Digital Transformation at Covestro

Utilizing PI to improve operations and increase OEE

Jane Arnold – Covestro

Andy Bane – Element

ELEMENT

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Speakers

- **Jane Arnold**
- EVP, Head of Process Control Technology
- Covestro
- Jane.Arnold@covestro.com

- **Andy Bane**
- CEO
- Element
- Andy@elementanalytics.com

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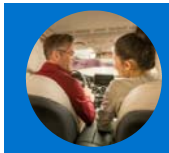
Covestro

World-leading chemical manufacturer of high-tech materials

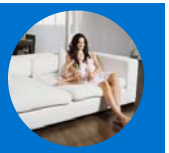
✓ 17.200 employees ✓ Total revenue of €12.4 bn ✓ 30 production sites worldwide

POLYURETHANES

€5.8bn | 47%

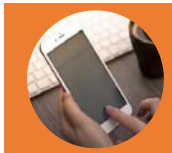

Your car seats

Your house


Your sofa

POLYCARBONATES

€3.5bn | 28%


Your smartphone

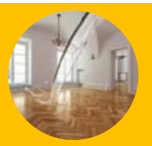
Performance cars

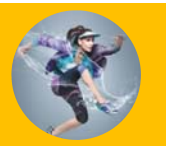
Medical products

COATINGS, ADHESIVES & SPECIALTIES

€2.4bn | 19%

Car coating


Robust floors


Your sports outfit

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Digital@Covestro: 3 Dimensions

Digital Operations

Leverage data and break data silos to improve safety and increase efficiency

Collect and structure production data

Visualize, analyze & predict

Digital R & D

Com-putational Chemistry

Mobile Working

Predictive Maintenance

Global impact on production, R&D, commercial and strategic decision making

Customer experience

Support dynamic customer decisions across multiple digital touchpoints

Customer contact through various media

Social media, WeChat, websites

Business models

Use digital technologies to enhance customer benefits

ONLINE MARKETPLACE
Buy and sell chemicals

ALIBABA FLAGSHIP STORE
Sell to smaller customers as well

1

TECHNICAL CUSTOMER SERVICES

Predict product properties

2

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Agenda

- Business Challenge
- Vision and Priorities
- Central PI Server
- Sensor and Data Health
- A/F Library, Template Definition
- Asset Health
- Scalability
- Conclusion

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Business Challenge: Data Hurricane!

Using digitalization to improve OEE

Goal: Reduce unplanned outages by 50%+

Improved Safety and Environment | Improved Energy Efficiency | Increased Revenue | Reduced Maintenance Spending

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Vision and Priorities

We would like to provide the right information at the right time so our people can make fast and informed decisions.

- Data Health:
- sensor health,
- accurate and digitalized documentation

Sensors

Emerson Pressure Transmitter

- Asset Health
- At a glance visualization
- anomaly detection,
- prescriptive input available to SME

Assets

- Unit Process Monitoring: Include asset and quality information for predictive unit performance

Production

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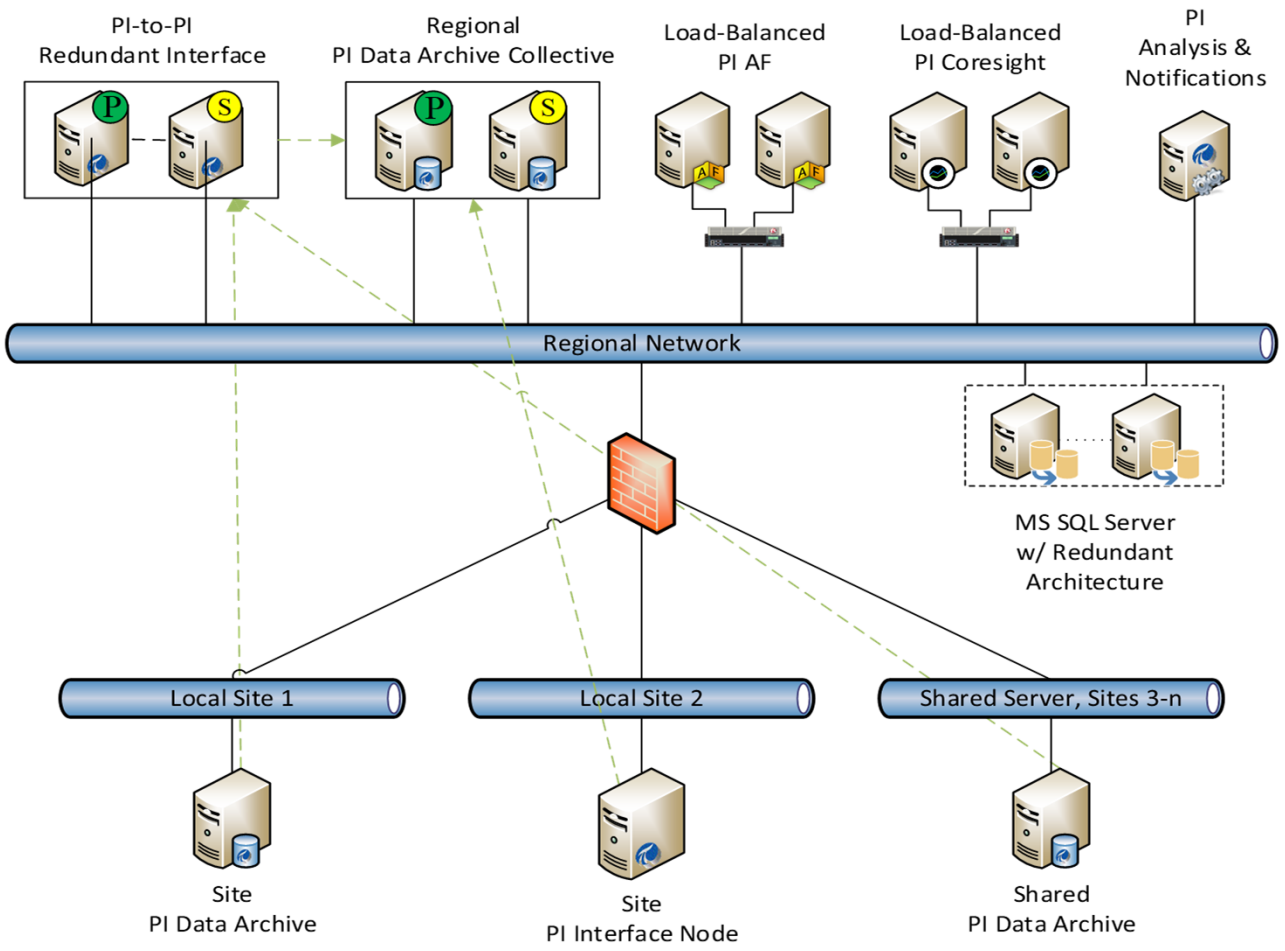
In progress: Central PI System

Each regional PI server will feed into the global server for data analytics and ease of sharing information.

Local → Regional
We will clean data and standardize tag names.



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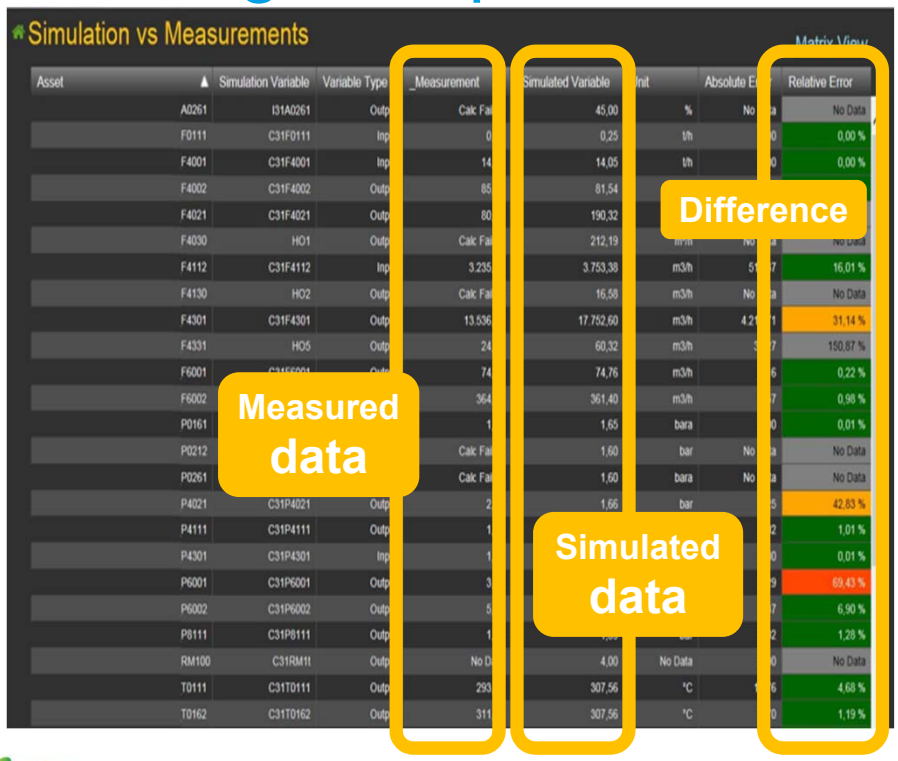
Integration of Online Process Models
Leverage the process modeling know-how



- Benefits from new integration concept
- Easier deployment and maintenance
- Easy supplement of missing sensors for KPI calculations in asset templates

➢ Early detection of deviations: Indication for sensor failure or process upset

➢ Validated model offers additional process insights

Comparison of online dynamic model with installed sensors.

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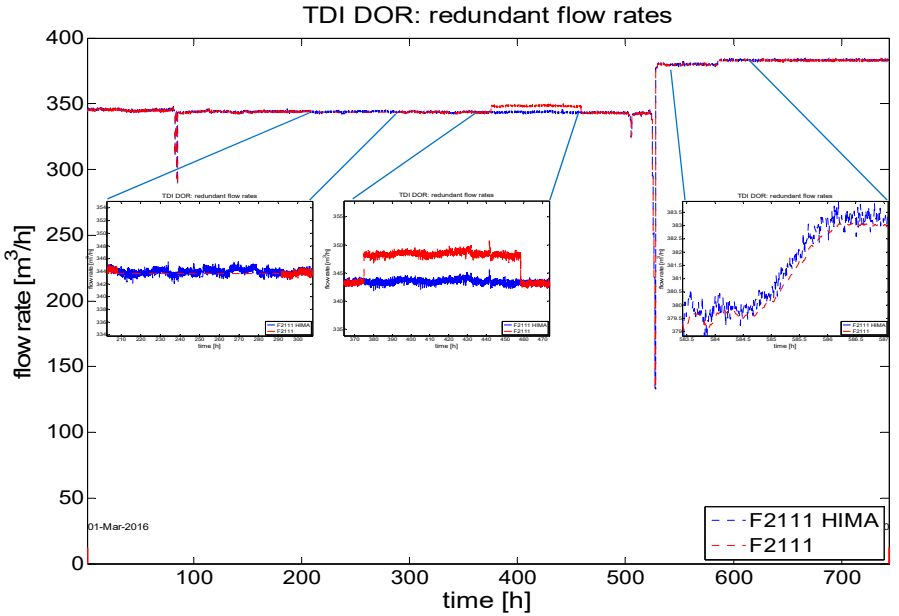
Sensor Malfunction: Offset /Freezing /Fouling

-- Redundant Safety Sensor Diagnostics --

- RSD algorithm successfully detects
  - Offset malfunction
  - Freezing malfunction
  - Fouling malfunction

- RSD reporting
  - Robust reporting of malfunctions over a month and over a day
    - Prevent false alarms
    - If a malfunction occurs, a clear step is reported



Redundant Sensor Diagnostics –
Active on all redundant safety sensors installed globally.

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Under Investigation: Can APERIO automatically tell us *which* redundant sensor is bad?

