It’s RAD: Operating by priority using anomaly detection

Leveraging the AVEVA PI System for rapid anomaly detection (RAD) in a hybrid cloud architecture

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Agenda

• Ovintiv Overview
• Ovintiv PI System Overview
• Initial Challenge
• Evolution of Rapid Anomaly Detection
• Rapid Anomaly Detection in Depth
• Cost Savings
• Lessons Learned
• Future Plans
• Q&A
Ovintiv Overview

High quality balance multi-production and basin portfolio

- 573 production (MBOE/d)
- 5211 Total Net Productive Wells
- 48% Gas, 52% Liquids
- E&P Focused
- ~1700 employees across multiple geographic locations
Ovintiv PI System Journey

From a “historian” to an OT integration, applications and streaming analytics infrastructure

- 1997 initial PI System install
- 600,000 PI tag system
- 50 interfaces
- 200+ automated scheduled reports
- 100 PI AF templates
- ~50,000 elements
- ~1,000,000 PI AF analyses/streaming calculations and analytics
- High availability, PI Data Archive collective
Enabling business value and a data centric decision-making culture

PI System Tag Growth Since 2014
Each has its own strengths and weaknesses

Together they make up a near perfect solution

Work as a cross functional team on how to deliver your data product

Analytics implemented in “layers” with the PI System/PI AF being foundational
Rapid Anomaly Detection (RAD)
Initial Challenge

- Identify leaking tanks as quickly as possible to reduce spill volumes

Challenge

- Tank leaks are difficult to detect and can go unnoticed until a site visit by operations.
- Faster identification of possible leaks will reduce the volume of a spill.

Idea

Using PI AF Analytics, develop an algorithm to monitor the tank level and slow rate of decline outside the normal of a pump rate or truck haul to have suspected leaks identified quickly and use PI Notifications to alert operations of a potential leak.
Tank Leak Early Identification

Solution

- Tanks were modeled in PI AF as an element template
- Algorithm required multiple iterations to become effective – leveraged powerful backfilling capabilities
- New template analysis to create event frames when a possible leak would occur
- Emails were sent using PI Notifications to USA Integrated Operations Center (IOC) identifying possible leaks
- IOC would review the data and notify operations to investigate
- Previous tank leaks were used to create and test algorithm
Tank Level Anomaly

Results

- Tank leaks were identified, and the IOC would notify operations
- Working to reduce false positivity rates as much as possible
- After a few weeks, the algorithm would not only identify tank leaks, but other process anomalies (plugged strainers, underpowered LACTs, leaking check valves, plugged filters, calibration issues, degraded pumps, etc.)
- Realization looking for tank leaks lead to early detection of process anomalies
- Questions started about ‘What other anomalies can we identify before issues occur?’
Rapid Anomaly Detection Begins with Collaboration Ideation

- Multiple team collaboration to create process anomaly ideas and algorithms
- Anomalies would be identified for users, instead of users manually looking for them
- Multiple systems could generate anomalies
- Results to be displayed in a dashboard
- Trending data
- Have people, process and technology in place to rapidly develop anomaly algorithms
- Hybrid technology and "layers of analytics" approach using
  - Collaboration platforms (SharePoint)
  - ETL tools (Azure Data Factory)
  - AVEVA PI System
  - Data engineering (Databricks)
  - Cloud Databases (SQL Server, Synapse)
  - BI / dashboard tools (Power BI)
Team Collaboration

Optimization
Machine Learning
Automation and Measurement
Data Engineering

Integrated Operations Center
Production Operations Digital Data
Operations Data Projects
Operations Control Center
Information Technology
Production Engineering
Field Operations
SCADA

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RAD Data and Process Flow
### Defining an Anomaly

#### Tank Level Anomaly
- **Anomaly Code**: USARAD010
- **Algorithm**
  - Exclude truck handed sites for Arabia
  - 2 consecutive SCADA polls in 3 hours
  - Negative slope in the last two hours
  - Tank level declining (less than 1 inch per hour)
- **WIN Criteria**
  - Operator finds leak on tank or auxiliary equipment tied to the tank in question
  - Operator finds leak

#### Net Gas Volume Declining
- **Anomaly Code**: USARAD009
- **Algorithm**
  - 7 day gross sales gas - 7 day gross injection
  - 7 day net gas
  - Yesterday’s sales gas - yesterday’s injection

#### ESD Valve Event
- **Anomaly Code**: USARAD008
- **Algorithm**
  - ESD valve open, gas rate still > 0
  - Anomaly not created if well is down in P&I

#### Choked Back
- **Anomaly Code**: USARAD007
- **Algorithm**
  - tubing pressure (3 hour avg) > (choked flowline) pressure (2 hour avg) > 10 psi

