



FLUKE®

Reliability

Azima DLI Vibration Solutions

Michael DeMaria

Director, Azima DLI Product Management

- Vibration Hardware and Software Systems

Background is Naval Nuclear Power Engineering (8.5 years)

- Machinery Condition Analysis

Joined DLI Engineering in 1995

- Engineering Lead / Analyst
- Program Manager, US Navy
- Director, Technical Support
- Director, Training
- Director, Product Management



FLUKE®

Reliability



Innovative
Software



World-class
hardware



Remote condition
monitoring services

Fluke Reliability: One mission, one shared purpose

“

We simplify connected reliability solutions for the people who keep the world up and running

”



Azima DLI History & Milestones



Founded

Development of Automated Diagnostic Software



Computer Controlled Processing



First Commercial Multi-channel Digital Data Collector

ExpertALERT™
First Expert Automated Software



Azima formed



First Tablet-style Windows® Based Data Collector

Launch of SPRITEMax



WATCHMAN Reliability Portal™



Strategic Business Level Metrics



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



Aircraft Carrier Contract



Narrowband Vibration Analysis



Military Sealift Command Contract



First Triaxial Vibration Sensor

AQ-204 Acquisition Hardware

First Online Diagnostic System



10th Generation ExpertALERT™ Automated Software



Azima DLI is formed



TRIO®
First Modular Data Collector



IIoT/AI APM Integration

Cloud-enabled complete PdM Program Solution

ExpertALERT™ Cloud-subscription

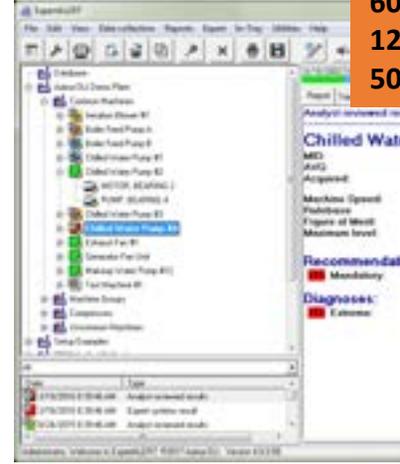


Watchman 360™ System

Remote Setup App



Expert Automated Diagnostic System



Vibration AI

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

Asset Data Lake



100,000
Unique Assets



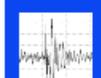
150,000
Asset Components



3,000,000
Machine Tests



150,000
Component Specific Faults



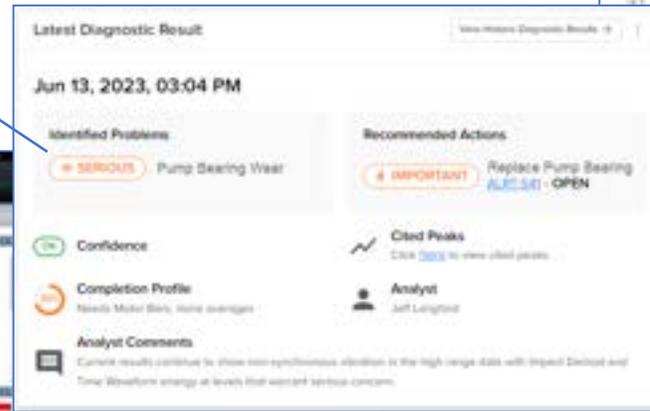
100 Trillion
Individual Vibration Test Points
approximately



Vibration Data Sources



Program Management



Watchman Portal™



Watchman Services

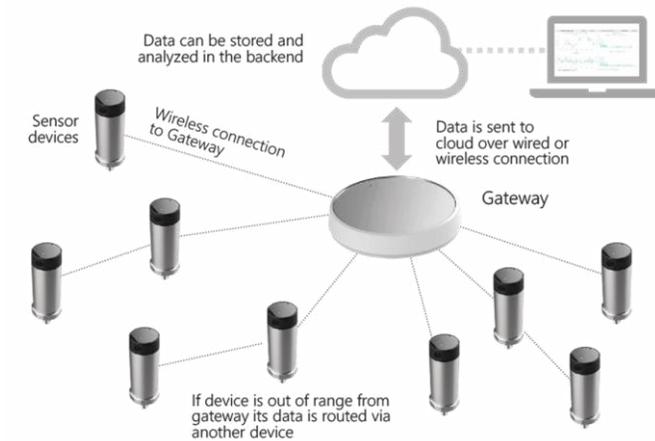
Level 2, 3, 4 ISO Certified
50k Assets Monitored
350k Annual Machine Tests