Aperio is a **scalable platform** that ensures **IIoT sensor data integrity** and **protects against data manipulation**

How it works

APERIO

1. IIoT sensors generate signals that respond to physical laws

2. Aperio translates these signals into mathematical & data models

3. **Aperio learns the fingerprint of every sensor individually and creates groups of correlated signals**

4. **Aperio identifies events on individual sensors and identifies if correlation between sensors changes**

5. Aperio ensures the authenticity and integrity of operational data

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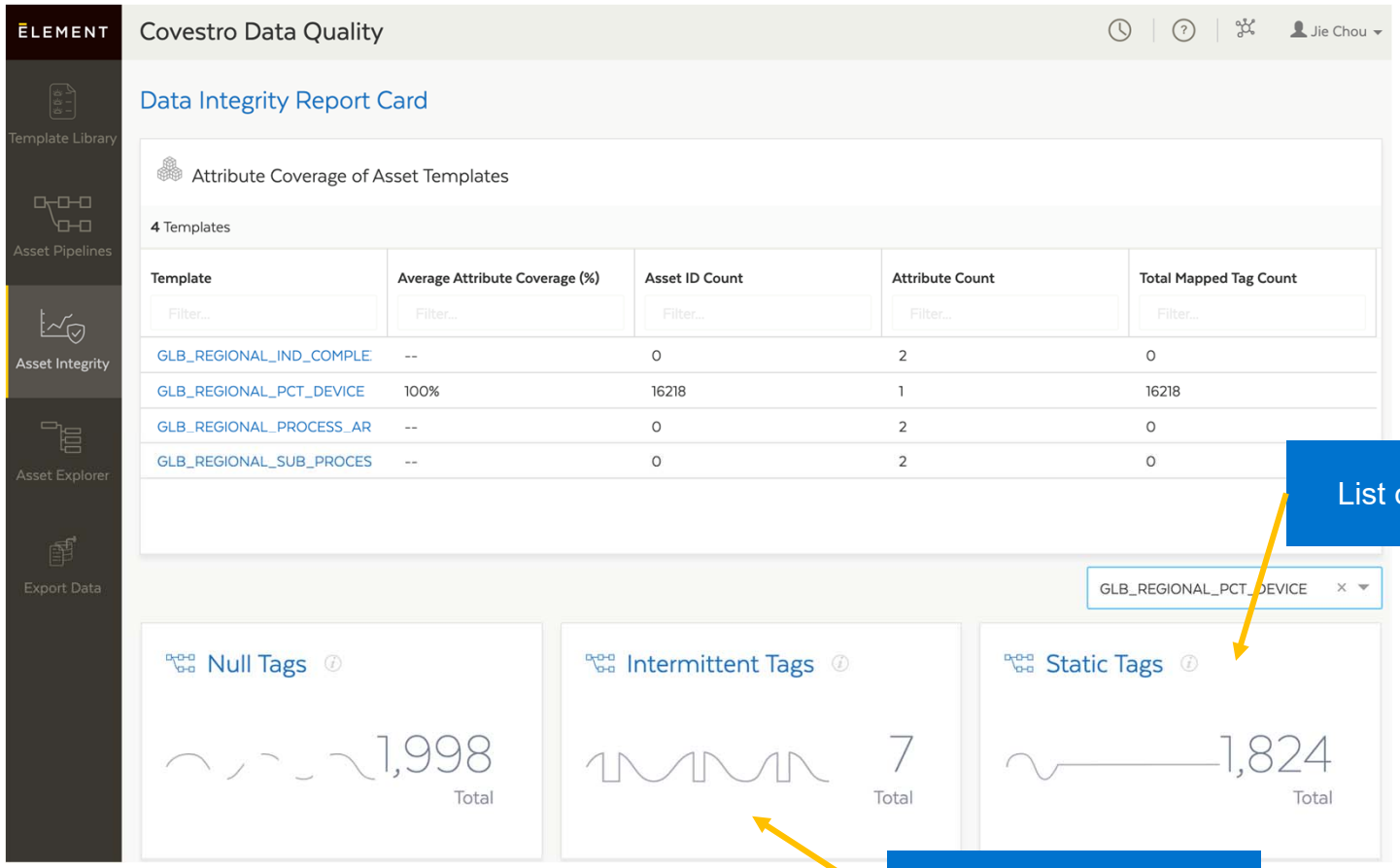
Sensor Diagnostics Pilot with Element: Outstanding first results!



List of problem tags

List Bad Transmitters

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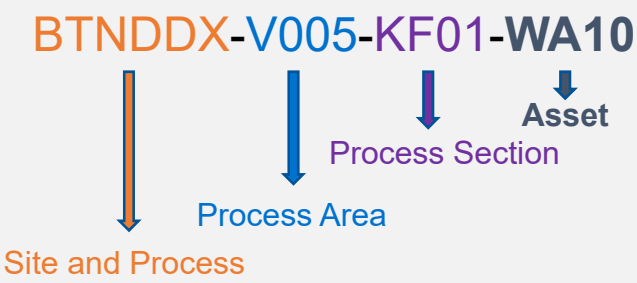
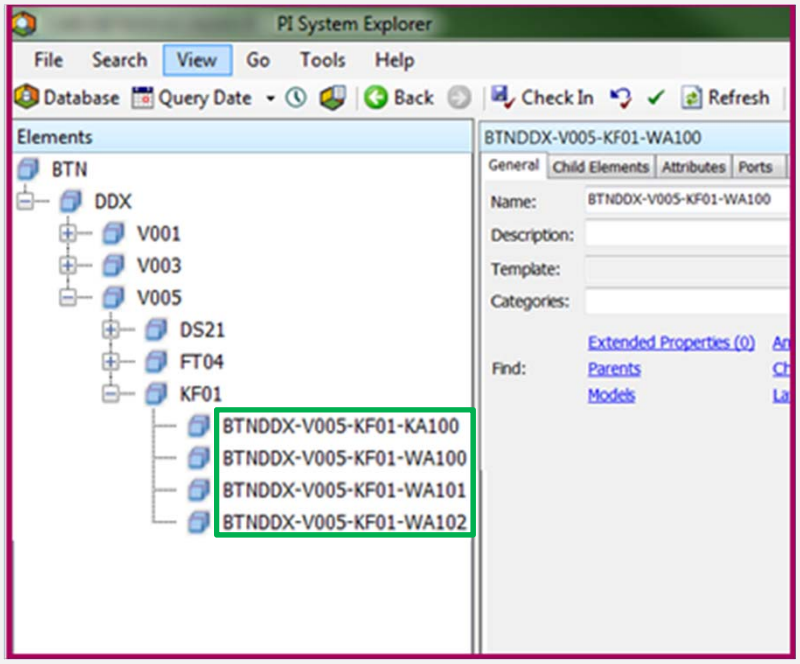
Move & Structure: FLoc Asset Hierarchy (AKZ Corp Standard)

- Definition of **asset hierarchy** based on FLoc



- Elements in this hierarchy are based on templates

  → Examples of typical templates include Pumps, HEx, Distillation Columns, Reactors, etc.



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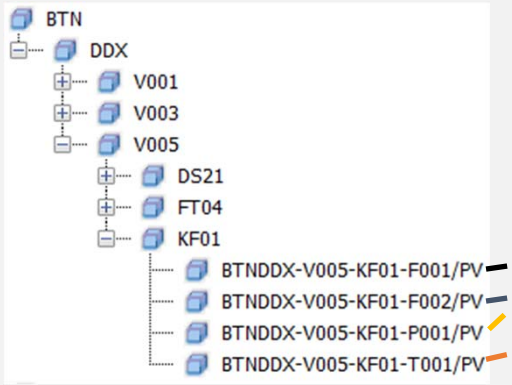
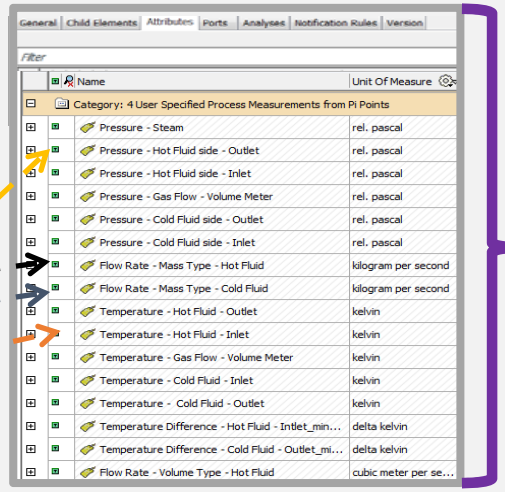
Move & Structure: Internal References

- Definition of **internal references** among tag and asset hierarchies

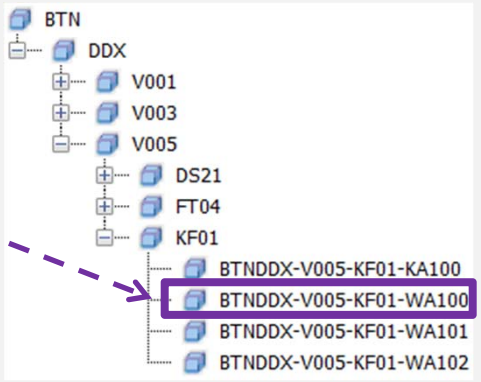
✓Tag AF hierarchy



✓Template attributes



✓Asset AF hierarchy



"Data Source"

Data + Context + Calculations

"Data Consumer"

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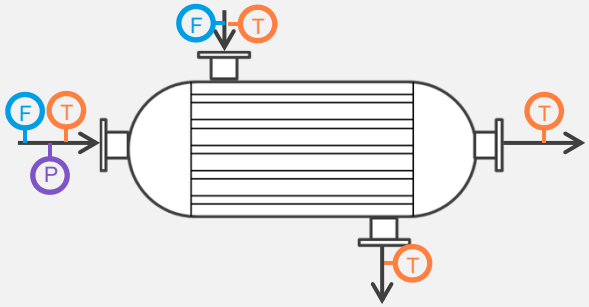
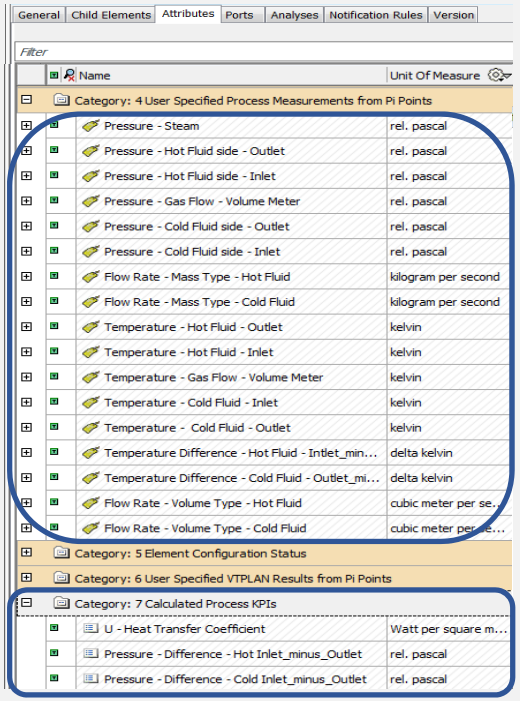
Monitor: AF Template Development

Measured process variables for WA100:

- Flowrates, Temperatures, Pressures



Standardized
PI AF Template



Calculated KPI's for WA100:

- Heat transfer coefficient "**U**"

$$U = f(\Delta T_{hot}, \Delta T_{cold}, F)$$

  - A decrease over time indicates fouling
  - Actionable information to plan next cleaning activity
  - Send notifications via Event Frames, if threshold is reached.