#### VRU Runtime Declining
- **Anomaly Code**: USARAD006
- **Algorithm**
  - VRU runtime decline in the last 24 hours compared to the previous 72 hours by 20%
### COA Rapid Anomaly Detection Dashboard

**ANOMALY**

<table>
<thead>
<tr>
<th>Anomaly Type</th>
<th>Operating Area</th>
<th>Operator Run</th>
<th>Severity</th>
<th>Asset Priority</th>
<th>Status</th>
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<tr>
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<td>Pipestone</td>
<td>PP 06-06</td>
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<td>Dawson North</td>
<td>TOW 02-12</td>
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**LOCATION**

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<tr>
<th>Location</th>
<th>Start Time</th>
<th>CYGNEX FAC</th>
<th>Priority</th>
<th>Severity</th>
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**ANOMALIES:** 44,079
Separator Health

Problem

• Anomaly targets upsets in our separation equipment to help avoid allocation issues and the additional cost associated with removing incorrect liquid phase from our dedicated tanks

• Cost associated with incorrect allocation can be recaptured through allocation correction and sundry approval but requires dedicated time from production accounting and engineering
  o Most commodity cost lost to outside third-party disposal companies is not recovered

• Cost associated with potential skimming, chem treatment (demulsification agent) and truck hauling listed below and will be what wins are associated with

• Cost estimate to recover upset volumes varied from ~ $1.00-$2.00/bbl.

• Previous time estimates for upset to be noticed varied between ~6 hours-3 days

• Average time to notify and resolve issue will be calculated at 6 hours
Separator Health Analytics

Algorithm logic

- 12 hours compared to previous 48 hours
- Gas rate is steady (40%)
- 20% increase in oil with 20% decrease in water OR 20% increase in water with 20% decrease in oil
- Exclude test separators
- Gas flow rate must not be 0 for 95% of the polled values in the last 4 days
- No communication outages when using accumulators to calculate volumes/rate
- Sustained for more than 6 hours
- Running every 30 minutes on every separator asset
Anomaly List

180+ anomalies currently monitored in Canada and USA
Cost Savings

2023 YTD (end of September)

Canada & USA – millions

- Production increase
- Production loss avoided
- Gas lift saved
- People hours saved
- Reduced equipment failures and replacement
- Reduced spill volumes
- Static dollar value

Notes:
- Cost savings are estimated
- Challenges in estimating true costs
  - Anomalies might be caught manually processes in a slower amount of time
  - True impact may vary if left unaddressed
KPIs
RAD Lessons Learned

Learning from our experience

• Tuning and refinement is biggest key to developing a successful anomaly
  o Too many anomalies or false positives can lead to missing actual events

• Drive accountability to a small subset of individuals to take ownership of certain anomalies to see the tuning process all the way through

• Define metrics of what is acceptable for users for daily anomaly counts

• Implement a feedback loop to assist tuning of anomalies

• Strong collaboration with a cross-functional team

• Start small with a few anomalies to establish process and procedures
  o Too many anomalies at once can be overwhelming for end users

• Focus on the target user group requirements
Future Plans

The journey continues...

• Continual addition of new anomalies and refinement of current anomalies

• Tying in more data sources to create anomalies

• Phase out anomalies where operational effectiveness eliminated the original anomaly (ie. process improvements)

• Expand to different user groups
  o Production engineering for surveillance and workflow efficiency

• Anomaly suppression

• Further integration of machine learning anomalies
“Rapid Anomaly Detection has allowed Ovintiv’s operations teams to expedite our digital transformation.

Utilizing the AVEVA PI System, we leverage multivariable event confirmation in real time eliminating the need for our team to ‘hunt’ these opportunities. This in turn allows us to focus on the right opportunities as they emerge reducing overall negative operational impact which drives value directly to the bottom line!”

-Tanner Messer (former) Ovintiv Manager, Integrated Operations Center
Enabling Rapid Anomaly Detection with Layers of Analytics

Challenge
• Reactive to operational issues
• Significant lost opportunity costs
• Wasted time looking for information and trying to determine causality
• Challenges in establishing a collaborative environment

Solution
• Leveraged the PI System and PI AF to provide streaming anomaly detection
• Used a multi-technology approach across a hybrid cloud with “layers of analytics”
• Focused on developing a collaborative culture in defining anomalies and approaches
• Evolved and created a “learning” algorithm to refine RAD and minimize false detection
• Facilitated empowering and enabling the SMEs to continue to develop and evolve RAD

Benefits
• Moved from a reactive to a proactive, exception-based culture
• Increased the time to focus, identify and capture higher value opportunities
• YTD savings
  ○ millions in Canadian & USA operations
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State your name and company.

Please remember to...

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