PROMETHEUS GROUP USER CONFERENCE

Managing the Chaos: **Prometheus APM** Nick Walker **IT Product Owner** Flint Hills Resources, LC April 18, 2023



Agenda

- Who is Flint Hills Resources?
- Transformation Journey with Prometheus APM
- Use Cases
- IT Perspective
- Looking Ahead
- Q&A







Who is Flint Hills Resources?



Flint Hills Resources



- Flint Hills Resources is a leading refining company
 - Operations primarily in the Midwest and Texas
- Based in Wichita, KS
 - Subsidiary of Koch Industries
- We produce fuels and aromatics
 - Gasoline, Jet Fuel, and Diesel
 - Chemical Intermediates
 - Asphalt, Base Oils, Liquid Fertilizer
- Key facts
 - ~3,000 employees
 - 3 refineries in MN and TX
 - 700,000 bbl/day refining capacity
 - 4,000 miles of pipeline



Monitoring POV

- Transformation is necessary
- Data must be continuously collected
- Good models + good data = detect defects + predict failures earlier & more effectively
- Goal: extend the P-F interval





Analytics & Monitoring Partners





AMP is a trusted business partner that improves utilization, yields and costs by providing:



Earlier detection of operating issues and opportunities



Automated data analysis



Clear communication of actionable information



Collaborative problem solving across disciplines and sites

7

Analytics & Monitoring Partners

- 2 monitoring centers, 1 team
 - Monitoring Analysts
 - Process Engineers
 - Mechanical Engineers
 - Operations
 - Modeling/Analytics Engineers
 - Process Engineers
 - Data Engineers
 - Ownership by technology vs location





Automated Anomaly Detection



Immediate response – Process Control capability Automated response – SIS, State Based Control, etc. Alarm - On-shift response required – Control system notification Modeling and anomaly screening – Monitoring capability Alert - Automated anomaly detection (AAD)



Our Transformation Journey



How did we get here?



Timeline

• 2017

• Process Data focus: contextualization, models

• 2018

- AMP Vision creation and alignment
- 2019
 - ASSET360 pilot + 3rd party services (other Koch customers: KAES & GP)
- 2020-2022
 - 13,500 models for 6 business lines
 - Reduced 3rd party dependency for config
 - Tag Backfill capability via API
- Today
 - 15,000 models for 3 business lines

Manage The Chaos via the Funnel

- Sensor Deployment
 - ~100K-200K measured data points
- Model Prediction
 - ~15,000 models
- Alert Screening & Diagnosis
 - ~1,200 active alerts
 - ~700 alerts not in Watch/Ignore state
- Issue Escalation
 - ~10-20 escalations/week



Model Deployment

<u>How</u>

- Cover as much of the process and equipment as possible
- What model types to use?
 - APR
 - Fixed Limit
 - Forecast
 - Moving/Rolling Average
 - Rate of Change
 - External

<u>Who</u>

- Asset Experts
- Monitoring Analyst/Engineer
- 3rd party service provider
- Data scientists



Why Prometheus APM? (Part 1)

- Alerts user interface is built for Screening
 - Save time & effort with Filter, Watch, and Views
 - Saved Trends Prebuilt and Custom
 - Add Notes to an Alarm or Model
 - Quickly move to Op Mode / Model Configuration / Issues Management
- Advanced modeling techniques
 - APR takes more work, but worth the effort
 - Fixed Limit easy to use
 - Forecast very useful but Context view is necessary vs the Trend view
 - Multivariate & Univariate

Alerts Display



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Why Prometheus APM? (Part 2)



- Self-service configuration
 - Assets & Tags "Greatest Addition Ever!"
 - Models Build, Train, Re-train
- Issues management
 - Initial great tool to communicate with other 3rd party monitoring services
 - Current not using in favor of CMMS
 - Future possible integration with CMMS

Model Configuration





Issue Management



Resolution Status			Pr	ionity								
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Use Cases



Example – Flow Control Valve





Actual vs. Expected Control Valve Flow Model Why is the deviation occurring?

- Pump switch with unequal pump performance?
- Physical hydraulic change (valve/piping/filter/nozzle)?
- Change in fluid flows (more/less flow somewhere else, impacting pump pressure)?
- Change in process conditions (temperature, composition, etc.)?
- Something else?

Steam Pump OB Bearing Temp



- Detect
 - Prometheus APM alert
- Diagnose
 - Bearing skin temp elevated after restart
- Resolve
 - Maintenance resource found cooling water blocked in at header and corrected the problem
- Model Trend Model History Model Context | Pump-OB Bearing Temperature | | Deg F 200 150 ш Брадор 100 50 14. Dec 28. Dec 11. Jan 25. Jan 8. Feb Expected Event

Outcome

Main Air Blower Discharge Flow



Detect

- Prometheus APM alert
- Diagnose
 - Rain event caused wet caked dust/dirt to decrease airflow
- Resolve
 - Daylight board operator worked with Operations to walnut hull the blower
- Outcome