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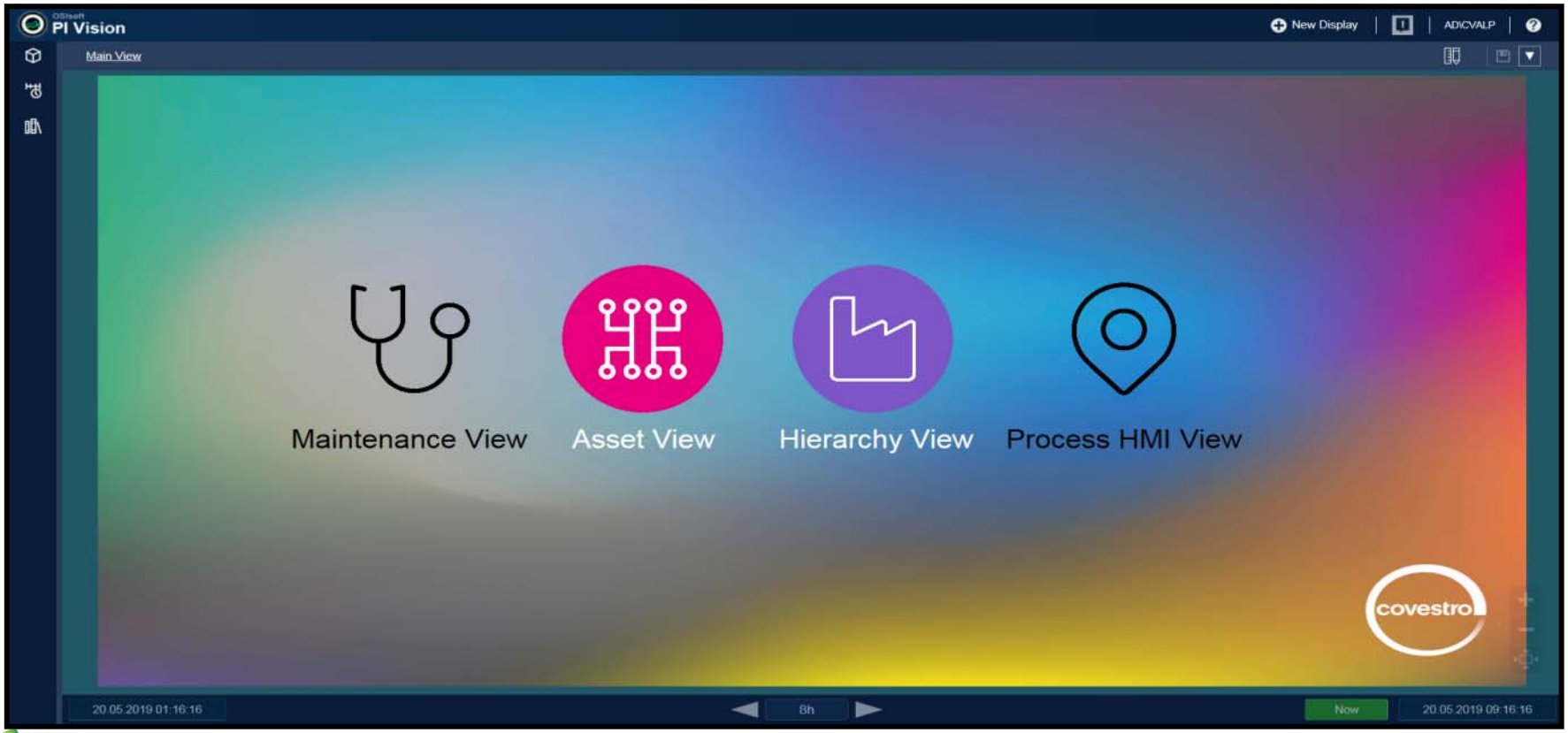
One-Stop-Shop Visualization: Navigation Cockpit



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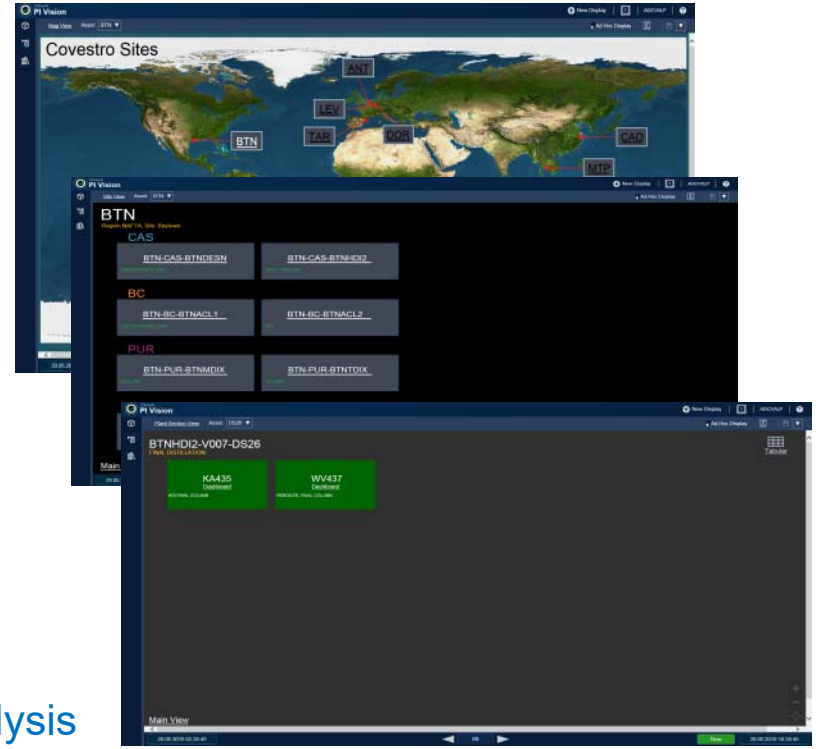
One-Stop-Shop Visualization: Navigation Cockpit

✓ Asset View

✓ Hierarchy View



ProDAVis: Process Data Analysis and Visualization at Covestro

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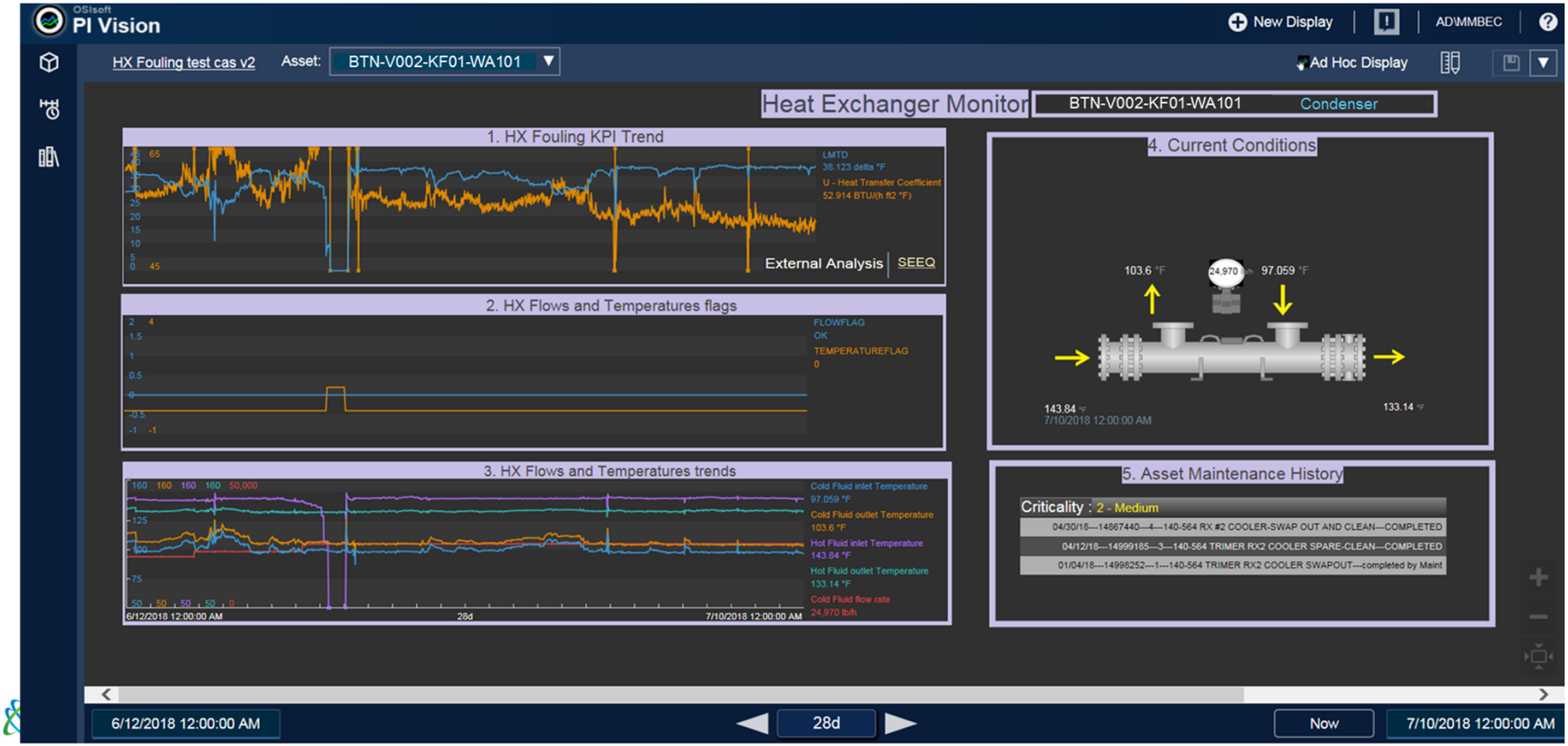
PI Vision Template – Heat Exchanger

PI Vision templates		
PI AF Unit operation templates	Self service analytics (e.g.SEEQ)	Unit operation online models



PI Vision Template – Heat Exchanger

PI Vision templates		
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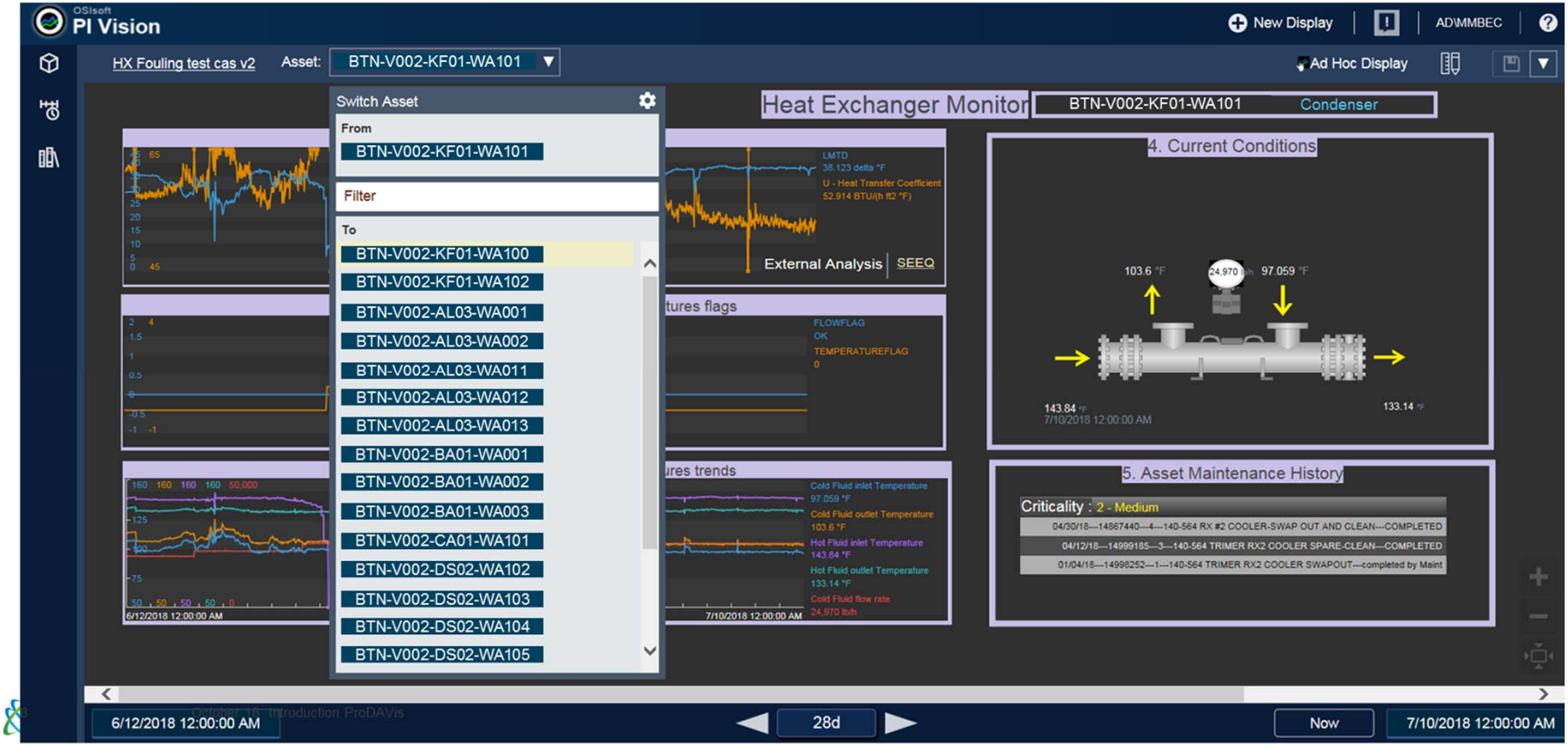
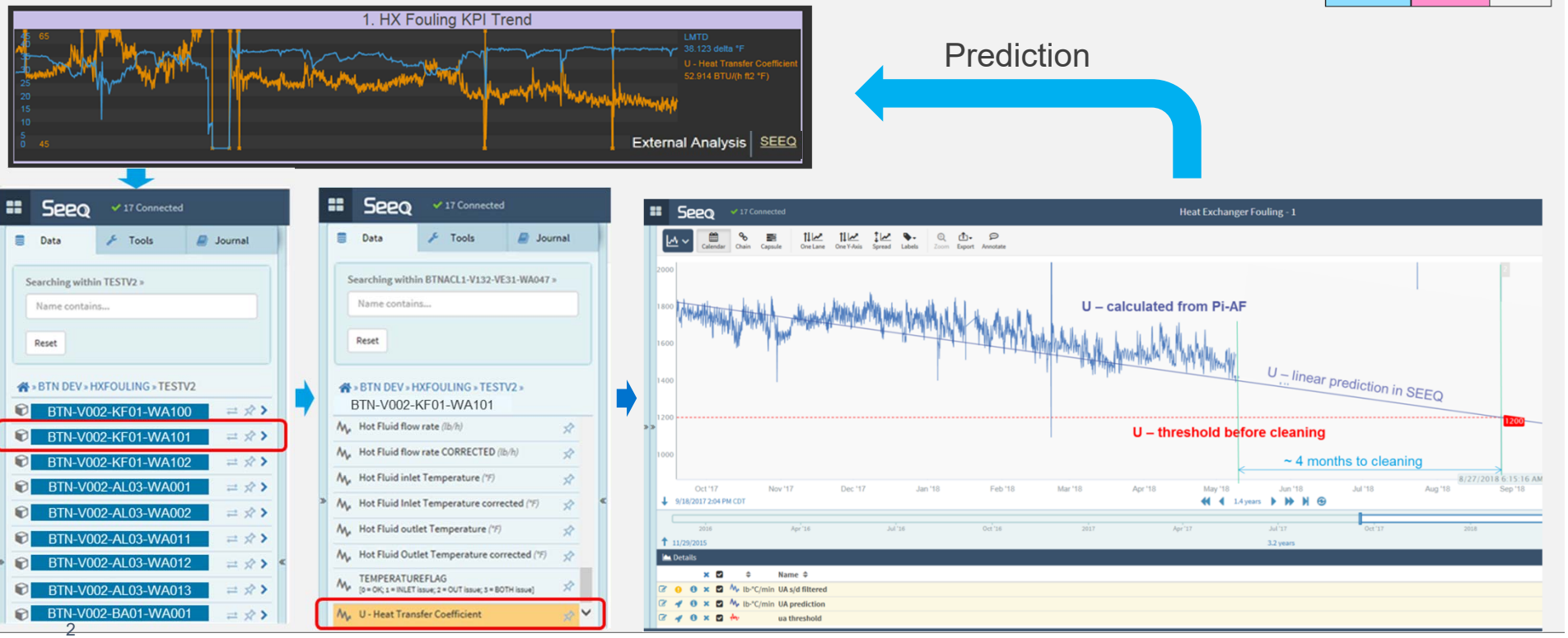