FLUKE

Reliability

Data Acquisition Hardware



Portable, Manual Acquisition TRIO – DP-2

- 4 simultaneous channels
- Largest asset coverage**
- All accessible, industrial, rotating assets

Tech Specs:

- 40kHz Fmax
- 102.4kHz sample rate
- 100g (w/ 100mV/g sensor)
- 25,600 lines of resolution

Permanent, Auto Acquisition Online i800

- 8 dynamic + 8 process
- Most versatile online system**
- Inaccessible, critical assets
- Compressors, gearboxes

Tech Specs:

- 40kHz Fmax
- 102.4kHz sample rate
- 100g (w/ 100mV/g sensor)
- 25,600 lines of resolution
- Wireless or wired
- Battery or line-powered

Permanent, Auto Acquisition Online i110 / i120

- 16 multiplexed or 8+8 simultaneous channels
- Monitoring down to 5 RPM**
- Paper & metals machinery
- Slow speed gearboxes

Tech Specs:

- 40kHz Fmax
- 102.4kHz sample rate
- 100g (w/ 100mV/g sensor)
- 51,200 lines of resolution
- >14M sample buffer
- Wireless or wired

Permanent, Fully Wireless Wireless Accel™ 310

- Hi-res, triaxial + temp
- Most connected program**
- Most common, industrial rotating assets
- Continuous running assets

Tech Specs:

- 6.3kHz - 10kHz Fmax
- 26.7kHz sample rate
- +/-16g input range
- 1,600 lines of resolution
- 3-year battery, fixed
- Mesh + gateway

Watchman AIR™ - Wireless Vibration Diagnostics

Why ours:

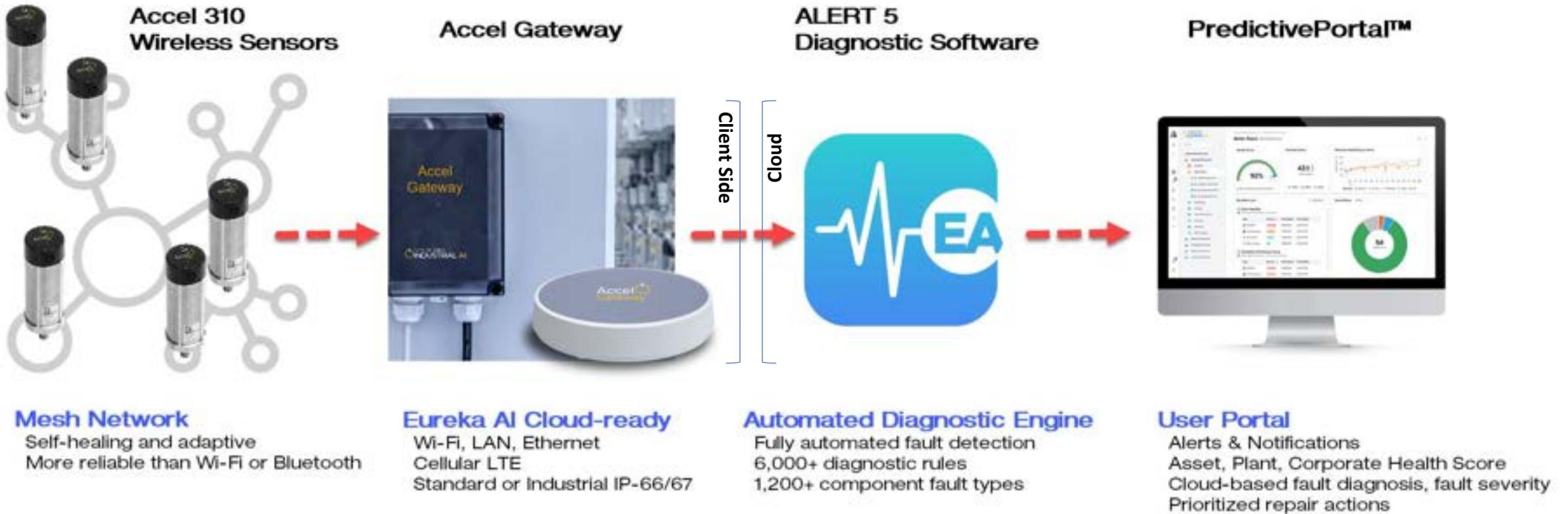
- Actionable Results, not just Alarms or Hand-raiser
 - Daily diagnostic fault analysis with prioritized, actionable results
- Automated Learning Mode
 - Avoid hassle of setting thresholds for all hourly data values
- Is-running Triggers
 - Collects data when machine is in a running state
- Impact Demod
 - Proprietary feature for early bearing fault detection
- Volume Management
 - Persistence Logic, Analyst Workflows
- Low-cost Analysis Services
 - Very cost-effective full solution
- 3-year Battery Guarantee
 - Sealed battery improves performance



