



Digital Transformation at Covestro

Utilizing PI to improve operations and increase OEE

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Andy Bane – Element



ELEMENT

Speakers



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- CEO
- Element
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ELEMENT



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

Digital@Covestro: 3 Dimensions

Digital Operations

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

Visualize, analyze & predict

Collect and structure production data

- Digital R & D
- Mobile Working
- Predictive Maintenance
- Computational Chemistry

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

2

Predict product properties

Agenda

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

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

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

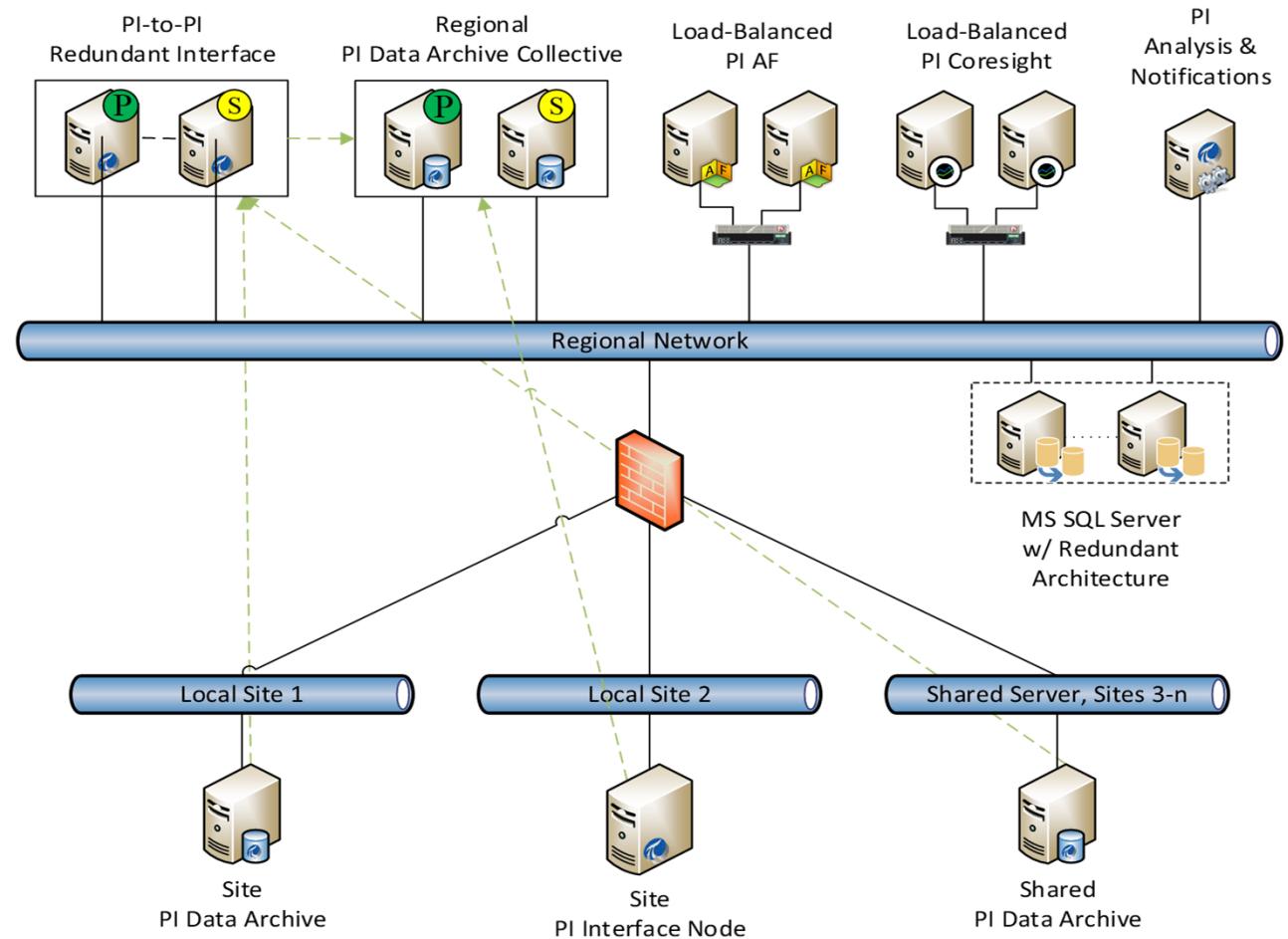
Production



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.



