

PREDICTIVE RELIABILITY FOR INDUSTRIALS

A man with a beard and glasses, wearing a white hard hat and a high-visibility yellow and blue jacket, is seated at a desk in an industrial setting. He is looking at two large computer monitors. The left monitor displays a software interface with various charts and graphs, including a line graph and a bar chart. The right monitor shows a similar interface with more data and charts. The background is a blurred industrial environment with lights and machinery.

Andrew Angkawijaya
Solution Consultant
Honeywell Connected Industrial

Singapore plant reality: reliability is now strategic

Jurong Island is a mature, high-value industrial ecosystem where reliability, safety, and competitiveness intersect.

100+

leading companies on
Jurong Island

Top 9

global hub by chemical
export volume

27k

people employed in E&C
sector

~20%

of Singapore manufacturing
output in 2020

Ageing asset base

Many process plants are beyond original design assumptions. Time-based maintenance alone cannot handle changing condition and degradation mechanisms.

Workforce transition

Retirements and contractor dependence create knowledge loss. Digital capture of events, cases, and RCA becomes a reliability control.

Tighter scrutiny

Process safety, hazardous substances control, and MHI expectations make reliable evidence and traceability more important.

Ageing is not just age. It is condition changing over time.

The risk is accumulated damage plus incomplete visibility.

Corrosion, erosion, fatigue, embrittlement, fouling,
mechanical looseness

Obsolete instruments and control interfaces

Incomplete drawings, history, or maintenance records

Increasing deviations from original design envelope

Higher reliance on a few experienced SMEs



**Predictive operations do not replace inspection and engineering judgment.
They help focus finite attention on the highest-risk exceptions earlier.**

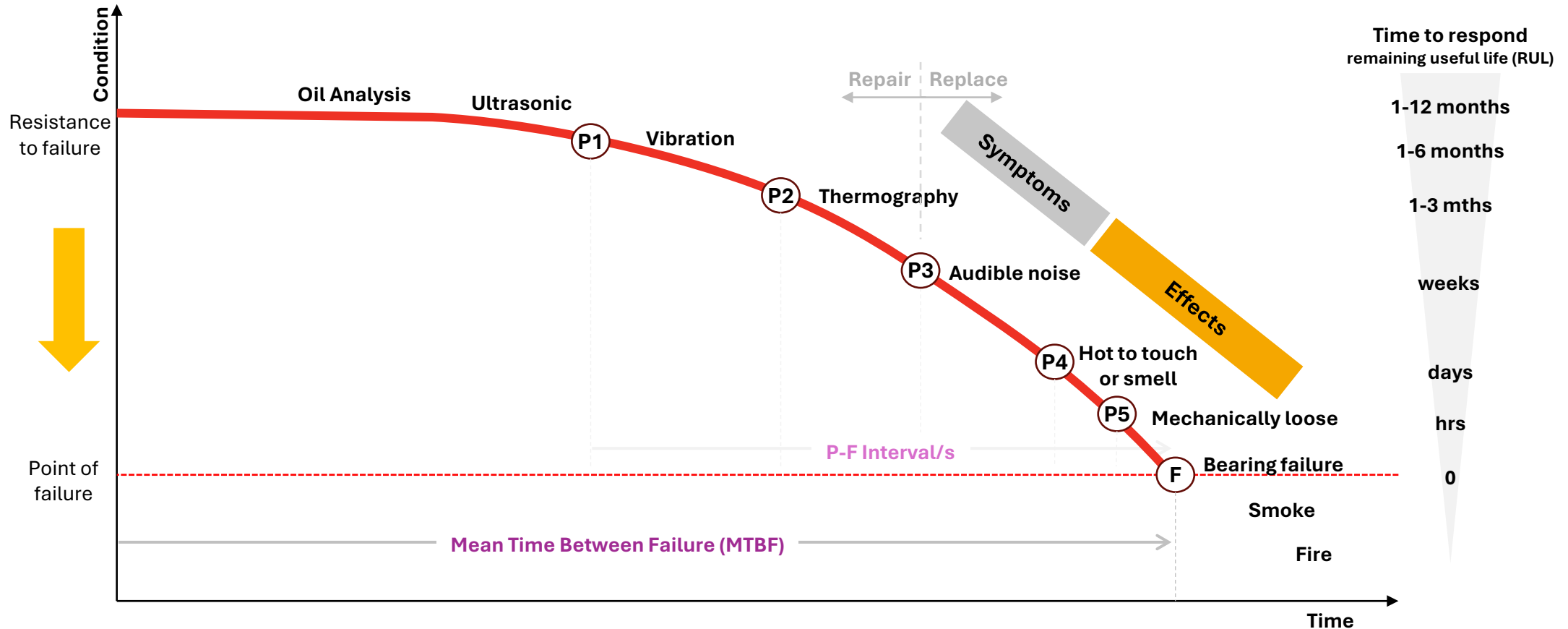
The shift: from run-to-fail to predictive operations

