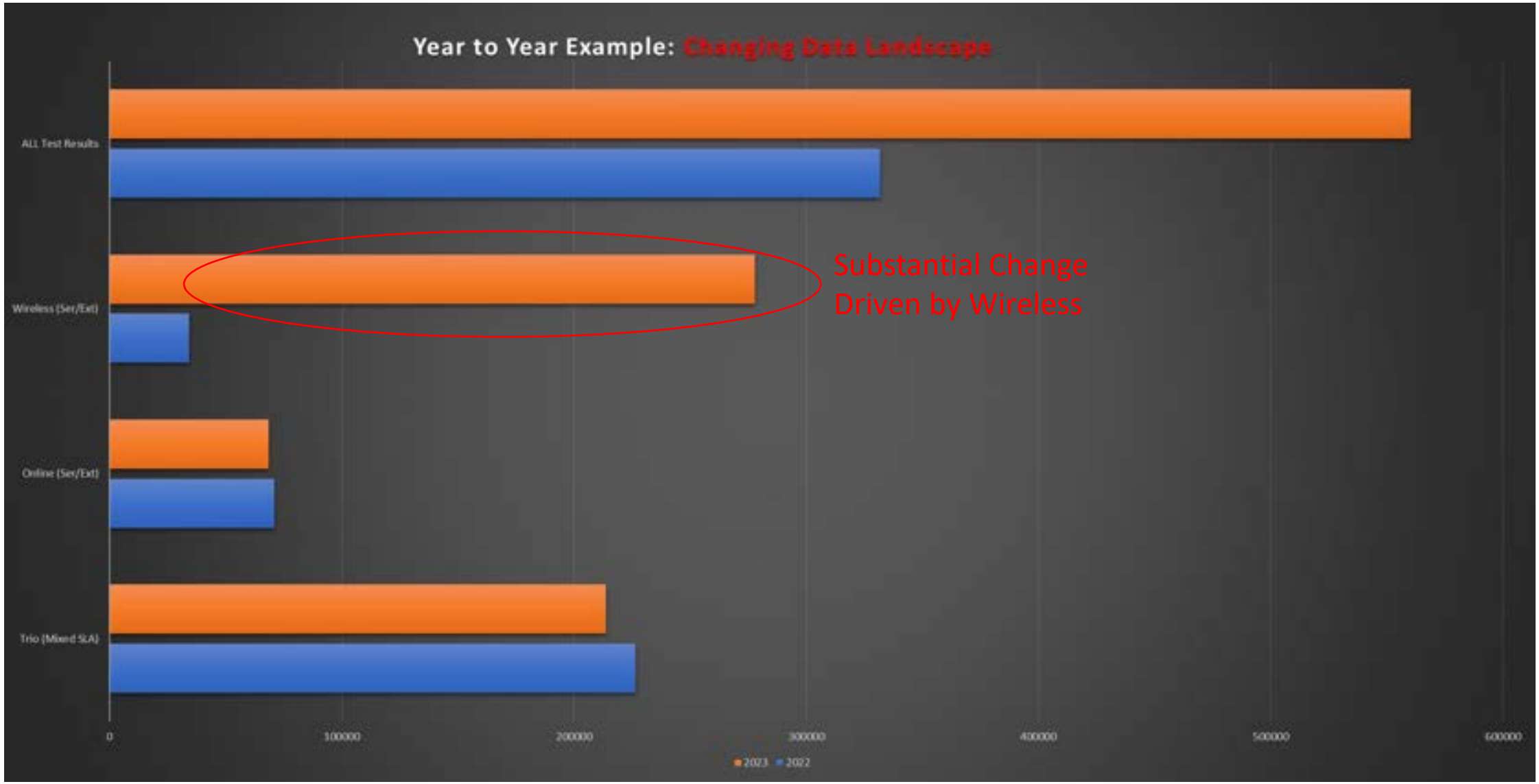
Need Better Approach

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



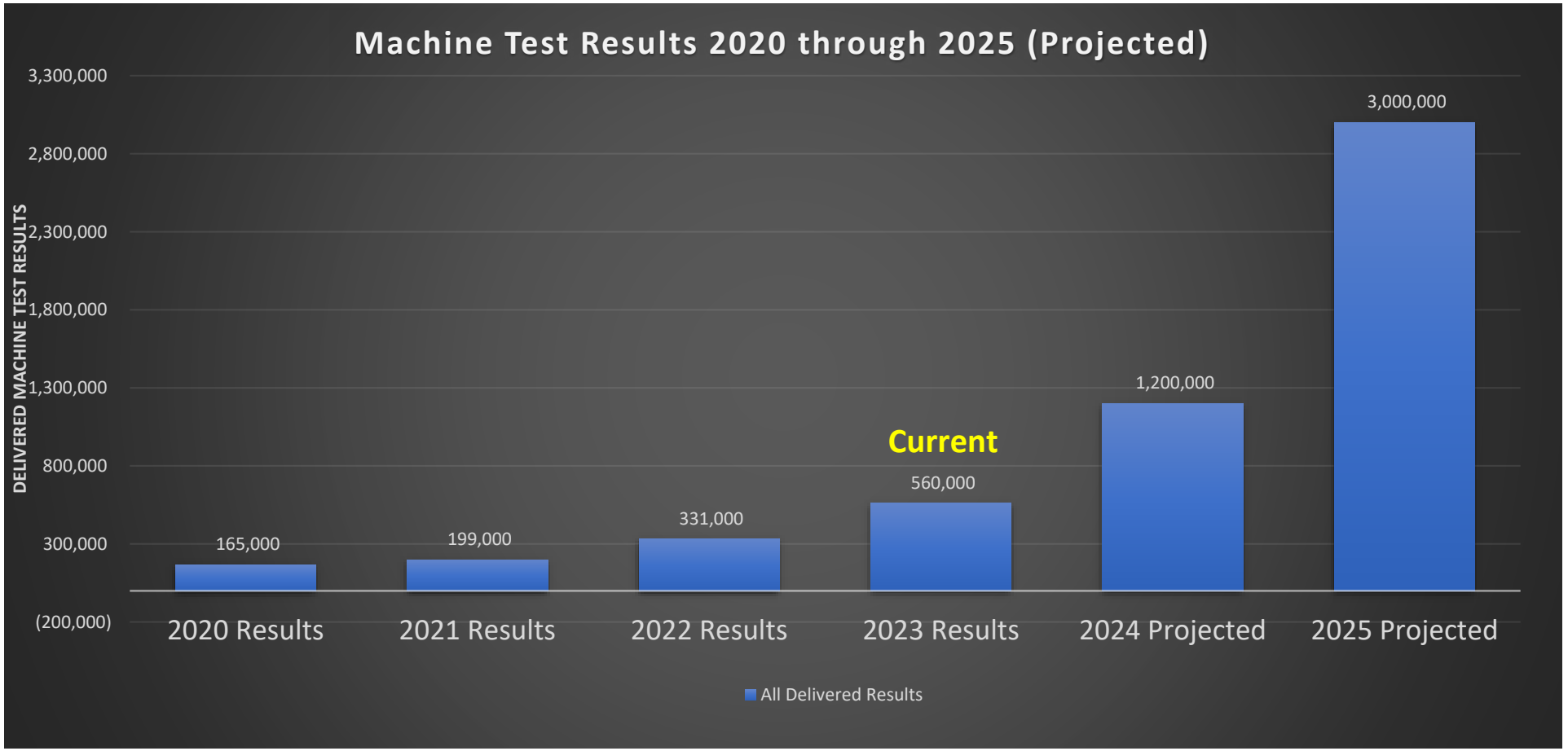
6 Analyst on-site

FLUKE Reliability



Azima History + Projections

of Test Results



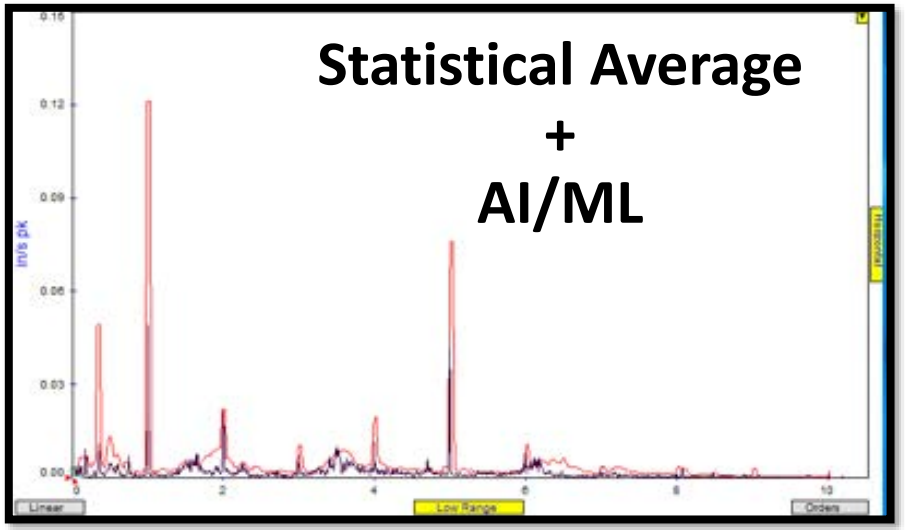
By Year

FLUKE Reliability

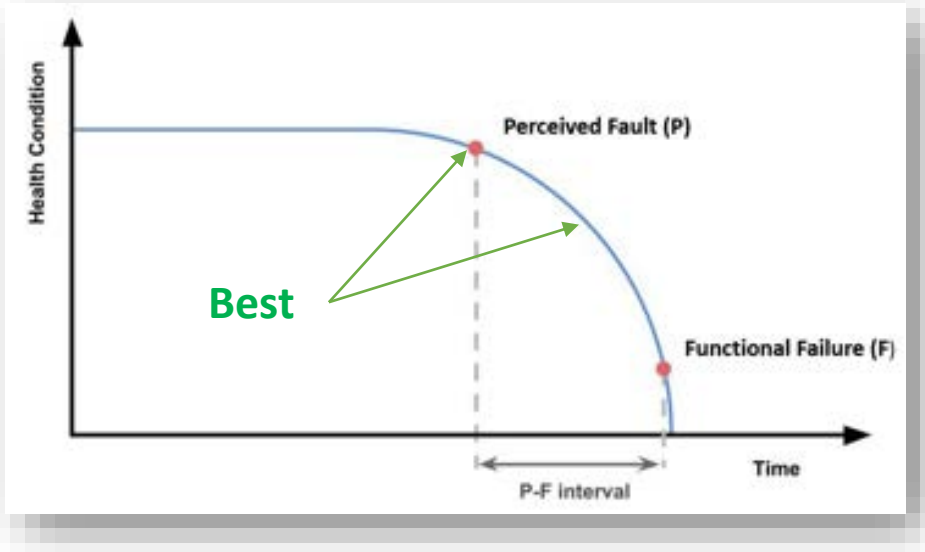
Azima DLI Watchman

Empowered Vibration Data Analytics

Diagnostic Engine + Manual Analysis



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

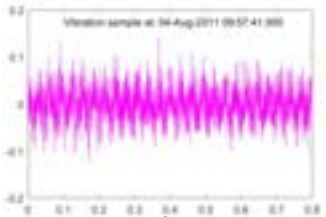


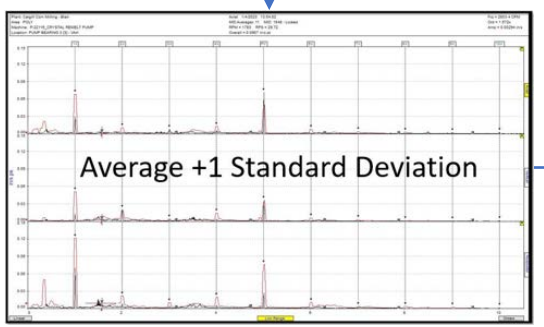
Diagnostic Recap

Diagnostic + Baseline/Grooming Process
{Analyst +AI}

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

Vibration Data





Baseline Screening

Analyst

Manual Analysis

Analyze | **Refine MID** | **Build Average** | **Certify**

Automation (Historical Data + AI/ML)

Machine Configuration

MID – Machine Internal Design

MID

Feature Extraction

Automated Analysis (Once Certified)