Seamless Integration of Self Service Analytics

PI Vision templates		
PI AF Unit operation templates	Self service analytics (e.g.SEEQ)	Unit operation online models



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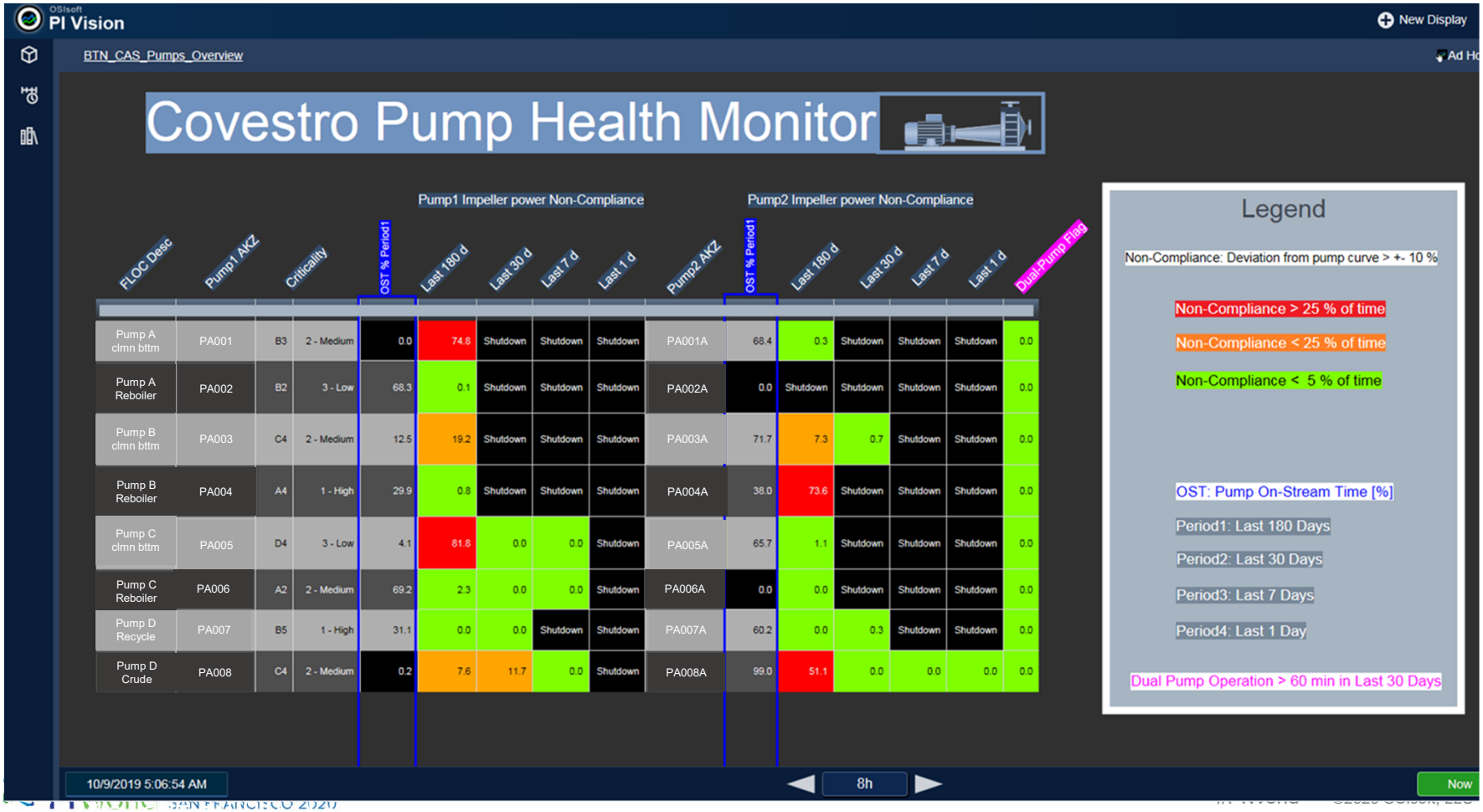
OSIsoft
PI Vision
New Display
BTN_CAS_Pumps_Overview
Covestro Pump Health Monitor
Pump1 Impeller power Non-Compliance
Pump2 Impeller power Non-Compliance
FLOC Desc
Pump1 AKZ
Criticality
OST % Period1
Last 180 d
Last 30 d
Last 7 d
Last 1 d
Pump2 AKZ
OST % Period1
Last 180 d
Last 30 d
Last 7 d
Last 1 d
Dual-Pump Flag
Pump A clmn bttm PA001 B3 2 - Medium 0.0 74.8 Shutdown Shutdown Shutdown PA001A 68.4 0.3 Shutdown Shutdown Shutdown 0.0
Pump A Reboiler PA002 B2 3 - Low 68.3 0.1 Shutdown Shutdown Shutdown PA002A 0.0 Shutdown Shutdown Shutdown Shutdown 0.0
Pump B clmn bttm PA003 C4 2 - Medium 12.5 19.2 Shutdown Shutdown Shutdown PA003A 71.7 7.3 0.7 Shutdown Shutdown 0.0
Pump B Reboiler PA004 A4 1 - High 29.9 0.8 Shutdown Shutdown Shutdown PA004A 38.0 73.6 Shutdown Shutdown Shutdown 0.0
Pump C clmn bttm PA005 D4 3 - Low 4.1 81.8 0.0 0.0 Shutdown PA005A 65.7 1.1 Shutdown Shutdown Shutdown 0.0
Pump C Reboiler PA006 A2 2 - Medium 69.2 2.3 0.0 0.0 Shutdown PA006A 0.0 0.0 Shutdown Shutdown Shutdown 0.0
Pump D Recycle PA007 B5 1 - High 31.1 0.0 0.0 Shutdown Shutdown PA007A 60.2 0.0 0.3 Shutdown Shutdown 0.0
Pump D Crude PA008 C4 2 - Medium 0.2 7.6 11.7 0.0 Shutdown PA008A 99.0 51.1 0.0 0.0 0.0 0.0
Legend
Non-Compliance: Deviation from pump curve > +- 10 %
Non-Compliance > 25 % of time
Non-Compliance < 25 % of time
Non-Compliance < 5 % of time
OST: Pump On-Stream Time [%]
Period1: Last 180 Days
Period2: Last 30 Days
Period3: Last 7 Days
Period4: Last 1 Day
Dual Pump Operation > 60 min in Last 30 Days
10/9/2019 5:06:54 AM
8h
Now

One-Stop-Shop Visualization: Asset Monitors

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Digitalization = Augmented Intelligence

We want to get all information
available to humans
to decide on path forward.

The machines give recommendations,
the humans pick and choose.

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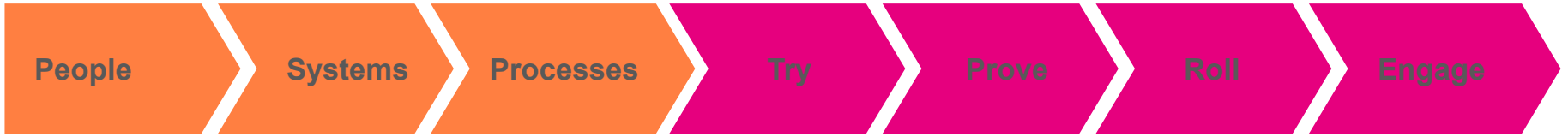
How do we make Digitalization in Operations Sustainable?

Pilot roll-out scheduled to write sustainable solution.



1. People are key to success
2. Must have adequate infrastructure and computing power.
3. Must have reasonable workflows, defined roles and responsibilities to achieve sustainability
4. Find something you like and try it out.
5. Do a proof of concept – quickly!
6. Start rolling out what works as soon as possible.
7. Engage different levels of the organization. Make them want it so they will own the solution.

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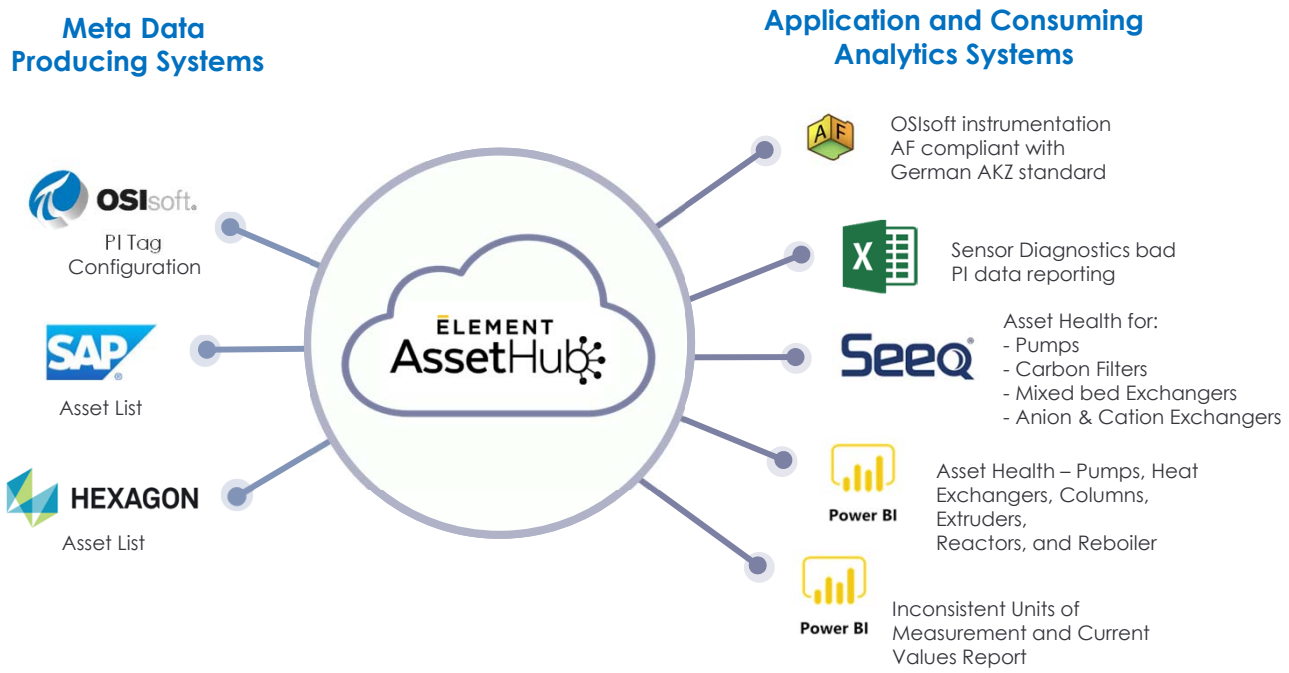
Enabling One-Stop Shop at Covestro