Wireless System Components



Watchman AIR™



Wirepas® Mesh

WiFi, LAN Cellular

Watchman Online – i110 Data Acquisition Hardware

- Higher Channel Utilization than i120
 - 16 multi-plexed channels vs 8 simultaneous vibr. + 8 process channels
- Targets:
 - Compressors
 - Slow-speed machines
 - Critical assets

What?

- Multi-channel advanced vibration acquisition device for critical & slow-speed assets down to 5 RPM

Why?

- Provides permanent application where wireless is insufficient



Online System Components

Watchman Online System

Online Acquisition Devices



Dynamic & Process Channels

Multi-channel input
Up to 102.4kHz sample rate @ 24-bit
LAN & WiFi Communication

ALERT Online Engine



Device Management

Localized data capture engine
Maps assets and sensors
Configure test intervals, priorities

ExpertALERT™



Automated Diagnostic Engine

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

PredictivePortal™



User Portal

Automated Alerts & Notifications
Asset, Plant, Corporate Health Score
Assignable alert tracking

Client Side with Services

Cloud With Services

Client Side Without Services

HTTPS Message Queuing

TRIO (v.5) – Portable Data Collection Hardware

Why ours:

- Simple user interface intended for operators and technicians
- Route-based thru advanced troubleshooting
- Focused interface on What's Expected
- Communication between field and remote analysts
- 8" and 10", Normal-use and HAZLOC-use options
- Automated Data Quality Checks
- Automated software updating
- Modular design, lower overall costs
- Microsoft Windows OS



TRIO System Components

Watchman TRIO System

TRIO®

Database Sync

ExpertALERT™

Watchman Reliability Portal™



Desktop or Embedded



Client Side Without Services
Cloud W or W/O Services



Portable Data Collection

4-channel + tach inputs
Up to 102.4kHz sample rate
Route + Advanced Data Acquisition

Communication Layer

Local database management
Route/Survey File Exchange
Cloud-hosted Synchronization

Automated Diagnostic Engine

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

User Portal

Automated Alerts & Notifications
Asset, Plant, Corporate Metrics
Fault event Tracking

Automated Diagnostic Deployment Options

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



Fully Automated, Prioritized, Actionable Diagnostic Results, Fully Trained Baseline, Fully Tagged Fault Coding, Persistence Logic, Confidence Score, plus optional Watchman Services & Delivery Portal

Best

Cloud

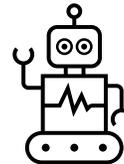
On-Premises



Synthetic or Manually Trained Baseline, Manually Tagged Fault Coding, plus Data Visualization and Reporting PC Application, Optional EADS Automated, Prioritized Diagnostic Output

Better

EADS
Expert Automated Diagnostic System



Automated, Prioritized Diagnostic Output Payload, Synthetic Baseline Criteria, 6000 rules, 1200 faults, 50 component types

Good

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)**

Expert Automated Diagnostic System



- Trained Diagnostics
- 6000+ Diagnostic Rules
- 1200+ Fault Conditions
- 50+ Machine Components
- Normalized Data
- Statistical Averages
- Prioritized Actions
- Supports:
 - Volumetric Analysis
 - Asset Template Leverage
 - Business Level Metrics

Analyst Reviewed Results

Main Service Pump #1

MID: 6
Averages: 4
Date Acquired: 11/5/2015 3:36:59 PM (UTC)

Machine Speed: 1781 RPM
Rulebase: 20130322
Figure of merit: 201
Maximum Level: 111 (+14) VdB at 1.00xM on Motor Drive End Axial