Rules Engine

Report Generation

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

FLUKE Reliability

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

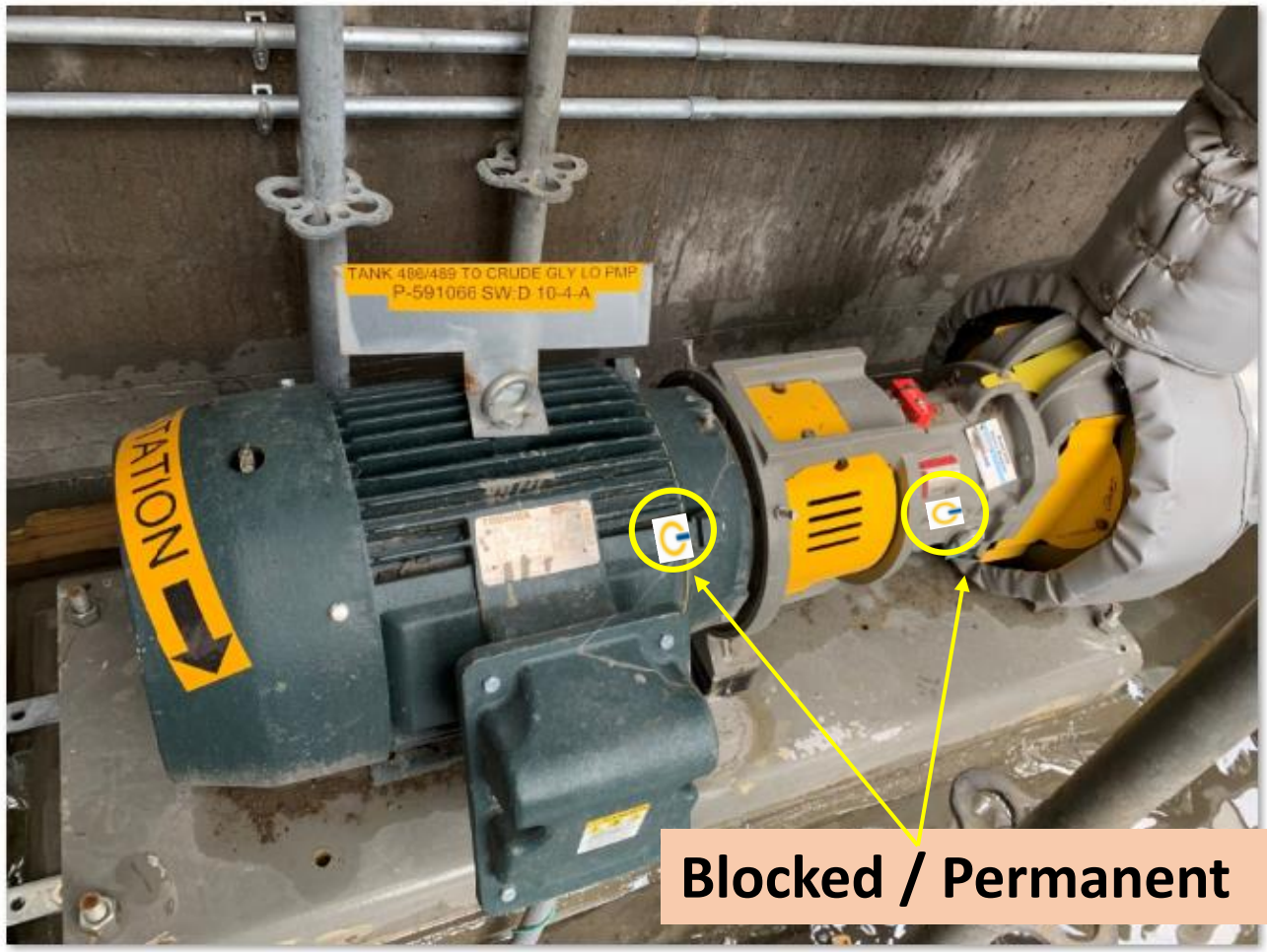
Machine List

Must Have	Must Have	Must Have	Must Have	Must Have	Must Have	Must Have	Must Have
							Yes/No
PLANT	Area	EQUIPMENT SAP/CMMS #	MACHINE Number and NAME	HP	RPM In	RPM Out	VFD
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