The Journey

Today

- AF Build
- AKZ tag renaming
- Sensor Diagnostics

Work in Progress

- SAP Evergreening
- Hexagon Evergreening
- Global Asset Monitoring
- Global Process Monitoring

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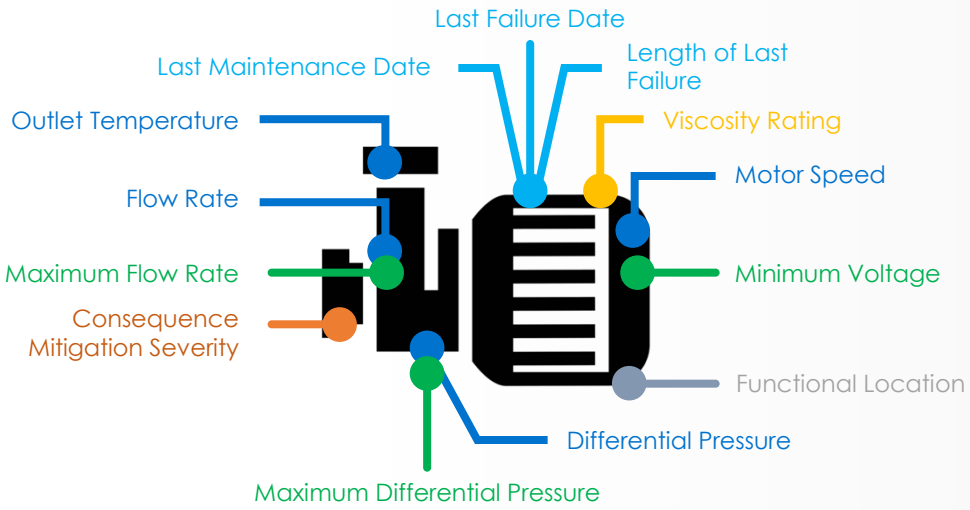
Industrial Asset Data Is Messy and Complex

One Pump:
Hard to Process, Multifaceted Data



- PI System Data
- OEM Data
- Work and Asset Management
- HazOps Data
- Design and Construction Data
- Lab Data

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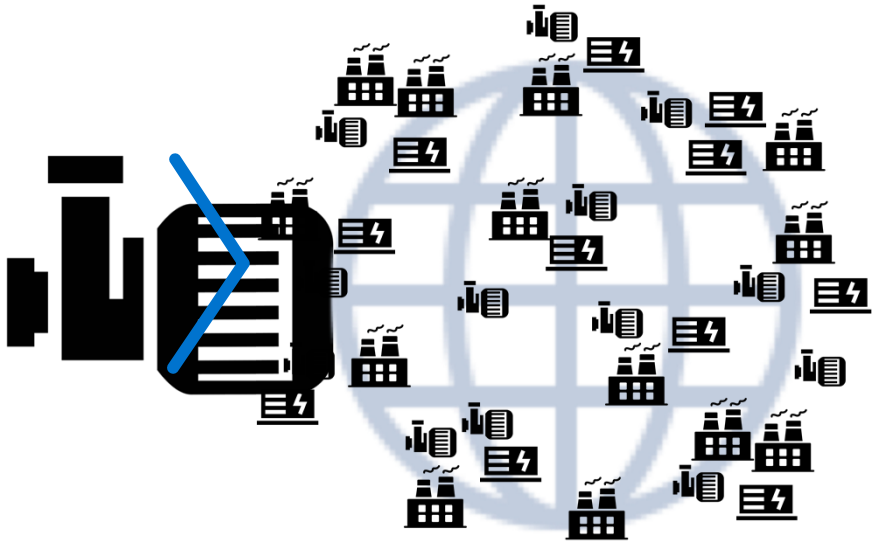
At Enterprise Scale, It's Unmanageable

1,000
pumps and
across
50
production sites



RESULTS IN

Virtual Blind Spots in Decision Making

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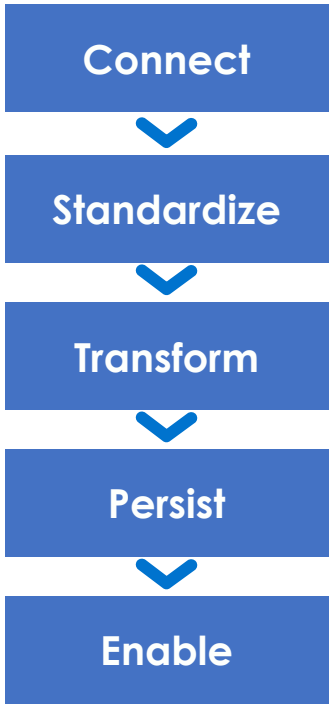
Building a Global Asset Hierarchy



- Systems of record for as-designed, as-operated, as-maintained view of assets and equipment.
- With templates for assets and processes.
- Integrate and enrichen PI System data with metadata from other systems.
- Manage data integrity and governance. Keep data synced across source systems.
- Analytics by quickly spinning up new AF's and shrinking schema planning requirements.

covestro

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AssetHub
Purpose-Built for Industrial Data

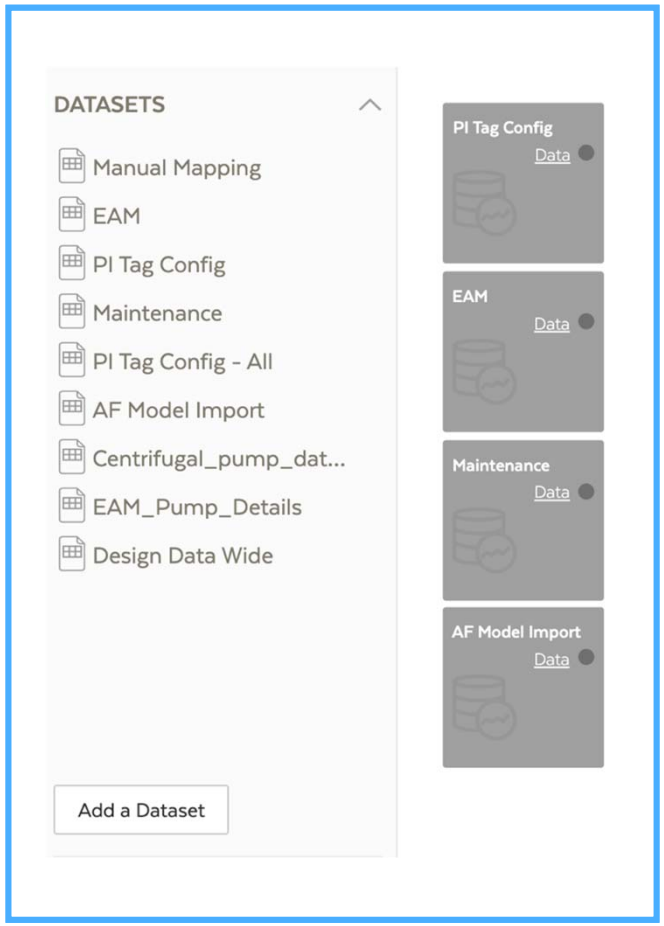
Connect — Across data silos

Standardize

Transform

Persist

Enable



Features

- Spreadsheet import
- ODBC, JDBC
- XML, JSON
- MSFT SQL Server, Oracle, PostgreSQL
- SAP, Maximo, Infor
- MSFT Access
- PI WebAPI import
- Integration APIs

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AssetHub
Purpose-Built for Industrial Data

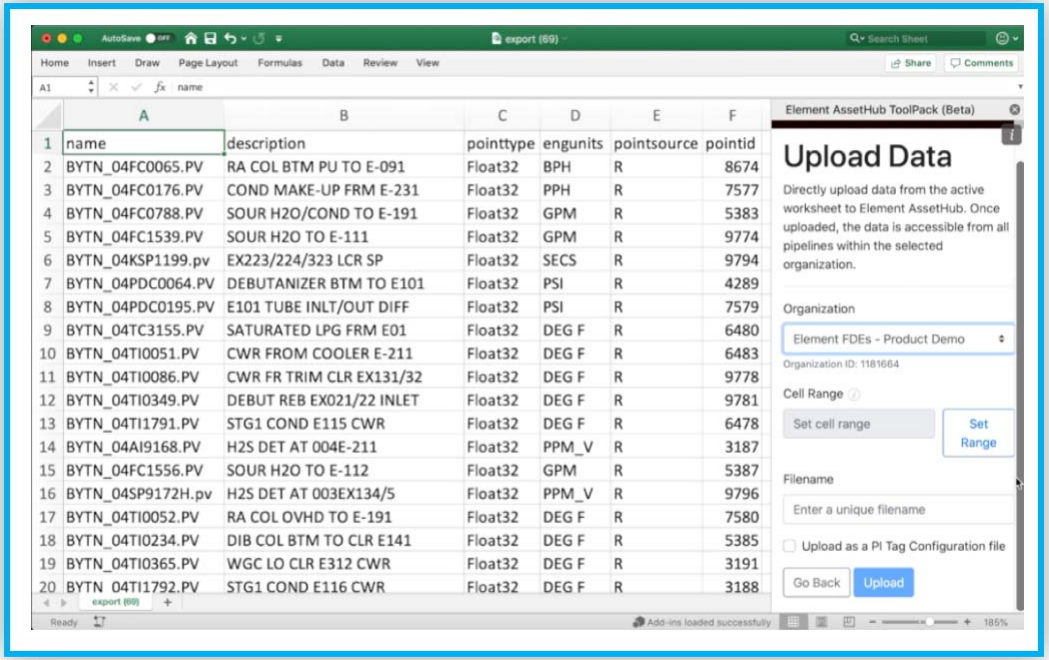
Connect — Across data silos

Standardize

Transform

Persist

Enable



	A	B	C	D	E	F
1	name	description	pointtype	engunits	pointsource	pointid
2	BYTN_04FC0065.PV	RA COL BTM PU TO E-091	Float32	BPH	R	8674
3	BYTN_04FC0176.PV	COND MAKE-UP FRM E-231	Float32	PPH	R	7577
4	BYTN_04FC0788.PV	SOUR H2O/COND TO E-191	Float32	GPM	R	5383
5	BYTN_04FC1539.PV	SOUR H2O TO E-111	Float32	GPM	R	9774
6	BYTN_04KSP1199.pv	EX223/224/323 LCR SP	Float32	SECS	R	9794
7	BYTN_04PDC0064.PV	DEBUTANIZER BTM TO E101	Float32	PSI	R	4289
8	BYTN_04PDC0195.PV	E101 TUBE INLT/OUT DIFF	Float32	PSI	R	7579
9	BYTN_04TC3155.PV	SATURATED LPG FRM E01	Float32	DEG F	R	6480
10	BYTN_04TI0051.PV	CWR FROM COOLER E-211	Float32	DEG F	R	6483
11	BYTN_04TI0086.PV	CWR FR TRIM CLR EX131/32	Float32	DEG F	R	9778
12	BYTN_04TI0349.PV	DEBUT REB EX021/22 INLET	Float32	DEG F	R	9781
13	BYTN_04TI1791.PV	STG1 COND E115 CWR	Float32	DEG F	R	6478
14	BYTN_04AI9168.PV	H2S DET AT 004E-211	Float32	PPM_V	R	3187
15	BYTN_04FC1556.PV	SOUR H2O TO E-112	Float32	GPM	R	5387
16	BYTN_04SP9172H.pv	H2S DET AT 003EX134/5	Float32	PPM_V	R	9796
17	BYTN_04TI0052.PV	RA COL OVHD TO E-191	Float32	DEG F	R	7580
18	BYTN_04TI0234.PV	DIB COL BTM TO CLR E141	Float32	DEG F	R	5385
19	BYTN_04TI0365.PV	WGC LO CLR E312 CWR	Float32	DEG F	R	3191
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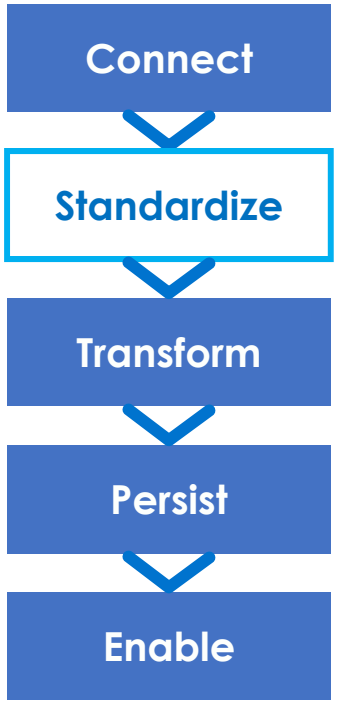
Template Library
Standardized class definitions