Integration of Online Process Models

Leverage the process modeling know-how

Simulation vs Measurements

Asset	Simulation Variable	Variable Type	Measurement	Simulated Variable	Unit	Absolute Error	Relative Error
A0261	I31A0261	Output	Calc Fail	45.00	%	No Data	No Data
F0111	C31F0111	Input	0	0.25	l/h	0	0.00 %
F4001	C31F4001	Input	14	14.05	l/h	0	0.00 %
F4002	C31F4002	Output	85	81.54			
F4021	C31F4021	Output	80	190.32			
F4030	HO1	Output	Calc Fail	212.19	l/min	No Data	No Data
F4112	C31F4112	Input	3.295	3.753,38	m ³ /h	517	16.01 %
F4130	HO2	Output	Calc Fail	16.58	m ³ /h	No Data	No Data
F4301	C31F4301	Output	13.536	17.752,60	m ³ /h	4.216	31.14 %
F4331	HO5	Output	24	60.32	m ³ /h	37	150.87 %
F6001	C31F6001	Output	74	74.76	m ³ /h	6	0.22 %
F6002	C31F6002	Output	364	361.40	m ³ /h	27	0.98 %
P0161	C31P0161	Input	1	1.65	bara	0	0.01 %
P0212	C31P0212	Input	Calc Fail	1.60	bara	No Data	No Data
P0261	C31P0261	Input	Calc Fail	1.60	bara	No Data	No Data
P4021	C31P4021	Output	2	1.66	bara	5	42.83 %
P4111	C31P4111	Output	1			2	1.01 %
P4301	C31P4301	Input	1			0	0.01 %
P6001	C31P6001	Output	3			9	69.43 %
P6002	C31P6002	Output	5			7	6.90 %
P8111	C31P8111	Output	1			2	1.28 %
RM100	C31RM100	Output	No Data	4.00	No Data	0	No Data
T0111	C31T0111	Output	293	307.56	°C	16	4.68 %
T0162	C31T0162	Output	311	307.56	°C	0	1.19 %

Measured data

Simulated data

Difference

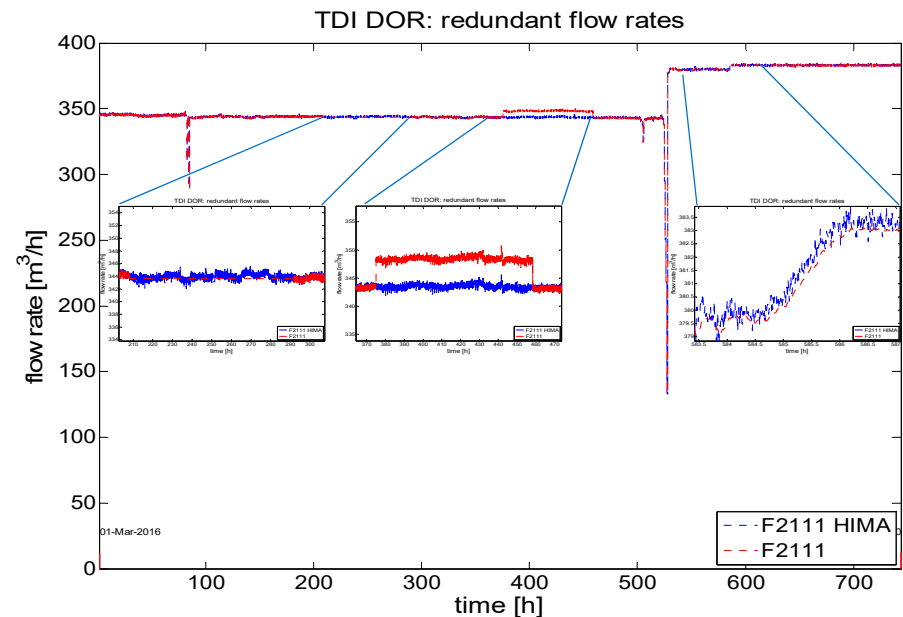
- Benefits from new integration concept
- Easier deployment and maintenance
- Easy supplement of missing sensors for KPI calculations in asset templates
- Early detection of deviations: Indication for sensor failure or process upset
- Validated model offers additional process insights