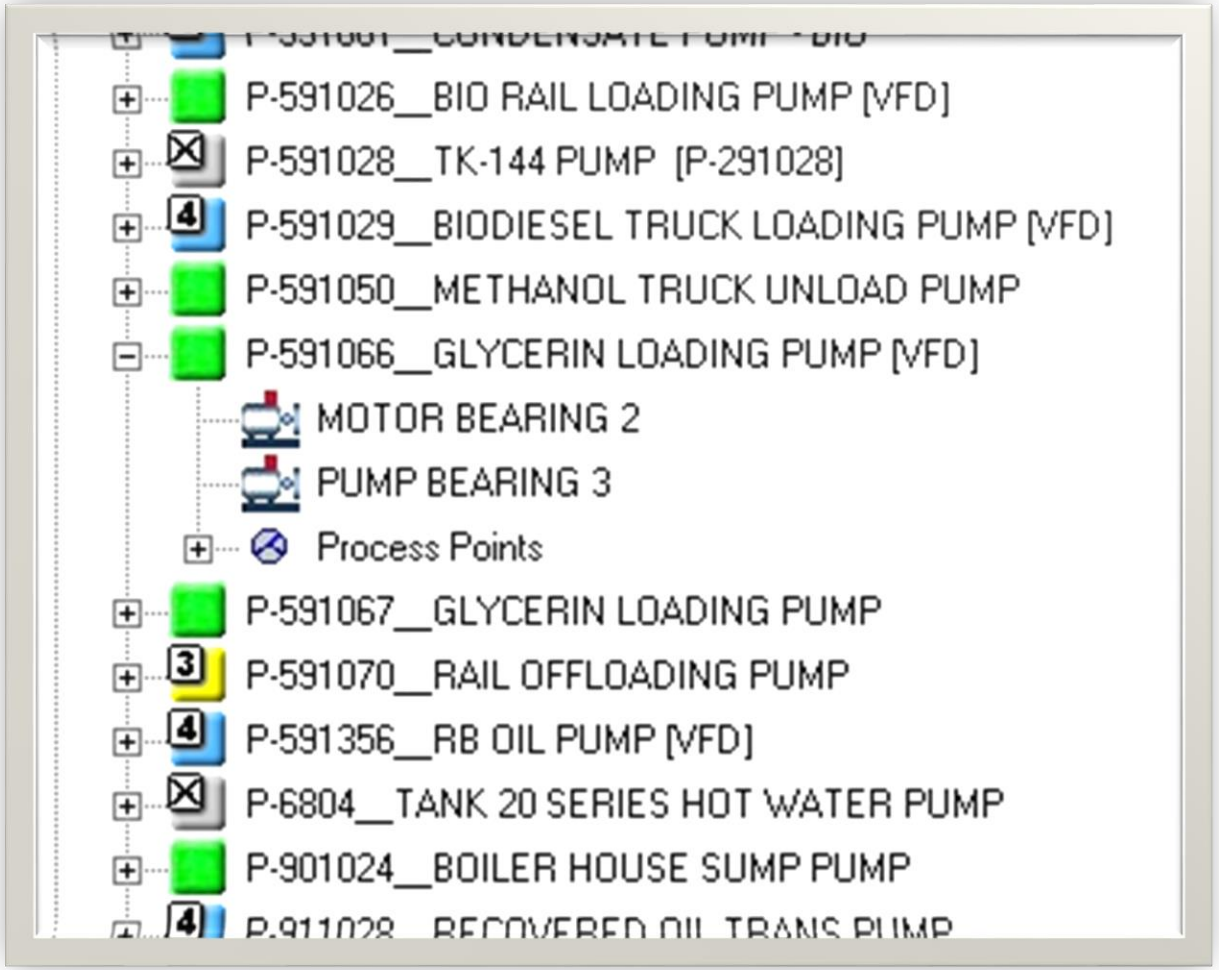
Implementation Walkdown. Photos, Vtags

FLUKE Reliability

Example Machine Setup



Centrifugal Pump



Template + Baseline Build / Certify

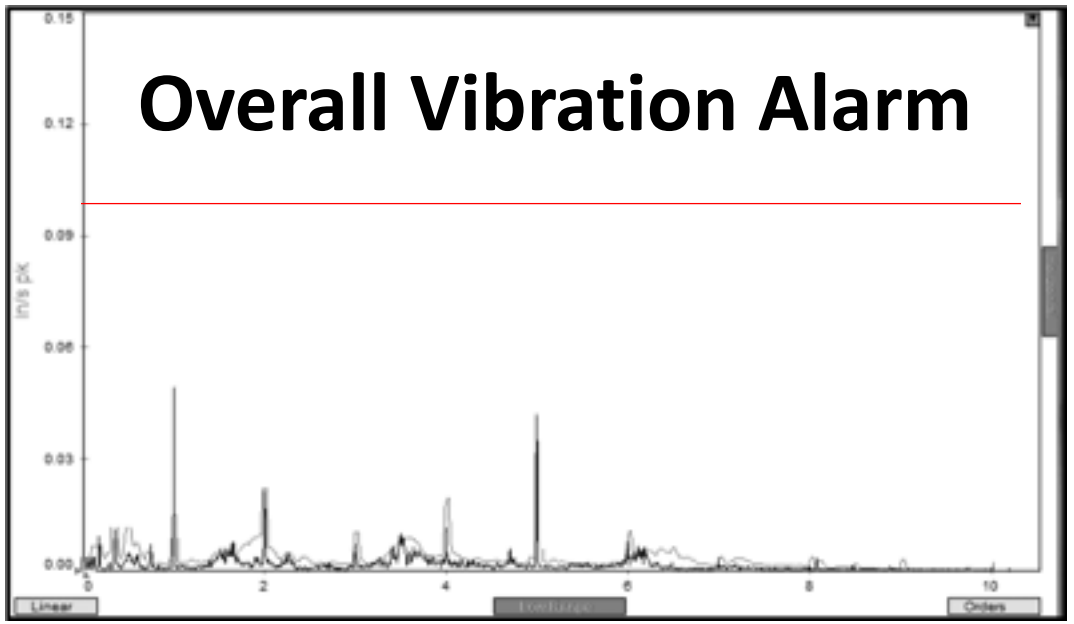
Diagnostic ML/AI Template Consist of:

- 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

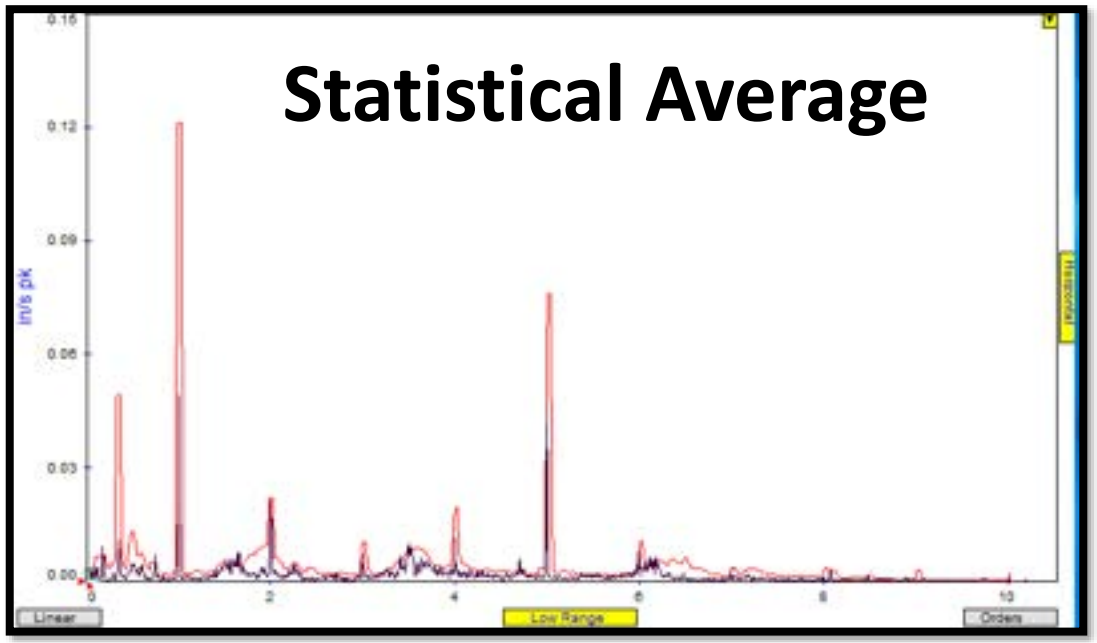
What is a Statistical Average

Others



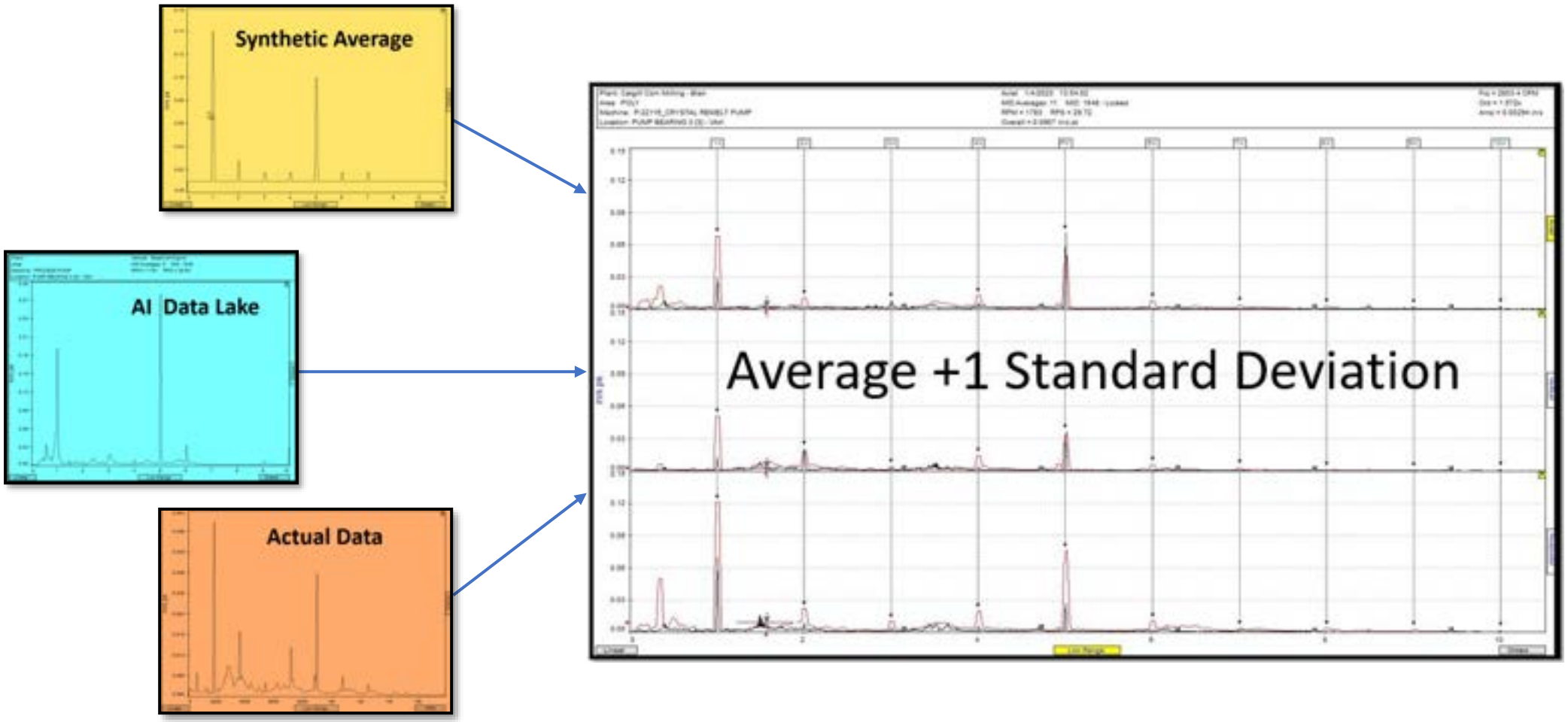
VS

AzimaDLI Screening



8000+ Line - Screening Criterion (per machine)

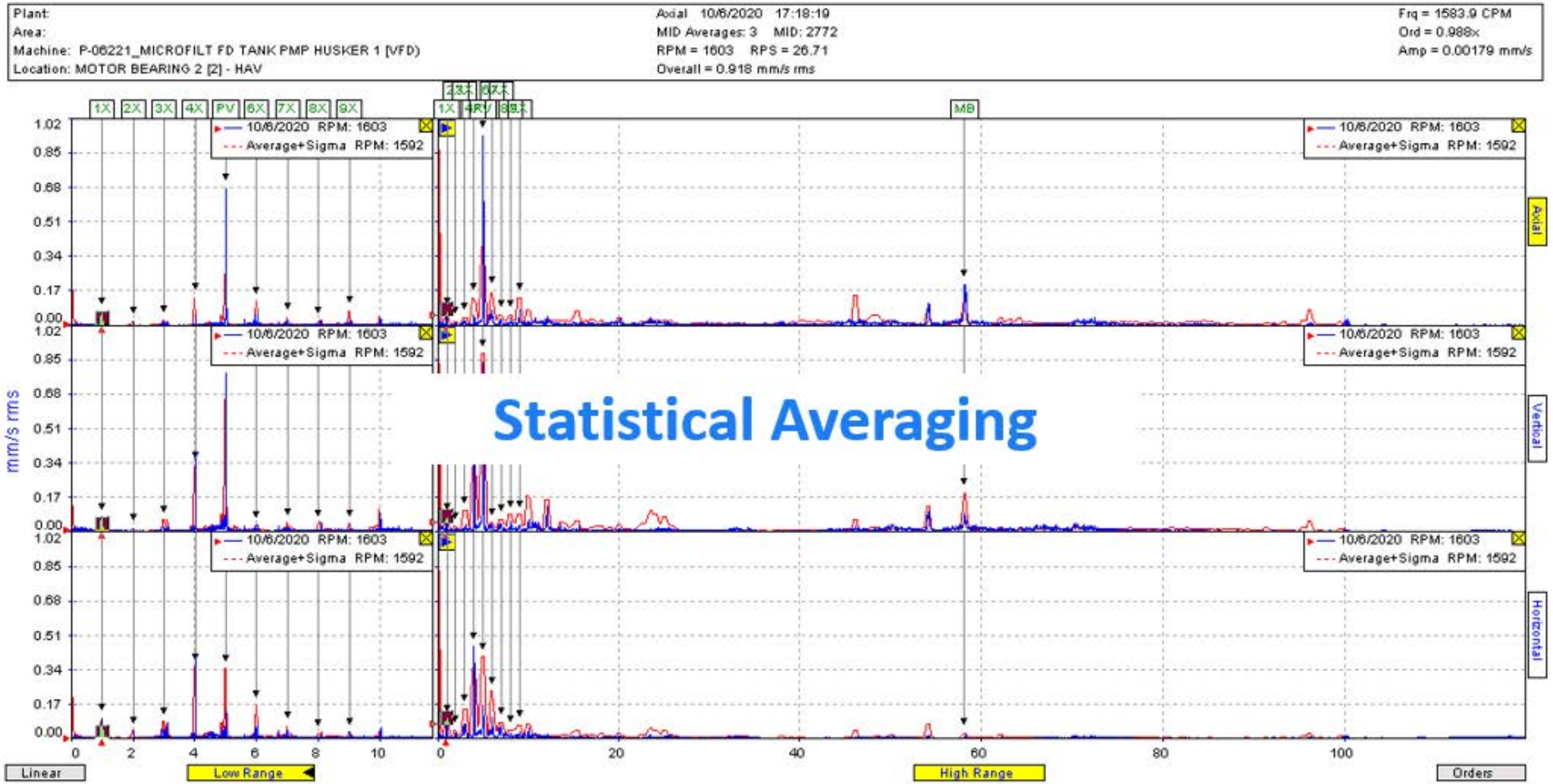
Robust Statistical Average



Statistical Average - Each Axis, Each Range, And Each Location of any Machine/Template