Pump (Element)

Description Base=Pump Generic

Standards Body

79 Attributes

Attribute Name	Attribute Type	Data Type	UoM
Age of Asset	Static	Double	
Ambient Temper...	Continuous Value	Double	degC
Axial Bearing Vib...	Continuous Value	Double	Hz
Bearing Tempera...	Continuous Value	Double	degC
Capacity - Norm...	Static	Double	GPM
Casing Temperat...	Continuous Value	Double	degC
Casing Vibration	Continuous Value	Double	Hz
Criticality	Static	String	
Current	Continuous Value	Double	A
Differential Head...	Static	String	ft
Differential Press...	Continuous Value	Double	psi
Differential Press...	Static	String	PSIG
Differential Press...	Continuous Value	Double	
Differential Press...	Continuous Value	Double	
Differential Press...	Continuous Value	Double	
Discharge Flow R...	Continuous Value	Double	m3/s
Discharge Pressure	Continuous Value	Double	psi
Discharge Pressu...	Static	String	PSIG
Discharge Pressu...	Control - Output	Double	
Discharge Pressu...	Control - Setpoint	Double	
Discharge Pressu...	Control - Mode	Double	
Discharge Tempe...	Continuous Value	Double	degC
Flow - HI	Static	Double	GPM
Flow - HIHI	Static	Double	GPM
Flow - LO	Static	Double	GPM

Cancel Edit Template

Features

- System, process, asset
- Easily import and modify existing templates
- 75+ templates
- ISO/API standards
- Template Inheritance
- Child Attributes
- Enumeration Sets
- Value Types
- Data References
- Config Strings
- Attribute Categories
- Event Frame templates

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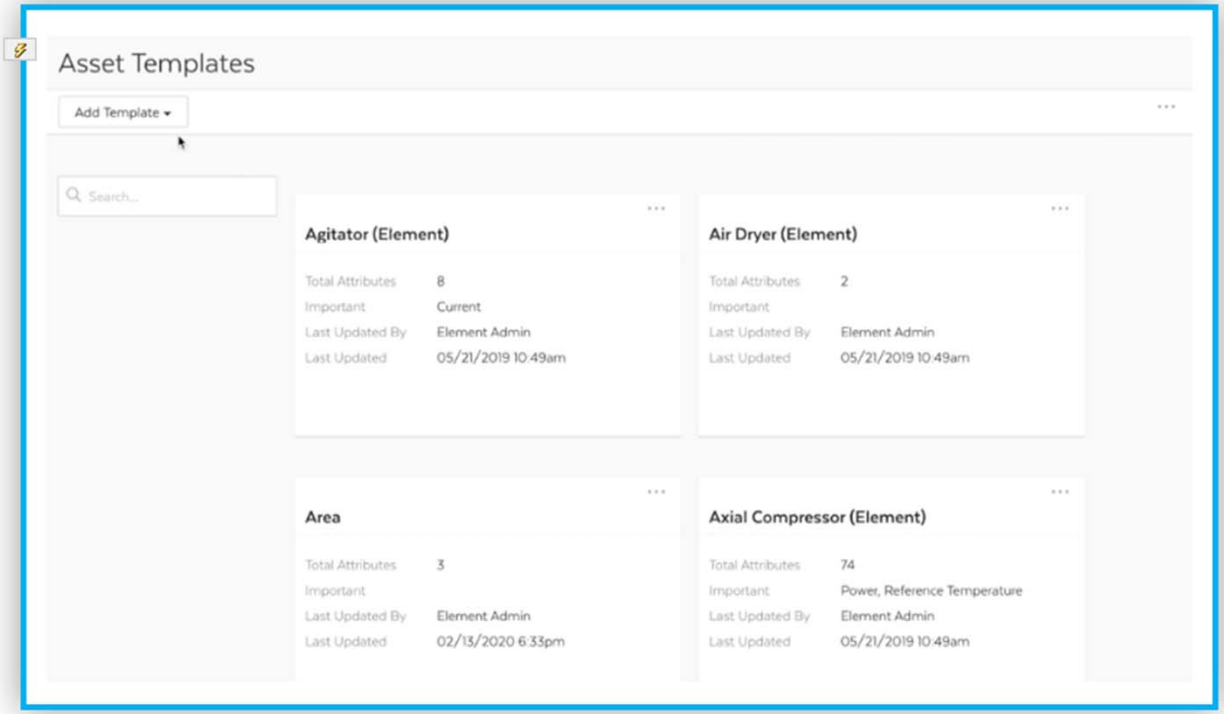
Template Library
Standardized class definitions

- Connect
- Standardize
- Transform
- Persist
- Enable



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Asset Pipeline

Transform, cleanse, and integrate data sources

Connect

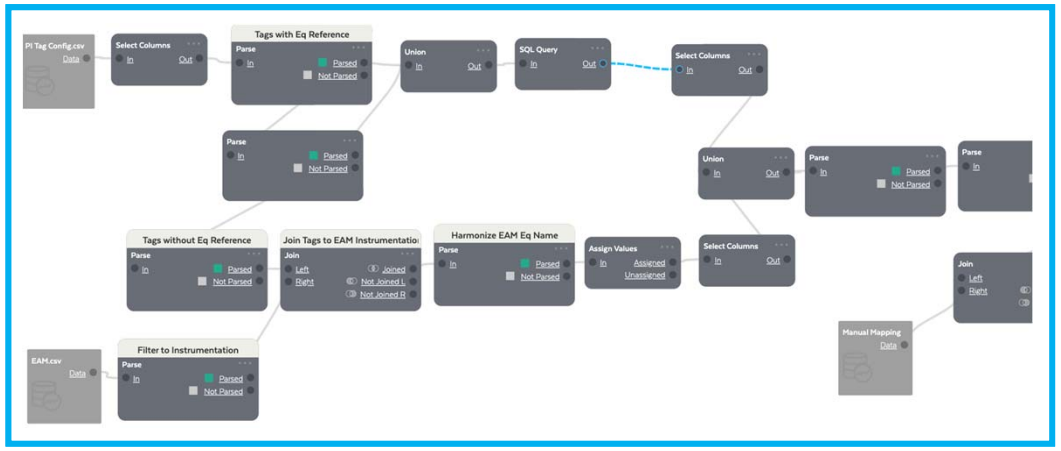
Standardize

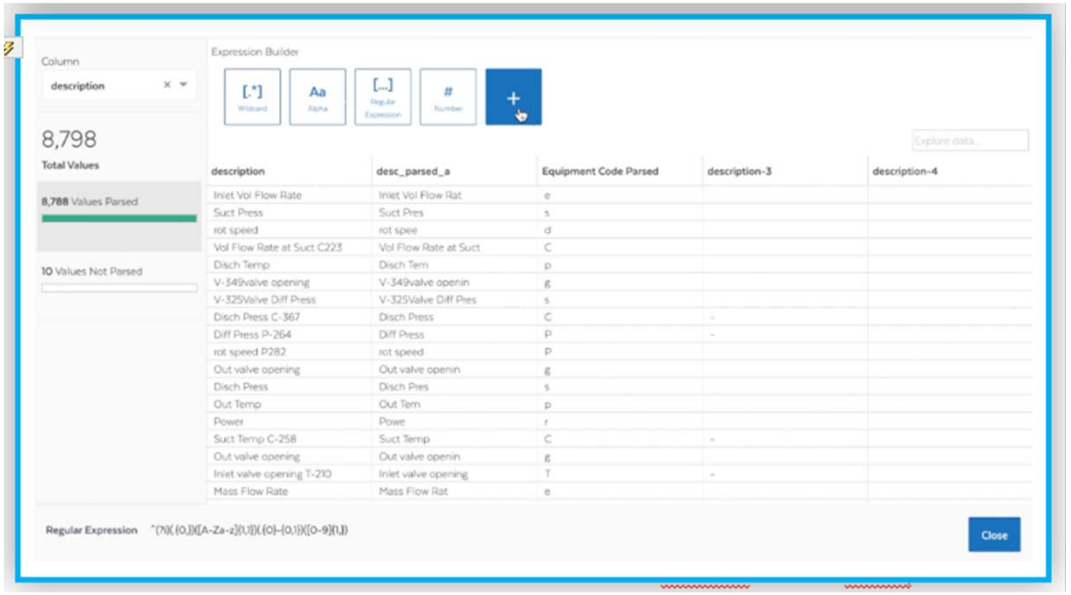
Transform

Persist

Enable

- No code / model driven development
- Orchestration and persistence
- Encode business knowledge
- Regular Expressions
- Fuzzy Logic
- Asset standardization





Asset Pipeline

Transform, cleanse, and integrate data sources

- No code / model driven development
- Orchestration and persistence
- Encode business knowledge
- Regular Expressions
- Fuzzy Logic
- Asset standardization

Search	Match	Accuracy
Filter...	Filter...	Filter...
Valve	VLV	100
Valve	vlv	100
Valve	VALVE	100
Valve	Valve	100
Valve	Vlv	100
Valve	VLVS	100
Valve	VALVES	100
Valve	vlvS	100
Valve	valve	100
Valve	Val	80
Valve	vl	80
Valve	Value	80

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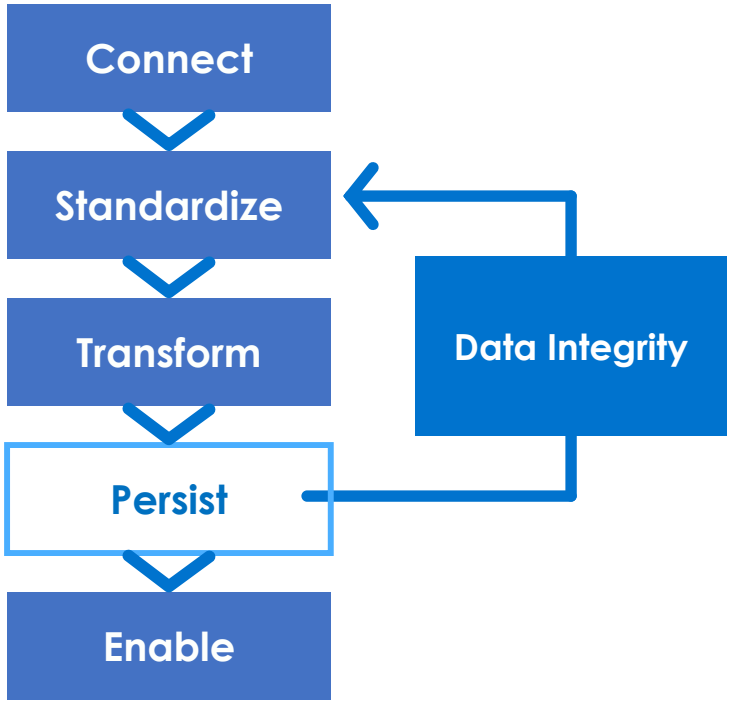
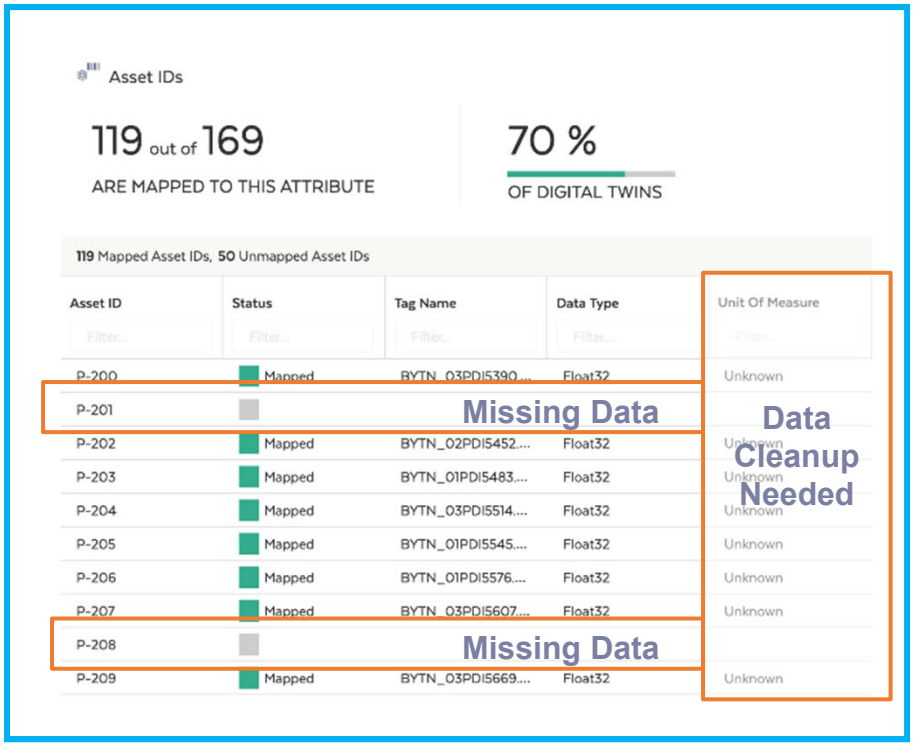
Asset Integrity Report Card