RECOMMENDATIONS:
<2> IMPORTANT: INSPECT COUPLING AND CHECK SHAFT ALIGNMENT

DIAGNOSTICS:
<2> SERIOUS: **ANGULAR MISALIGNMENT**
111 (+14) VdB Motor Drive End Axial at 1.00xM
107 (+11) VdB Motor Drive End Tangential at 1.00xM
107 (+12) VdB Pump Drive End Axial at 1.00xM
105 (+12) VdB Pump Drive End Tangential at 1.00xM
103 (+11) VdB Pump Drive End Radial at 1.00xM
103 (+ 8) VdB Motor Drive End Radial at 1.00xM
96 (+ 8) VdB Pump Drive End Axial at 2.00xM

DISCUSSION BY ANALYST:
The vibration has increased over the previous tests.

Analyzed by: Jeremy Smith 11/5/2015 10:27:49 PM (UTC)

Repair Priority

Repair Recommendation

Fault Severity

Fault Diagnostic

Cited Peaks

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



Analyst Comments

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



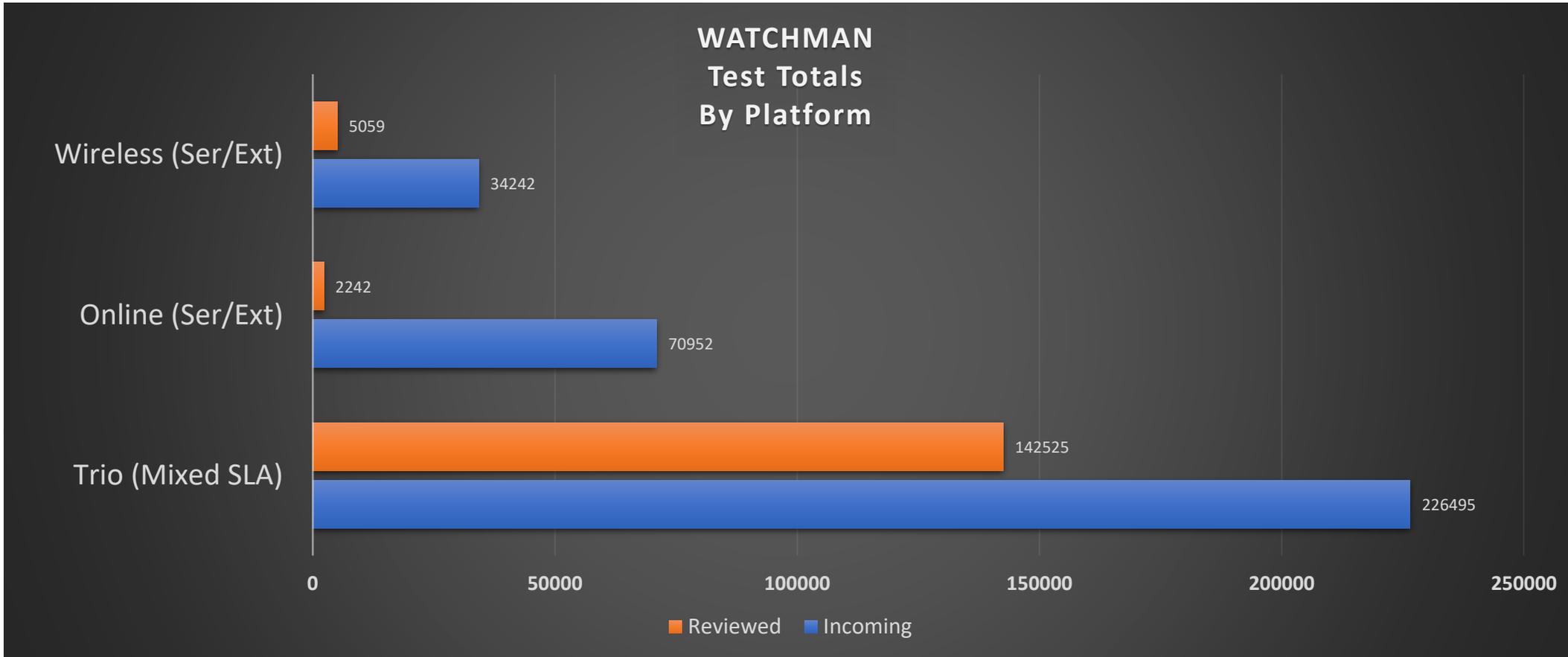
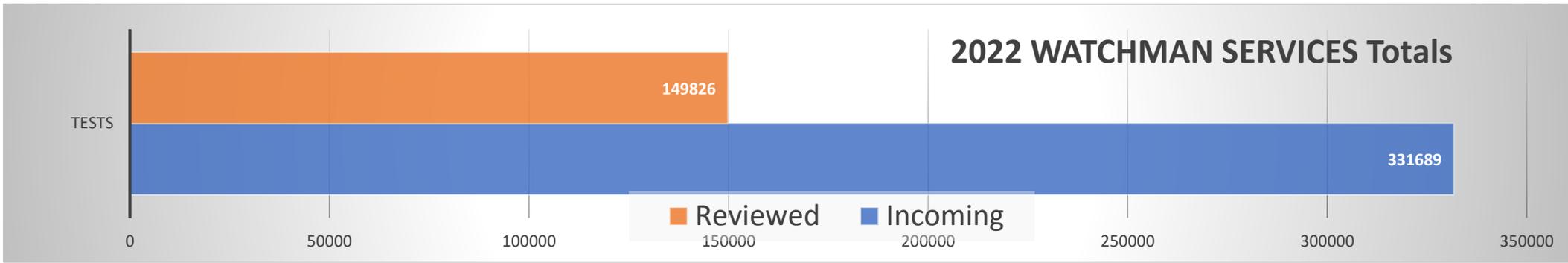
Cited Peaks