Predictive maintenance is a stage in a broader operating model, not a dashboard alone.



A practical target: maintenance is triggered by asset condition, risk, and operating context, then closed through work execution.

The value is created in the P-F interval



PERSISTENT CHALLENGES

1. Fragmented data: siloed systems, lack of integrated insights
2. Limited coverage: often critical assets only are monitored continuously/comprehensively
3. Heavy SME Reliance: Diagnostic tools require expert analysis prone to delays, inconsistencies, or errors

ROOT CAUSES

72%
PROCESS & OPERATIONAL
FACTORS

12%
MAINTENANCE
FACTORS

16%
AGE OR
ENVIRONMENTAL

Operational upsets are silent killers

WHY?

	Not all changes are noticeable as immediate vibration or performance issues
	Repeated or severe upsets cause mechanical stress leading to fatigue and distortion
	Overtime they can lead to hidden failures

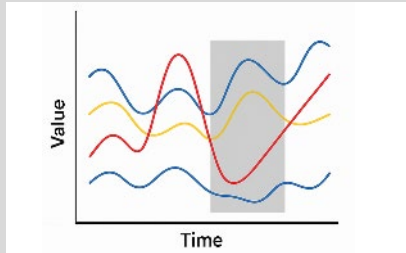
HOW?

	Thermal Shock & Stress
	Load Swings & Pressure Surges
	Process Excursions
	Flow Instability & Off-Design Operations

YET PROCESS DATA IS OFTEN NOT INTEGRATED INTO ASSET MONITORING

Digitisation of asset reliability: integrate what already exists

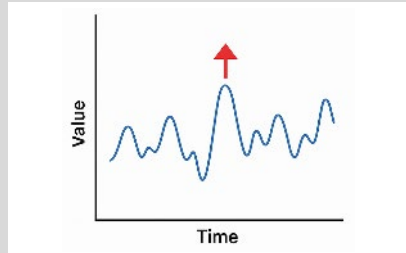
3



PATTERN RECOGNITION

AI/ML model, Vibration analytics combined with first principles to learn normal behavior and detect anomalies

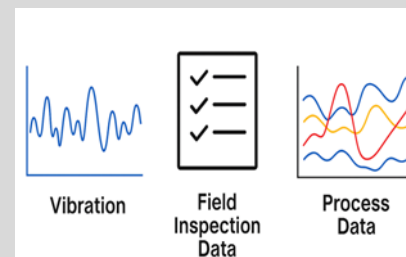
2



TREND / STREAM ANALYTICS

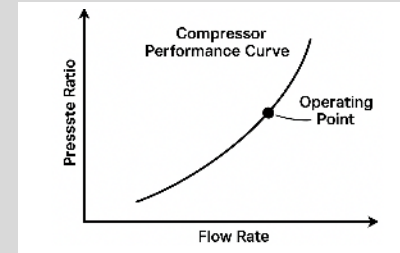
Uni-variate real-time analytics for all key variables in site using online statistics and features

1



MULTIPLE DATA SOURCE INTEGRATION

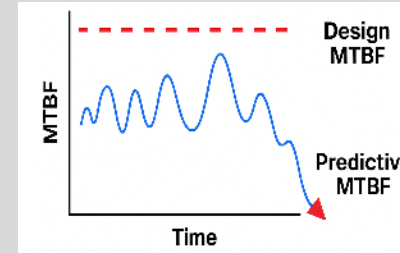
Integrating available data sources to accelerate ROI