Identify model gaps to ensure trusted applications





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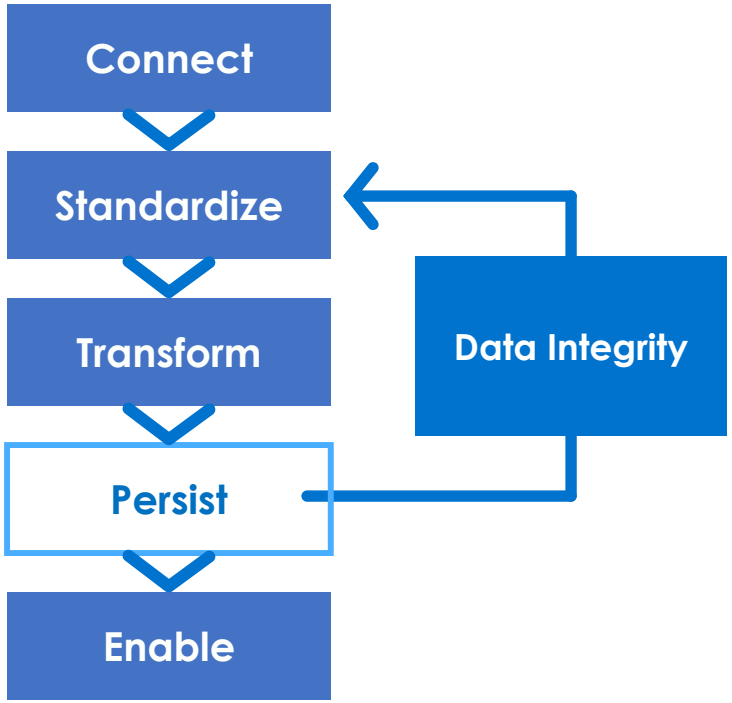
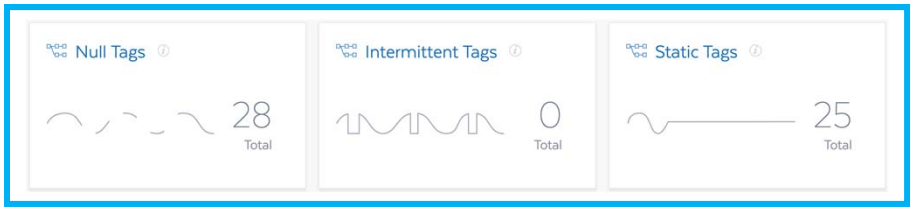
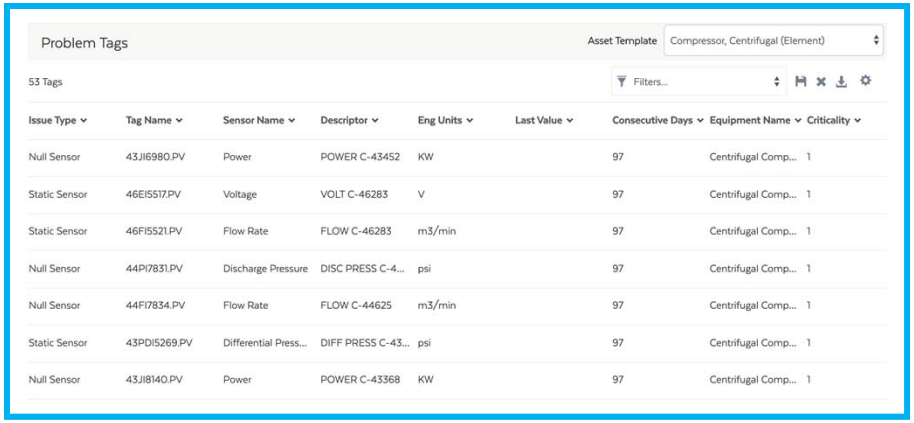
Sensor Diagnostics
Identify tags reporting bad data



Features

- Null, intermittent, static tags
- Asset context to prioritize and resolve data collection issues





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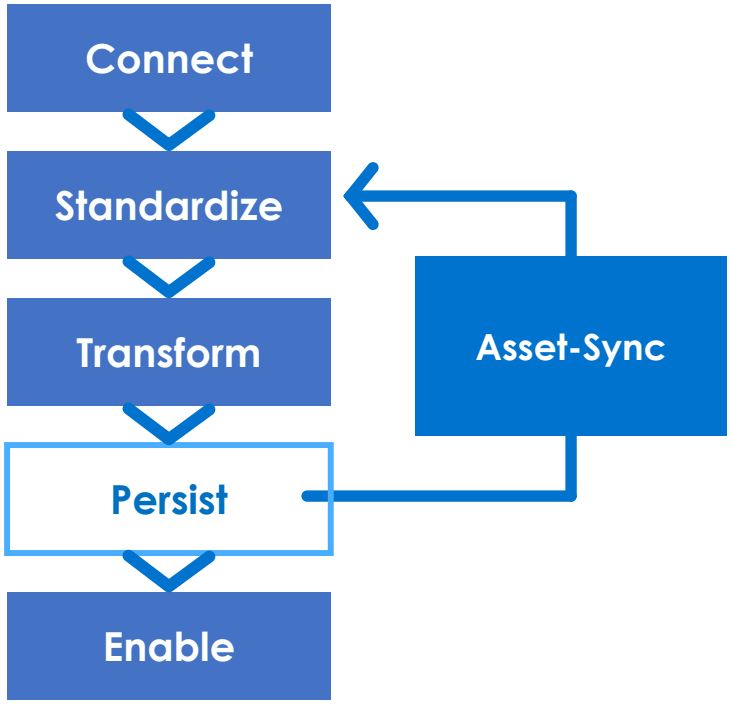
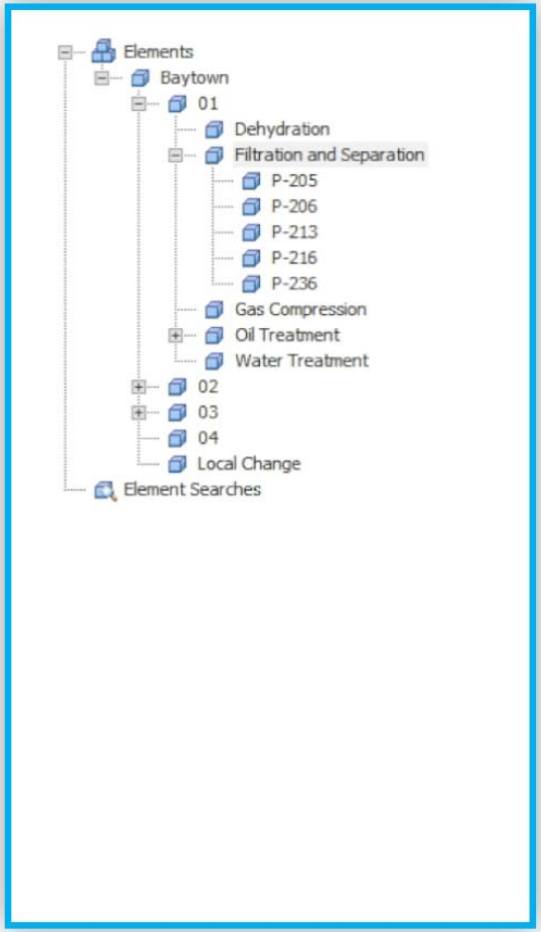
Asset-Sync

Evergreen models to stay in sync with physical asset changes



Features

- Update AF with new assets
- Remove out of service AF elements
- Ensure template and hierarchy governance
- Identify local AF changes



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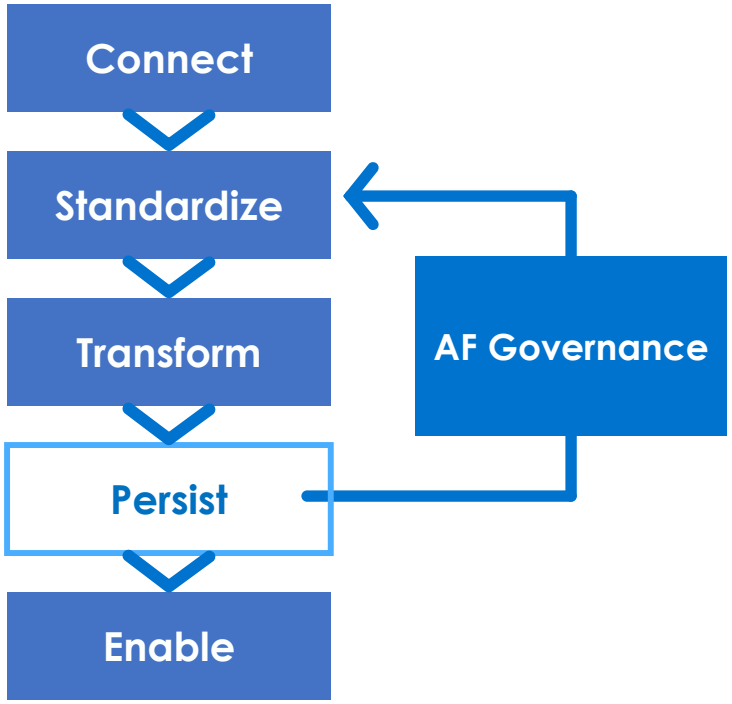
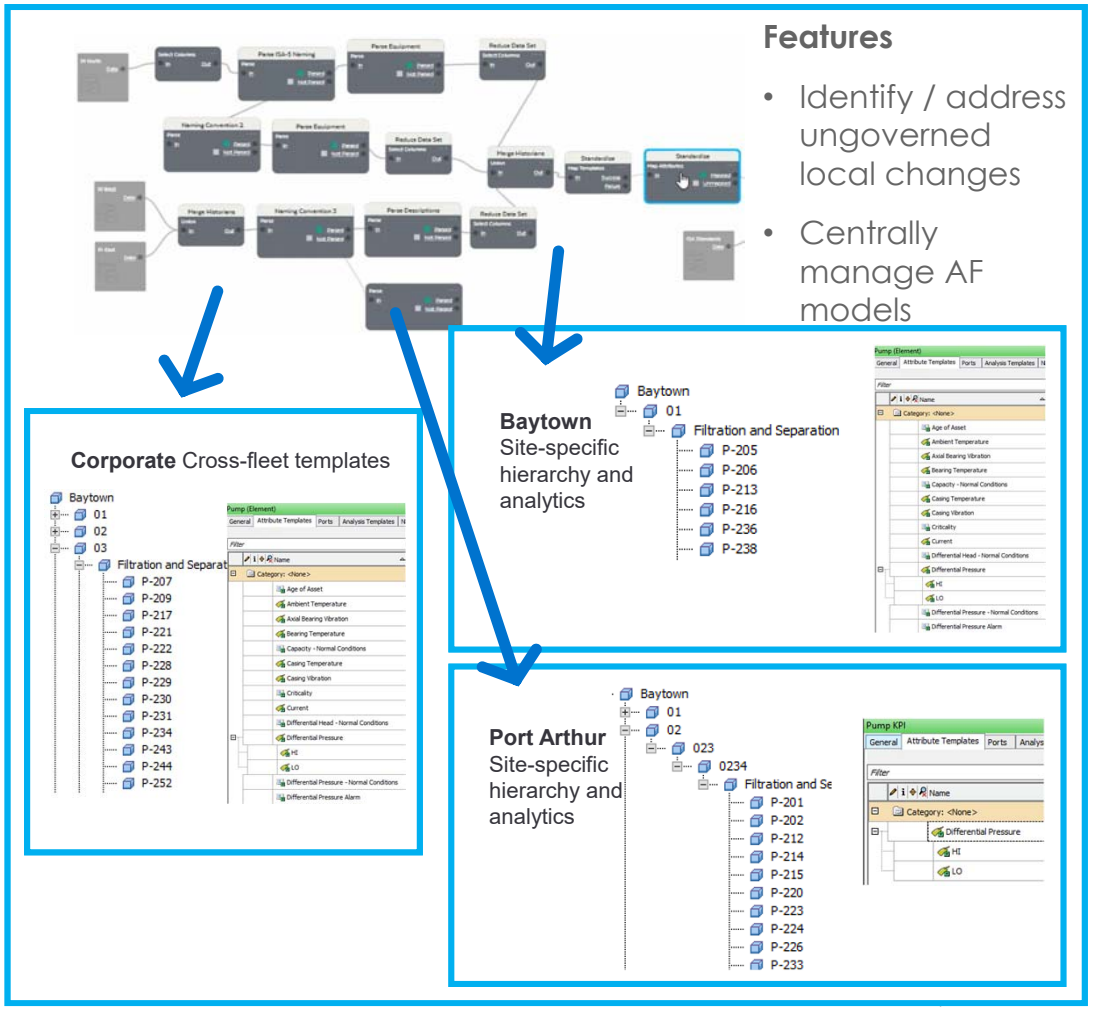
AF Governance