Click [here](#) to view cited peaks



Analyst

Manjunath



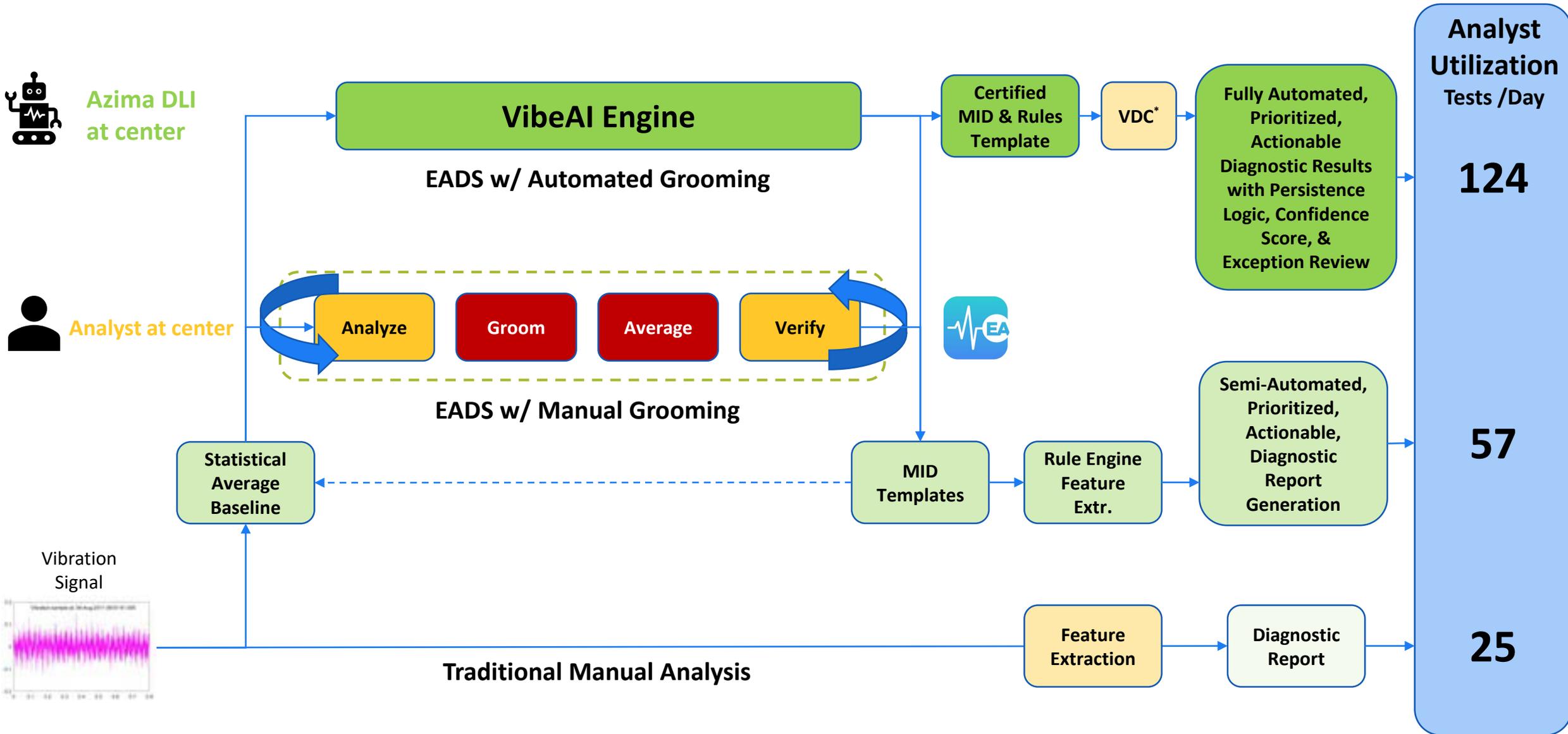
Diagnostic Intelligence – Watchman Services Capabilities