Comparison of online dynamic model with installed sensors.

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.**






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**



APERIO

How it works

-  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

Sensor Diagnostics Pilot with Element: Outstanding first results!

Element Covestro Data Quality 🕒 ? 🔧 Jie Chou

Data Integrity Report Card

Attribute Coverage of Asset Templates

4 Templates

Template	Average Attribute Coverage (%)	Asset ID Count	Attribute Count	Total Mapped Tag Count
GLB_REGIONAL_IND_COMPLE	--	0	2	0
GLB_REGIONAL_PCT_DEVICE	100%	16218	1	16218
GLB_REGIONAL_PROCESS_AR	--	0	2	0
GLB_REGIONAL_SUB_PROCES	--	0	2	0

GLB_REGIONAL_PCT_DEVICE

Null Tags 1,998 Total

Intermittent Tags 7 Total

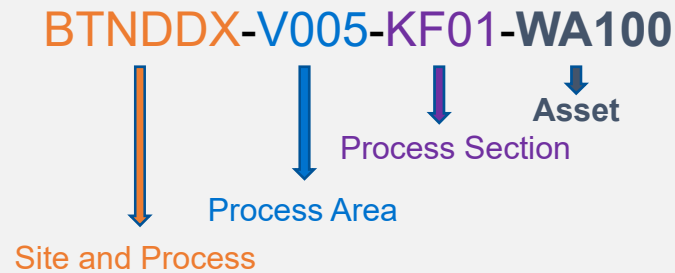
Static Tags 1,824 Total

List of problem tags

List Bad Transmitters

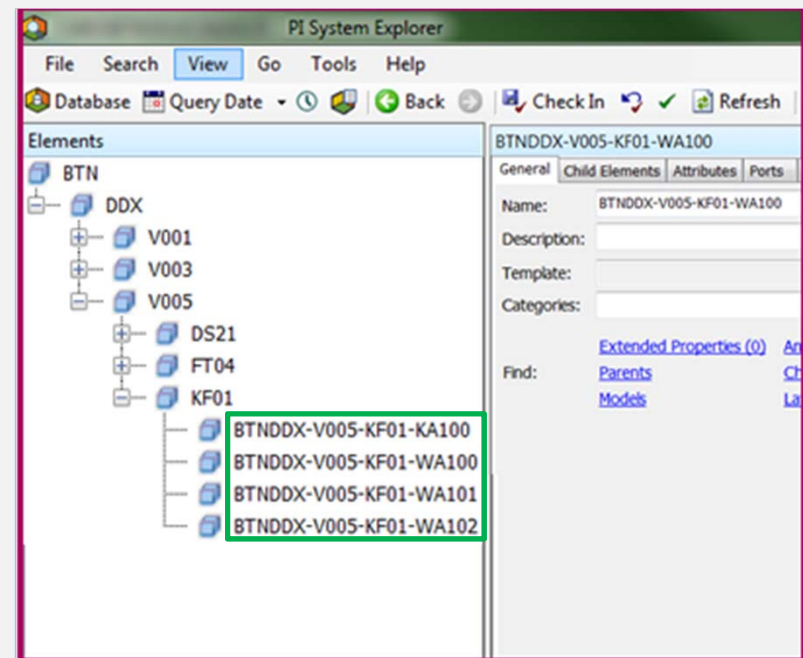
Move & Structure: FLoc Asset Hierarchy (AKZ Corp Standard)