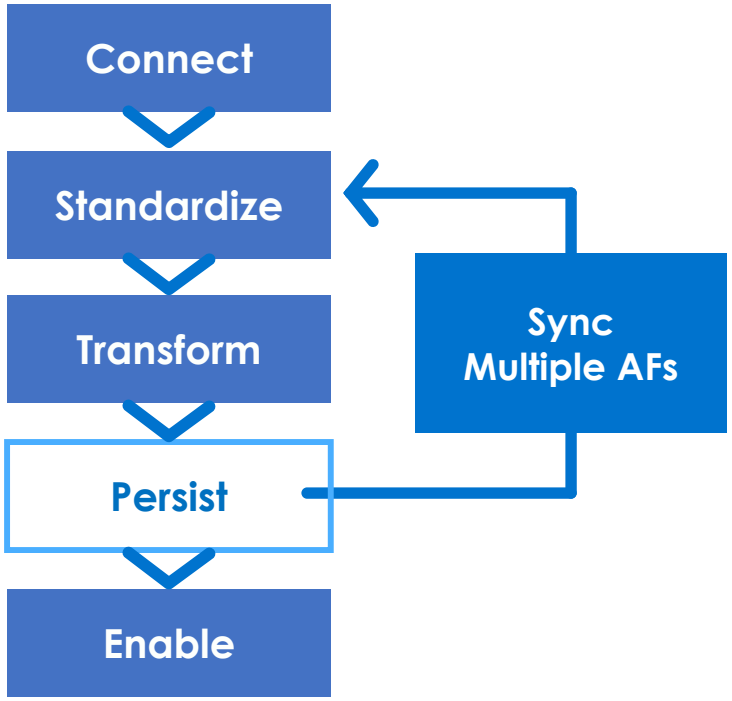
Empower sites and ensure corporate standards

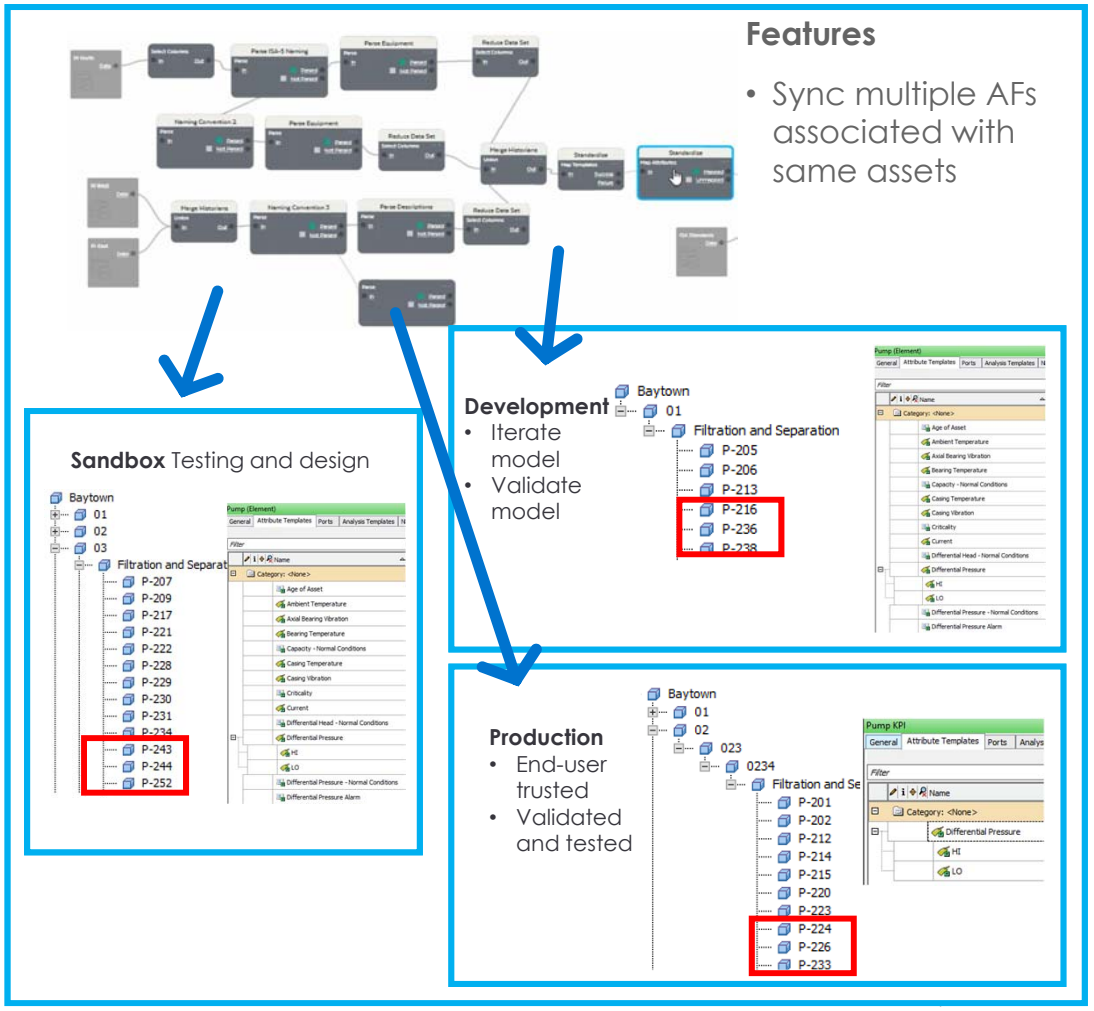




AF Synchronization

Keep multiple AFs in sync

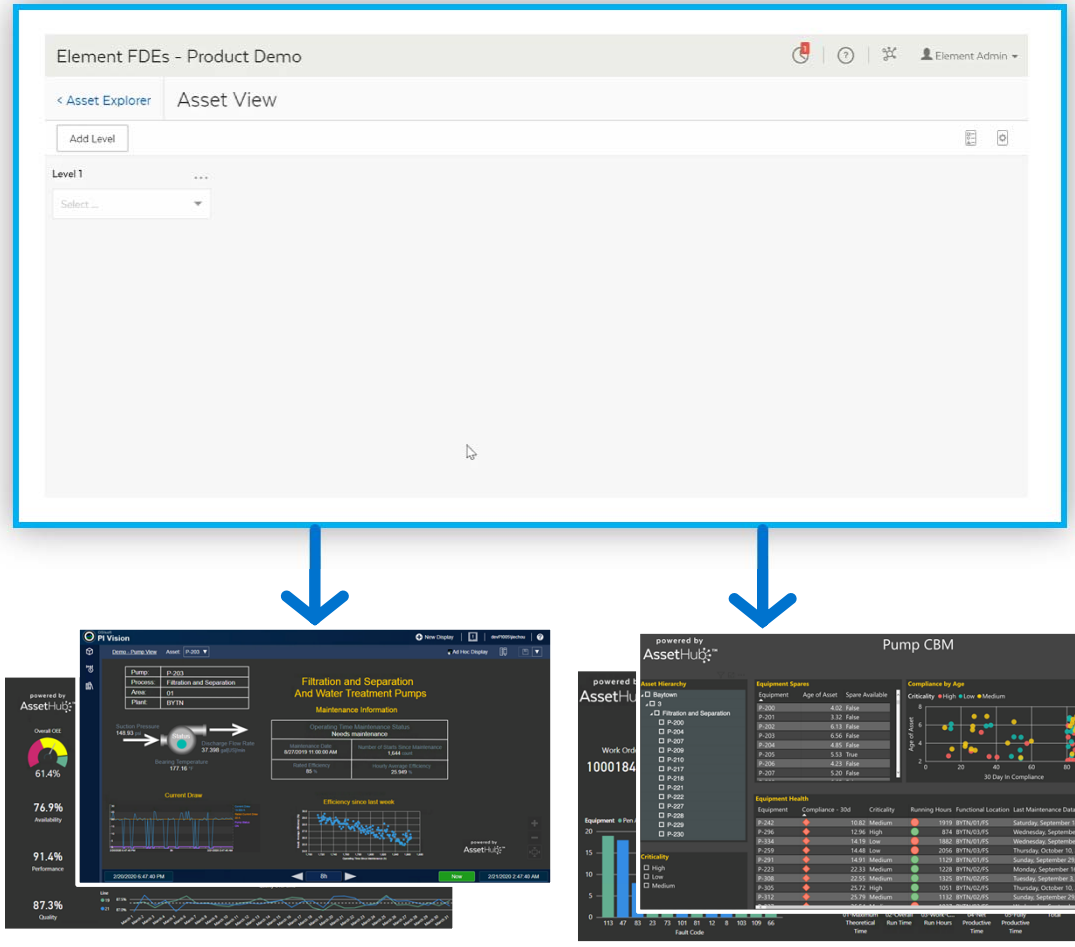




Asset Explorer
Rapidly create new AFs

- Connect
- Standardize
- Transform
- Persist
- Enable

Unlimited use case and personas



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Benefits:

Scale Organized Data to Infinite Use cases

Build the model once and consume as use cases demand

Ops Reliability

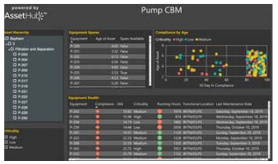
- Reduced Downtime
- Ensure uptime of operations
- Increased visibility on asset health

Applications

- Cross fleet asset health
- Root cause analysis
- Heat exchanger fouling
- OEE

Maintenance

- Shift from calendar-based to condition or runtime-based maintenance
- Reduce time-consuming data analysis



Applications

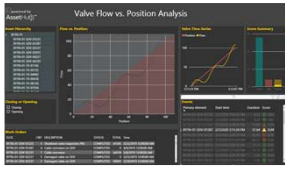
- Integrated maintenance and process reports
- Track out of compliance assets
- Track maintenance spend

ELEMENT AssetHub

Central Repository for Collaborative Lifecycle Management of Asset Frameworks

Instrumentation SMEs

- Ensure process safety



Applications

- Flow vs. Position Analysis
- Valve travel time report
- PHA

Data Science

- Unlock silos of data
- Think big, model once, go fast
- Reduce redundant work

Applications

- Advanced analytics
- R/Python
- Data Lake

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Orchestrating People, Process & Technology

TECHNOLOGY

Connect to, and import, PI tag and asset metadata

Define Asset Templates

Build and maintain AF models

Deploy AF models and configure PI Vision & AF Analytics

PEOPLE

- Industrial Operations, Automation & Controls
- OSIsoft PI System and AF

- Big data modeling and analytics
- Innovation focus and culture
- People first

PROCESS

Discovery › Implementation › Education › Customer success

Agile, sprint-based approach generates quick wins

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Summary

CHALLENGES

- Data Hurricane
- Tag naming errors
- Sensor failures
- Data mismatch
- Too many unplanned outages!

SOLUTION

- PI Data Cleanup and harmonization
- A/F – Vision for Asset Monitoring
- Global deployment
- SS Analytics and Machine Learning

BENEFITS

- Standardized visualization
- Fast insights = Fast Action
- Improved OEE

> Having accurate and easy to understand data is the key to success for improving operations and maintenance in the chemical industry.

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