Furnace Draft Fan IB Bearing Temp

Detect

- Prometheus APM alert
- Diagnose
 - IB bearing temp 20-30°F higher
 - Initially not deemed an issue
 - Later found cooling water lines to the bearing housing plugged with black sludge
- Resolve
 - Maintenance opened the lines and cleared them
- Outcome



Pump Degraded Performance



- Detect
 - Prometheus APM alert
- Diagnose
 - Water Pump discharge pressure was drifting down
 - Initial contact with Operations
 - Escalation to Business Team; Operations found the suction screen was plugged with grass and weeds
- Resolve
 - Operations cleaned the screen
- Outcome



Desalter Power Grid



- Detect
 - Prometheus APM alert
- Diagnose
 - Power blip knocked out Desalter Grid
- Resolve
 - Electric team restored power
- Outcome





Modern Technology



IT/Technology Perspective

- Preferred Deployment Model
 - SaaS / Cloud
 - Multi-Tenant
 - Single Sign-On, Role-Based Access
- Lightweight Integration
 - MDTransfer connects your process data
 - APIs for reporting and tag backfill
- Responsive Support
 - Support Portal
 - Knowledge Base



series data. Retrieval of model results is

not supported in this API.



Looking Ahead



Next Steps

- Univariate Models
- Dashboards
- Issues Management
 - Automated Issue creation
 - Send Issue to CMMS
 - Send CMMS status back to Issue





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-0	Losses Steam Turbina Canarator	1027916	CCCW pump discharge seems more restricted since Oct 2	\$1,536,000.00	Resolved	Medium	Plant Operations	Cooling Capacity	08/20/2018	LauthJG@bv.com	Y
65	Transformer	1028573	Diverging SSH inlet temperatures Unbalanced SH spray fl	\$1,461,600.00	Resolved	Medium	Plant Operations	Boiler Cleanliness Decre	10/08/2018	LauthJG@bv.com	B
20	Natural Gas Plants	1029784	BFPT Lube Oil Tank Level Increasing	\$1,218,000.00	Resolved	High	Plant Operations	Lube Oil Tank Level Incre	12/26/2018	AtteberyAR@atonix.con	
	 Industrial Plants 	1035226	Sulfur Rich Gas- Main Gas Blower Demand	\$300,000.00	Work Defin_	High	Plant Operations		08/24/2021	AtteberyAR@atonix.con	
	Fertilizer Plant Pulo & Paper Company	1028666	PA Fan Vibrations High	\$268,750.00	Diagnosing	High	Outage Maintenance	Generic M&D	10/15/2018	Test@Kevin.com	
	✓ Pulp & Paper Facility	1029844	HP Turbine Hot Drains	\$232,746.30	Resolved	Medium	Plant Operations	Drains Valves Leaking	01/02/2019	AtteberyAR@atonix.con	
	Paper Machine	1026528	Condenser Performance	\$184,550.00	Resolved	High	Plant Operations	Condenser Air In-leakag	04/30/2018	LauthJG@bv.com	
	Power	1027651	MBFP A Suction Strainer	\$170,520.00	Resolved	Medium	Outage Maintenance	Suction Strainer DP Cha	07/30/2018	LauthJG@bw.com	
	Mine Sites	1023547	Cooling Tower Fan Motor and Gearbox Vibration Elevated	\$158,752.00	Site Review	High	Outage Maintenance	Fan Bearing Type Increa	05/03/2017	LauthJG@bv.com	
		1029845	ID Fan 1 Motor Winding Temperatures Increasing	\$116,505.00	Resolved	High	Plant Operations	Fan Motor Temp Increas	01/02/2019	AtteberyAR@atonix.con	
		1025463	CT Fan 205 Vibration Steady Increase	\$113,146.07	Resolved	Medium	Plant Operations	Motor Bearing Vibration	01/08/2018	LauthJG@bv.com	
	Feed Gas Desulfurization S Drimony Deformer System	1025535	HP FWH 1 Normal Drain 100% Open	\$108,306.56	Resolved	Medium	Plant Operations	Feedwater Heater Level	01/15/2018	LauthJG@bv.com	
~	Secondary Reformer System	1029683	CRH DSH Spray Flow Leak-By with BFP Block Valves Closed	\$103,150.00	Resolved	High	Plant Operations	Spray Valve Demand Incr	12/17/2018	LauthJG@bv.com	
CO	High Temp Shift Converter:	1029256	FWH 7 TTD Performance Issue	\$98,112.00	Resolved	Medium	Plant Operations	Feedwater Heater TTD D	11/19/2018	LauthJG@bv.com	
4	Low Temp Shift Converter 5	1030165	Power Turbine Generator Winding Temp E Elevated	\$85,000.00	Diagnosing		Plant Operations	Winding Temperature In_	01/25/2019	AtteberyAR@atonix.con	
	CO2 Removal System	1027918	4A CT Pump Motor Outboard Brg Temp High	\$75,272.11	Resolved	Medium	Plant Operations	Motor Bearing Temperat	08/20/2018	LauthJG@bv.com	
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Thank you





Questions?

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