Result = 8000+ Line Screening Criterion per Machine

FLUKE Reliability



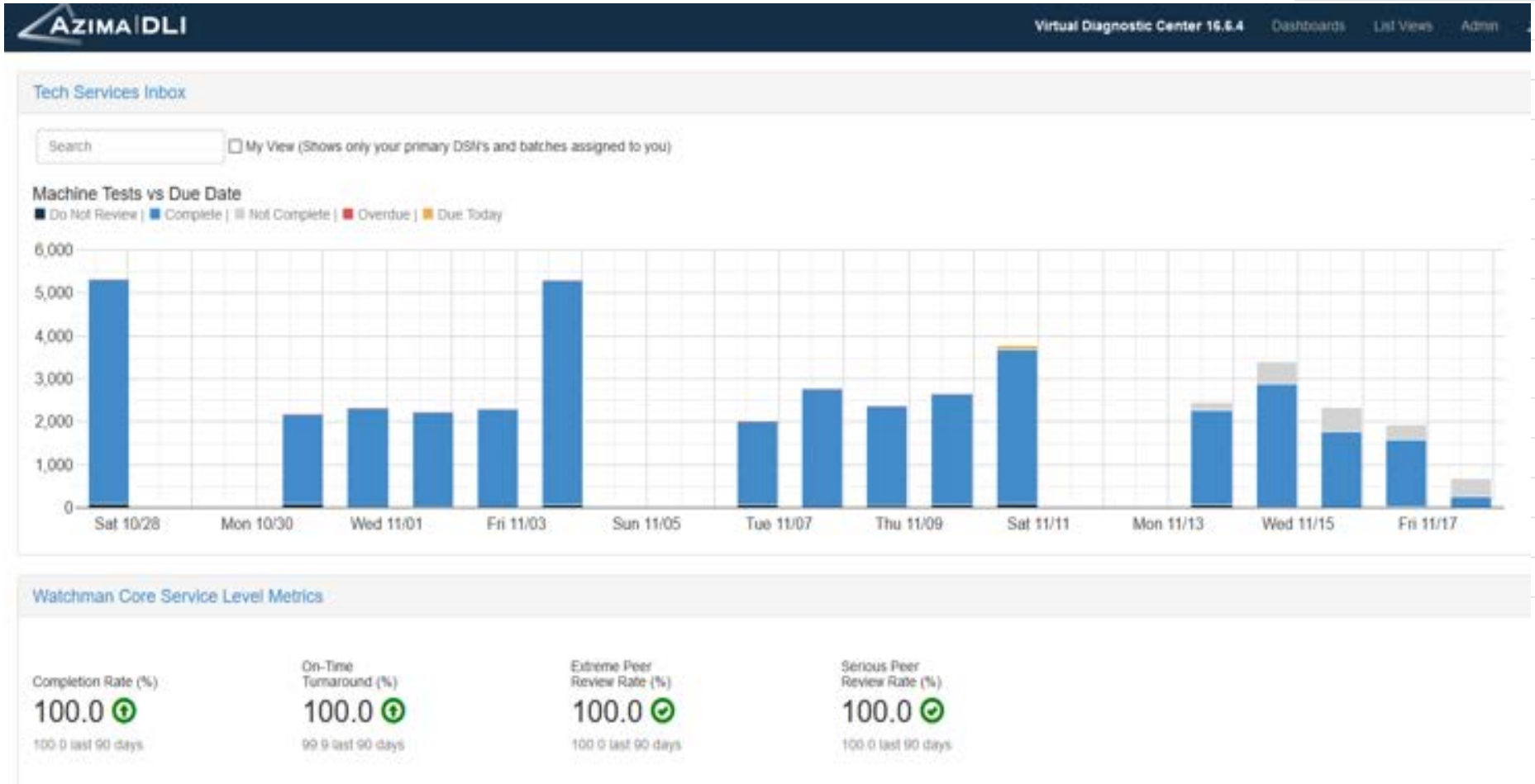
FLUKE Reliability

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

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				



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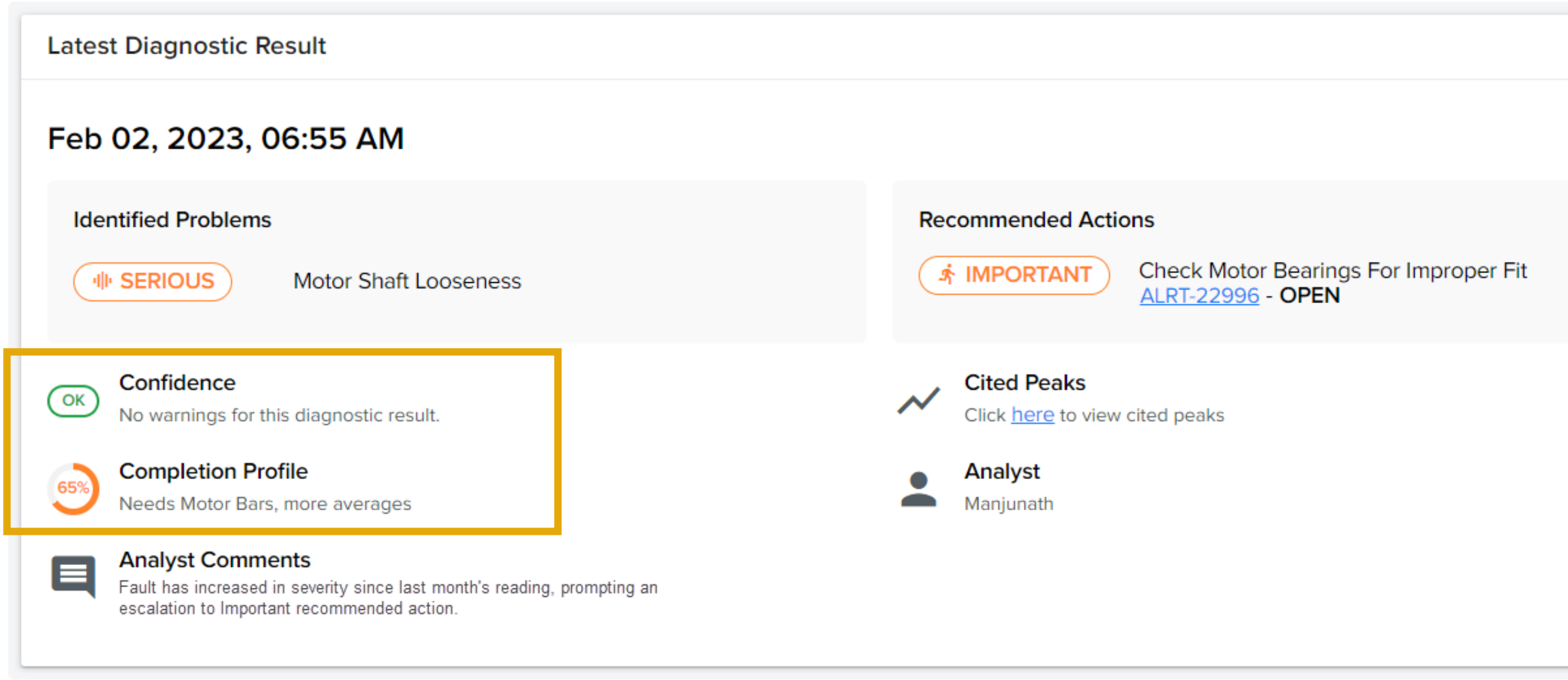
Additional Process