Why ours:

- ~30 seasoned & certified analysts available
 - Full – Priority Exceptions – Second Opinion – Setup & Coaching
 - 500+ years combined vibration analysis experience
- VibeAI Applications & Completion Scoring
 - Understanding gaps in template setups preventing fully automated diagnostics
- Diagnostic Confidence Level
 - Level of trust in repair action recommendations
 - Feedback loop, KPIs, Metrics
- Analyst Efficiency
 - ~350k machine test / year on platform
 - ~1500 machine tests / analyst / month (avg)
 - ~86% machines tests automated / month
 - Volumetric analysis & automation essential for wireless & online systems
 - Fault Code Finder, Automated Average Baselining
- High Diagnostic Accuracy
 - <4% false positive rate
- Program Management & Reporting
 - Bad Actors, Key Saves, ROI, Program Recommendations



Watchman Service Advantage



Analysis - Automated Diagnostics

Setup / Input

Asset Details

Install Sensors

Grooming / Learning



Diagnostics / Output

Automated Review & Workflow

Analyst Assignment per SLA

Prioritized Actions & Alerting

Asset Configuration for Expert Automation

- 6000+ Trained Diagnostic Rules
- 1200+ Fault Conditions
- Automated Baseline Averaging
- Automated Fault Code Finder
- Result Confidence Scoring
- Result Persistence Logic

Workflow Automation for Volumetric Analysis

Watchman 360™ System

Remote Setup App



Expert Automated Diagnostic System



Vibration AI

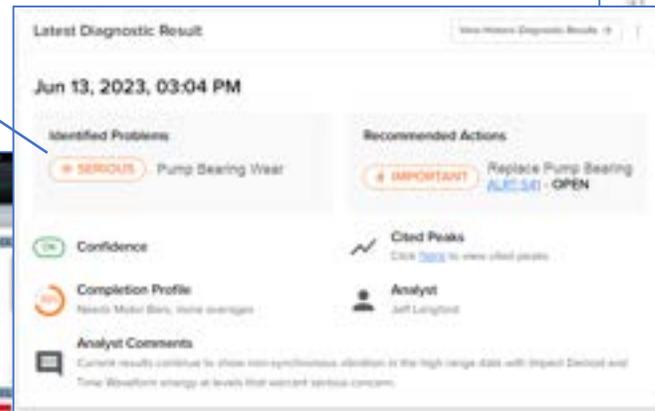
6000+ Trained Diagnostic Rules
1200+ Identifiable Fault Conditions
50+ Asset Component Library



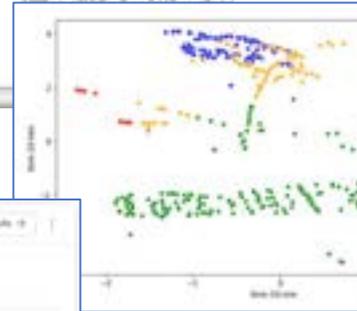
Vibration Data Sources



Program Management



Watchman Portal™



Watchman Services

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
350k Annual Machine Tests





FLUKE®

Reliability

QUESTIONS ?

THANK YOU!