PROACTIVE PERFORMANCE ANALYTICS

Physics based equipment fundamentals compared against OEM specifications for varying conditions

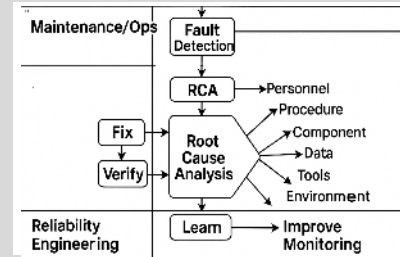
4



PREDICTIVE VS DESIGN MTBF

Predict MTBF based on historical and current varying condition of asset and assess failure risk

5



ACTIONABLE INSIGHTS AND KNOWLEDGE CAPTURE

Detect and prioritize exceptions, conduct RCA on failure to reassess strategy, historize events, and update models

6

SCALE THROUGH AUTOMATION, REAL TIME RISK ASSESSMENT & AI ASSISTANT

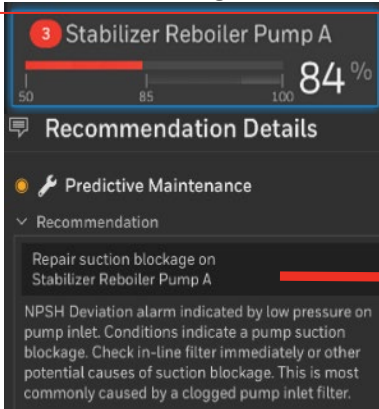
Close the loop: alert to case to work order to learning

Reliability

PREDICTIVE MONITORING

- Unified sensory data
- Real-time-continuous
- Performance digital twins
- Embedded OEM models
- Embedded client models
- Machine learning analytics
- Data science (Python, etc)

Case Management



PdM alert, root cause analytics and maintenance work order request to CMMS



**Notification
W/O Request**

CMMS interface

CMMS

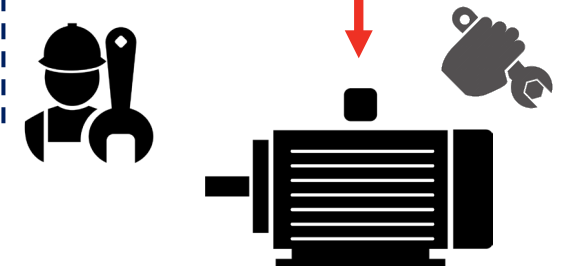
- Asset identifier linked to apm naming
- Asset Component Hierarchy
- Service Parts & SCM Details
- Estimated Work Hours
- Scheduling
- Associated activity costs
- Reporting metrics of all PM activity

PLANNERS

WORK ORDER GENERATION

MRP, REQUISITIONS, SCM

RELIABILITY & MAINT. TEAM



Field Rounds Data
(Non-Instrumented data)

Field Inspections

- Operator Rounds
- Maintenance Inspections
- Field Data Collection
- Reporting



Mobile



Field Tasks

Field Observations triggering Work order request to CMMS

Field Inspection

RECYCLE GAS COMPRESSOR TRIP avoidance

PROCESS UNIT

- HYDROTREATING UNIT

SOLUTION

A hybrid analytics-driven approach was deployed:

- Streaming Analytics – Process & condition
- Performance comparison with OEM curves at operating inlet conditions
- Predictive Analytics to generate early alert
- Prescriptive & fleet wide risk analysis integrating with asset strategy in real time

ACTION

- Increase water wash in opportunity window and consequently vibrations normalized

IMPACT

- Prevented Downtime Hours (20hrs) & Production loss (~\$2M)
- Maintenance Cost Savings (\$72k)
- Extended Asset/Component life

PROCESS IMPROVEMENT

- Established Proactive and Predictive maintenance practices through hybrid model & semi automated workflow