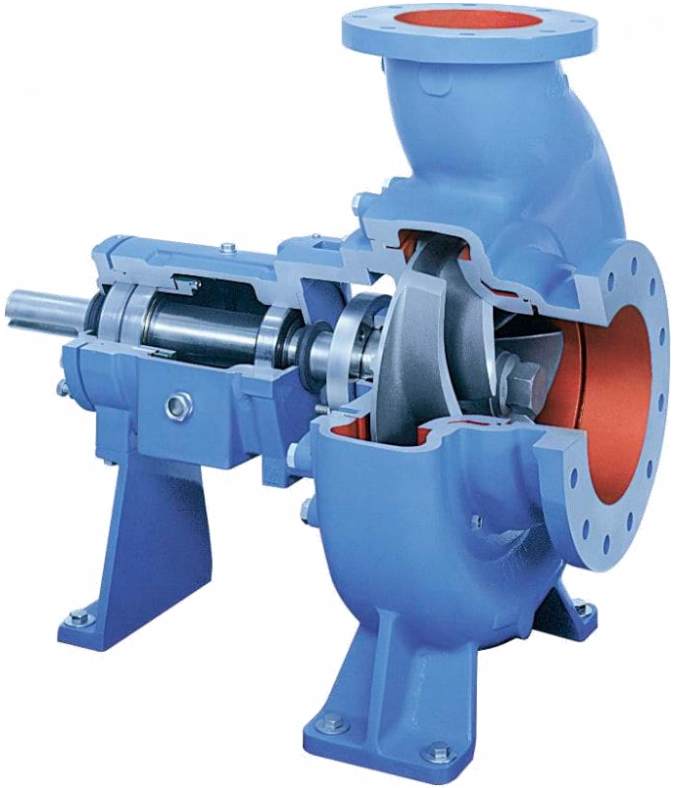
- **Persistence**
  - Automate Persistent (Continuous) Fault Reporting
- **Confidence Scoring**
- **Profile Completion Scoring**
- **Automated Fault Code finder**

