Extending AVEVA™ PI System™ with cloud data integrations

Flint Hills Resources

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• Flint Hills Resources (FHR) Background
• FHR Data Pipeline Background
• Modern Cloud Data Integrations
• “Poseidon”
Flint Hills Resources (FHR) Background

A subsidiary of Koch Industries

- **FHR Background**
  - 2 refineries
  - ~4000 miles of pipeline
  - ~20 terminals
  - OSIsoft/AVEVA customer for 30+ years

- **AVEVA Solutions Deployed**
  - 11 AVEVA PI Server collectives (~7.43MM PI Points)
  - 11 AVEVA PI Server asset framework instances
  - 9 AVEVA PI Vision instances
  - 100+ PI Interfaces & Connectors
  - 3 AVEVA (Wonderware) Historians
  - AVEVA Enterprise SCADA (Oasys)
FHR Data Pipeline Background
What is FHR’s Data Pipeline

• Data Pipeline – collection of reliable and repeatable systems for data acquisition, contextualization, and storage

• Primarily focused on data "within the fence line"

• Many vendors adopting cloud first solutions, requiring "hair pinning" the data back to us

• Ingress opportunities can be a pull (interact with vendor endpoint) or a push (vendor send to our endpoint)

• Data egress opportunities mirror these strategies (e.g sending historian data to AI/ML)

• Publicly available data sources: weather, prices, USGS, utilities, etc.
How does FHR think of data ingress and egress?

• Functional requirements for data platform:
  o Contextualization
  o Be able to continue using AVEVA PI Server asset framework structures for analytics (avoid rework)
  o FHR naming standards
  o Scheduling
  o Authorization
  o Data monitoring and quality

• AVEVA products with similar or complementary functionality:
  o AVEVA Data Hub
  o AVEVA Adapters
  o AVEVA Open Message Framework (OMF), a PI Web API
  o PI (USL) Connectors & PI Interfaces

“Poseidon” is the tool that handles these constraints and uses the PI Web API to deliver data that flows through FHR’s Data Pipeline
Flint Hills Resources extends data pipeline by integrating cloud data into AVEVA™ PI System™

Challenge

• Integrate valuable cloud-based data sources into company’s existing data platform—bringing new information and insight to decision makers.

• Share data with authorized external partners, some of which don’t use AVEVA PI System.

• Minimize integration work & continue analytics based on asset framework data structure

Solution

• Use cloud-based data aggregator to feed new data sources into company’s existing AVEVA PI System, retaining contextualization and analytics based on PI Server AF data structures.

• Design reusable interfaces for future expansion of data sources.
Building FHR’s “Poseidon”
Role of Poseidon

A modern cloud data infrastructure

- Extension of our Data Pipeline for cloud-based data
- Utilizes PI Web API to interact with AVEVA PI System
- Modularly built for reusability and configurability
  - Code for ingress/egress is always going to be the same, just different settings (i.e. interpolated vs. recorded, etc.)
Architecture of Poseidon

Cost efficient infrastructure, easily expandable

- Built on AWS infrastructure:
  - API Gateway & CloudFront for API/front end
  - Lambda for backend
  - DynamoDB for backend database storage
  - Simple Queue Service (SQS) for queuing and retry logic
  - S3 bucket for data storage

- Egress – LMIs (Last mile integrations) for subscription flows (different modules)
- Ingress – FMIs (First mile integrations) for integration flows
- Ingress – Webhooks (HTTP endpoint) for event based integration flows
Data ingress/integrations

- Inverse of data subscriptions
- Run on schedule determined by business
- When off-the-shelf interface is not available, can write code to reach out to API endpoints and contextualize that data
- Reusable process pulls data into AVEVA PI Server
Integrations data flow
Data ingress/integration examples

- Weather data (publicly available)
- Weather data (on site weather transmitters)
- Energy pricing data (publicly available)
- Sample testing vendor
- Natural gas pricing data (publicly available)
- ...and more!
Event-based ingress/integrations (webhooks)

- Pushed instead of pulled
- Specific code to translate the webhook and contextualize that data
- Sends to reusable process to ingest into PI
- Event based

**Practical example: Valve position sensors**

- LoRaWAN sensors at plant that measure valve positions
- Data is sent to vendor’s cloud platform
- Can view data on their dashboards
- Need to get that data back, they POST to our API
Webhooks data flow
Data egress via subscriptions

• Create subscriptions to send PI data
  o Externally to vendors for advanced analytics
  o Internally to other FHR applications
• Specify target, AF path, frequency, and extraction type
• Optionally filter by categories/templates
  o Provides performance enhancements over PI Web APIs
• Validations occur to ensure path/categories/templates are all valid
Data egress/subscription examples

- FHR’s internal data lake
- FHR’s internal work order platform
- Email with .CSV attachment
- Environmental reporting vendor
- Coker drum analytics vendor
- Water quality analytics vendor
- Python calcs (more later!)
- ...and more!
Data subscription flow

- AWS Schedule runs every minute (special EOD logic) to determine which subscriptions need to run.
- Data is extracted (puller) and dropped into S3 bucket, the LMI handles the special logic for the specific endpoint.
Performing calculations outside asset framework

- LMIs don’t always have to be sending data externally.
- Some calculations go beyond what is possible with asset framework analytics.
- Python can do these calcs quite easily (i.e. array calcs, linear regressions, etc.).
- Business sponsors helped write python calcs.
- Poseidon handles these on a scheduled basis no different than built-in analyses.
Platform transparency strengthens security

- Surfaced logs to the front end to be better self serviced by business users and not always IT
Potential Poseidon enhancement

• Use AVEVA PI Vision to help admins migrate displays between environments:
  • When an environment doesn’t support scheduled syncs
  • When you need to restore displays from a SQL backup

• With AVEVA PI Vision 2022 release, we can automate:
  • Sync of displays between environments (changing AF servers / PI servers), with persistent folder structures
  • Back-up of displays on a regular cadence (daily)
  • Restoration of individual displays
Summary

• Data infrastructure must easily integrate multi-vendor data and deliver data to multiple endpoints (tools, analysis platforms and business applications) -- particularly those that are cloud-based. Examples below.

• With reusable processes, new integrations & endpoints can be stood up in hours instead of days.

• Data infrastructure must handle the required context, standards, and synch scheduling that business desires.
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• Design reusable interfaces for future expansion of data sources.

Results
• Support for these interfaces is way easier than one off scripts.
• All integrations in one place, making support easier.
• Leverageable platform for other Koch companies to use.
• New integrations use reusable code and can be created in hours instead of days.
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