Performance Degradation Alert

22-Nov-2022 11:00 hrs

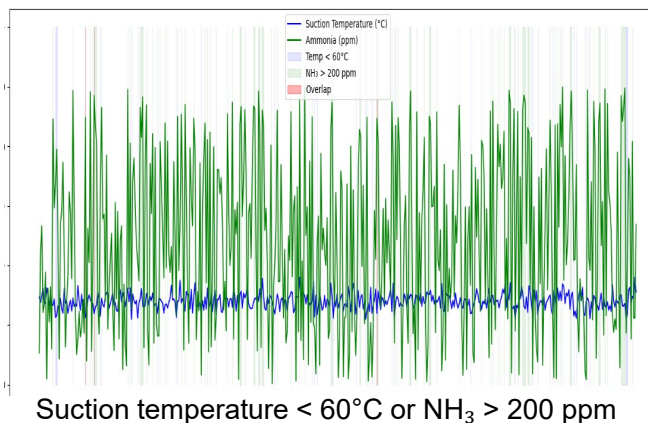
Rotor Anomaly Early Alert

24-Nov-22 17:40 hrs

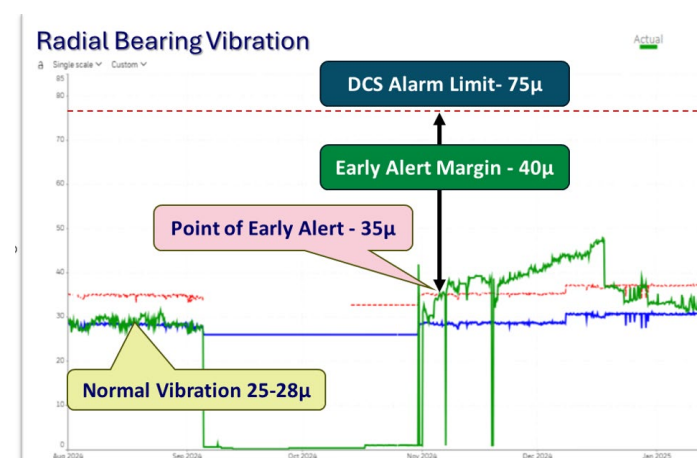
Rotor Anomaly Early Alert

25-Nov-22 09:30 hrs

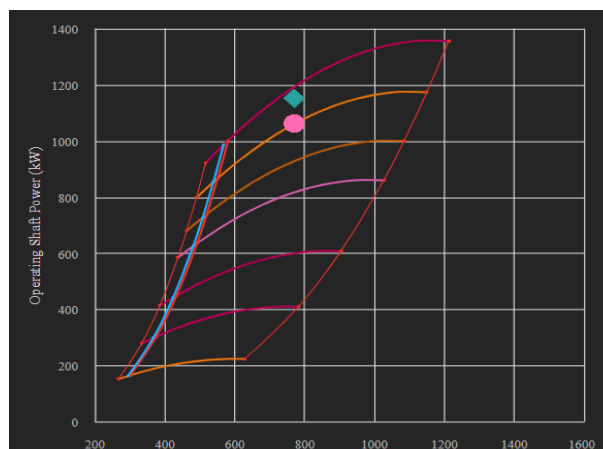
STREAMING ANALYTICS & DIAGNOSTIC EVENT



PREDICTIVE ANALYTICS & PREDICTIVE EVENT



PERFORMANCE ANALYTICS & PROACTIVE EVENT



PRESCRIPTIVE ANALYTICS & RECOMENDATIONS

FAULT

Rotor Anomaly Due to Fouling

(A) AND (B OR C OR D OR E) AND NOT (LO Temp rH AND LO Press rL)

SYMPTOM

A – Polytropic Efficiency Residual from prediction is high(H)

B - DE Radial vibration overall (X/Y) (residual H)

C - DE Casing Vibration (H) (rH)

D – 1X amp (X/Y) (rH)

E – BPF Amp (rH)

High-value use cases for brownfield chemical plants

Pick use cases where failure impact, signal availability, and actionability overlap.

Rotating equipment

Pumps, compressors, fans, gearboxes: vibration, energy, temperature, process load.

Heat transfer assets

Heat exchangers, furnaces, boilers: fouling, duty loss, efficiency deviation, tube risk.

Pressure systems

Vessels and piping: corrosion, wall thickness trends, pressure/temperature excursions.

Control valves

Stiction, hysteresis, poor control, compressed air issues, travel anomalies.

Utilities

Steam, cooling water, power, compressed air: island operations and energy cost optimization.

Process safety layers

Alarms, trips, safety-critical equipment: degraded demand readiness and failed-state exposure.

Selection filter: criticality × data availability × intervention feasibility × sponsor ownership

Thank You