Confidence Level & Completion Score

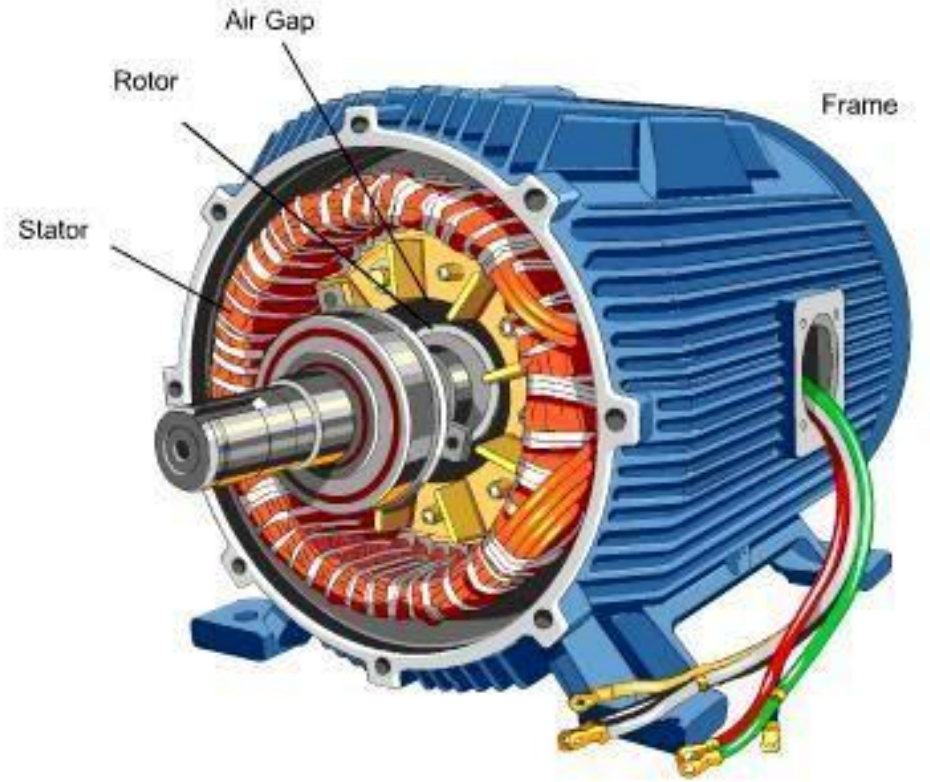


Vibration AI: Automated Fault Codes Examples

Identifies number of pump vanes



Identifies number of motor rotor bars



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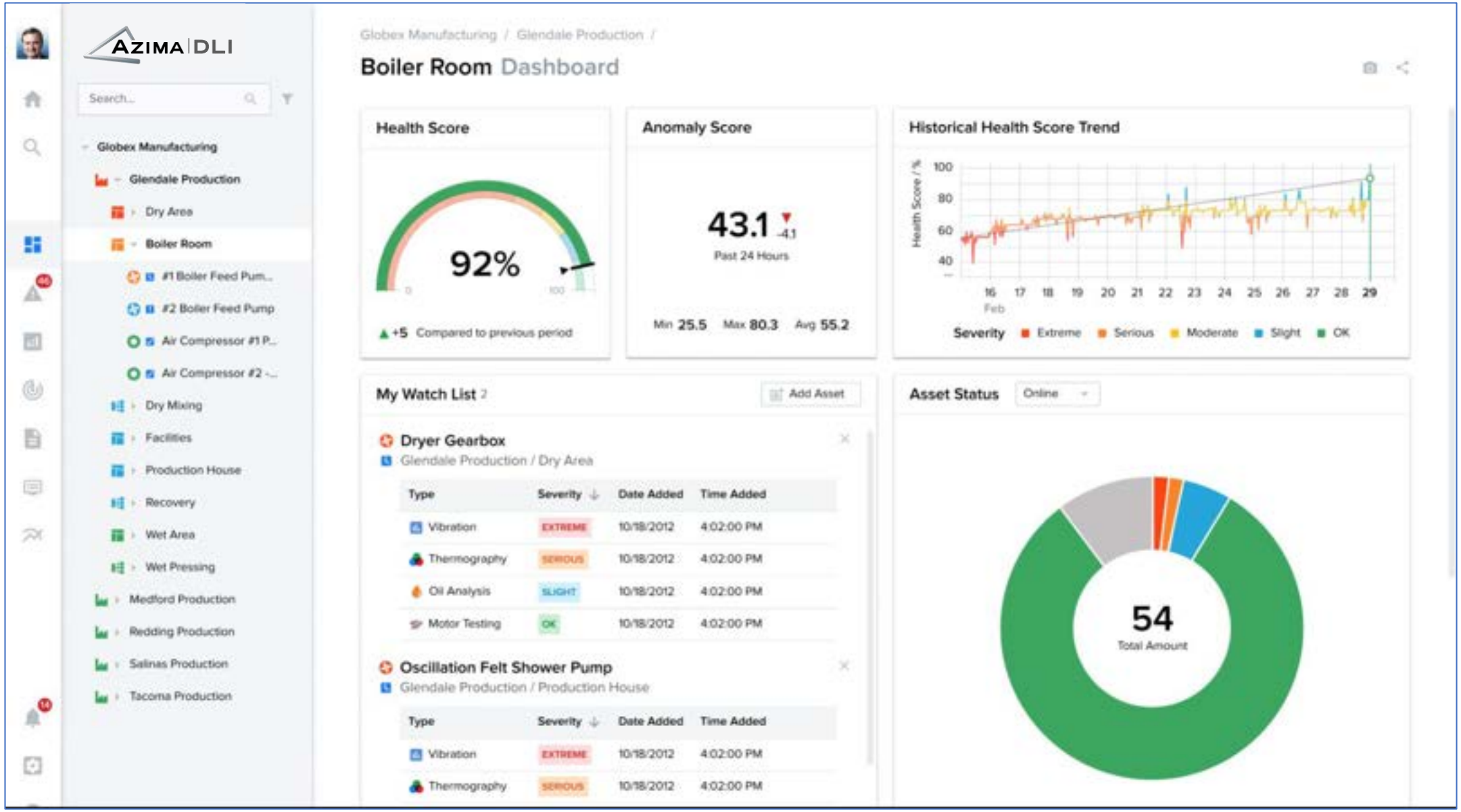

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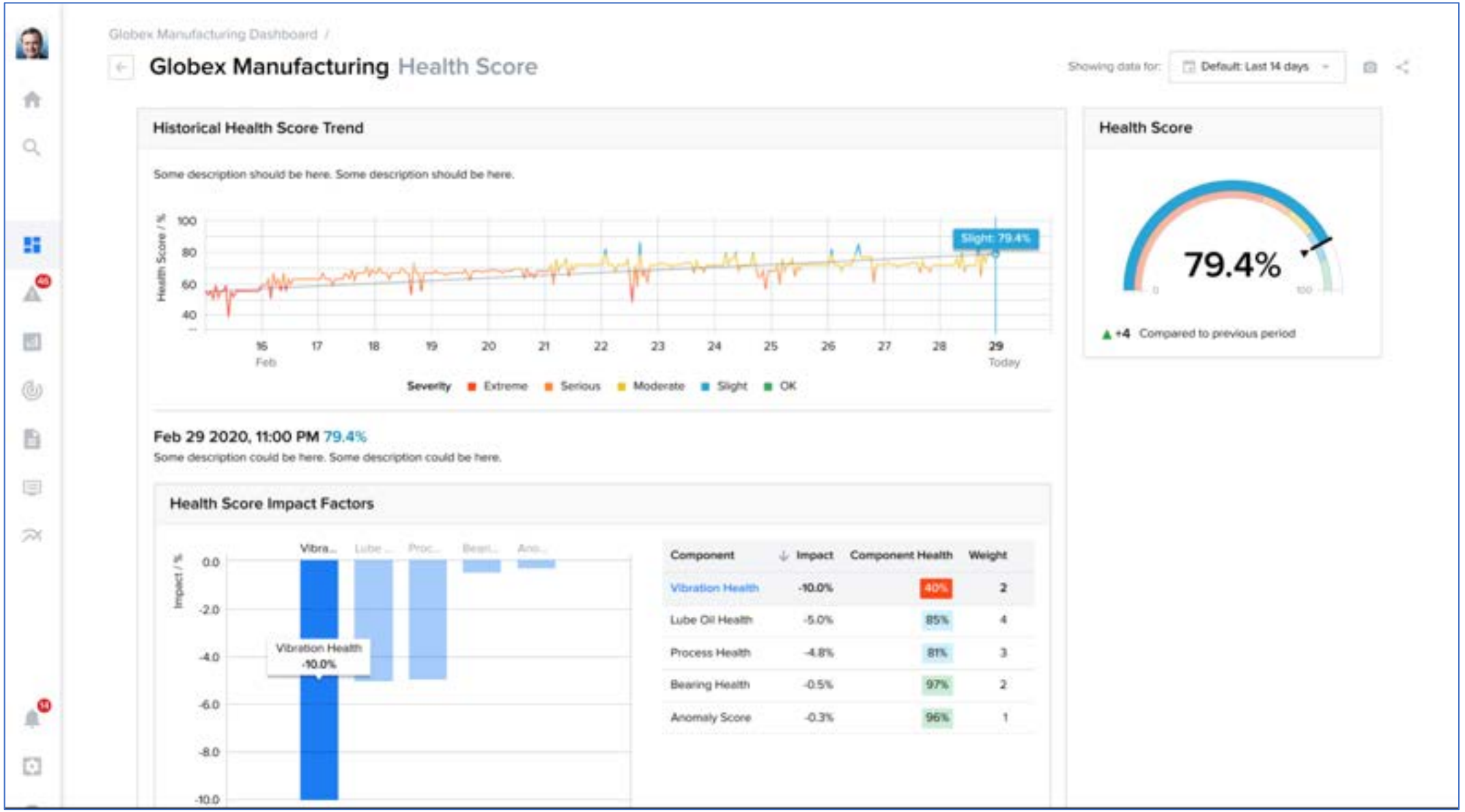

FLUKE Reliability

FLUKE®
Reliability

THANK YOU!

Abstract

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.