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



- Elements in this hierarchy are based on templates

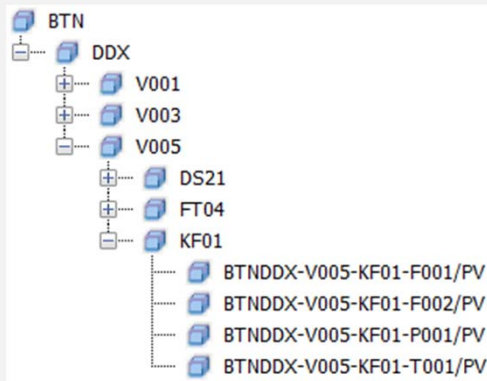
→ Examples of typical templates include Pumps, HEX, Distillation Columns, Reactors, etc.



Move & Structure: Internal References

- Definition of internal references among tag and asset hierarchies

✓ Tag AF hierarchy



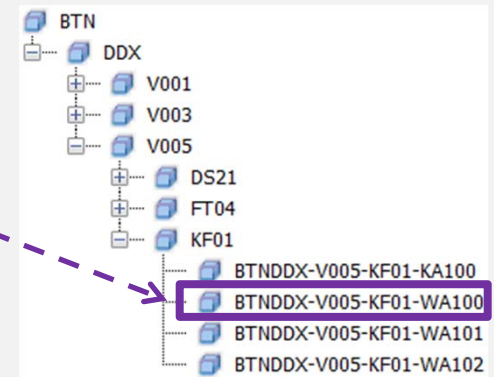
“Data Source“

✓ Template attributes

Name	Unit Of Measure
Category: 4 User Specified Process Measurements from PI Points	
Pressure - Steam	rel. pascal
Pressure - Hot Fluid side - Outlet	rel. pascal
Pressure - Hot Fluid side - Inlet	rel. pascal
Pressure - Gas Flow - Volume Meter	rel. pascal
Pressure - Cold Fluid side - Outlet	rel. pascal
Pressure - Cold Fluid side - Inlet	rel. pascal
Flow Rate - Mass Type - Hot Fluid	kilogram per second
Flow Rate - Mass Type - Cold Fluid	kilogram per second
Temperature - Hot Fluid - Outlet	kelvin
Temperature - Hot Fluid - Inlet	kelvin
Temperature - Gas Flow - Volume Meter	kelvin
Temperature - Cold Fluid - Inlet	kelvin
Temperature - Cold Fluid - Outlet	kelvin
Temperature Difference - Hot Fluid - Inlet_min...	delta kelvin
Temperature Difference - Cold Fluid - Outlet_mi...	delta kelvin
Flow Rate - Volume Type - Hot Fluid	cubic meter per se...

Data + Context + Calculations

✓ Asset AF hierarchy

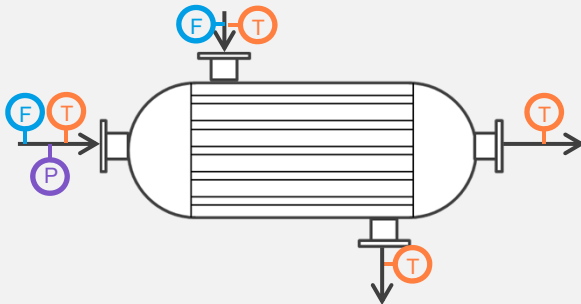


“Data Consumer“

Monitor: AF Template Development

Measured process variables for WA100:

- Flowrates, Temperatures, Pressures



Calculated KPI's for WA100:

- Heat transfer coefficient "U"

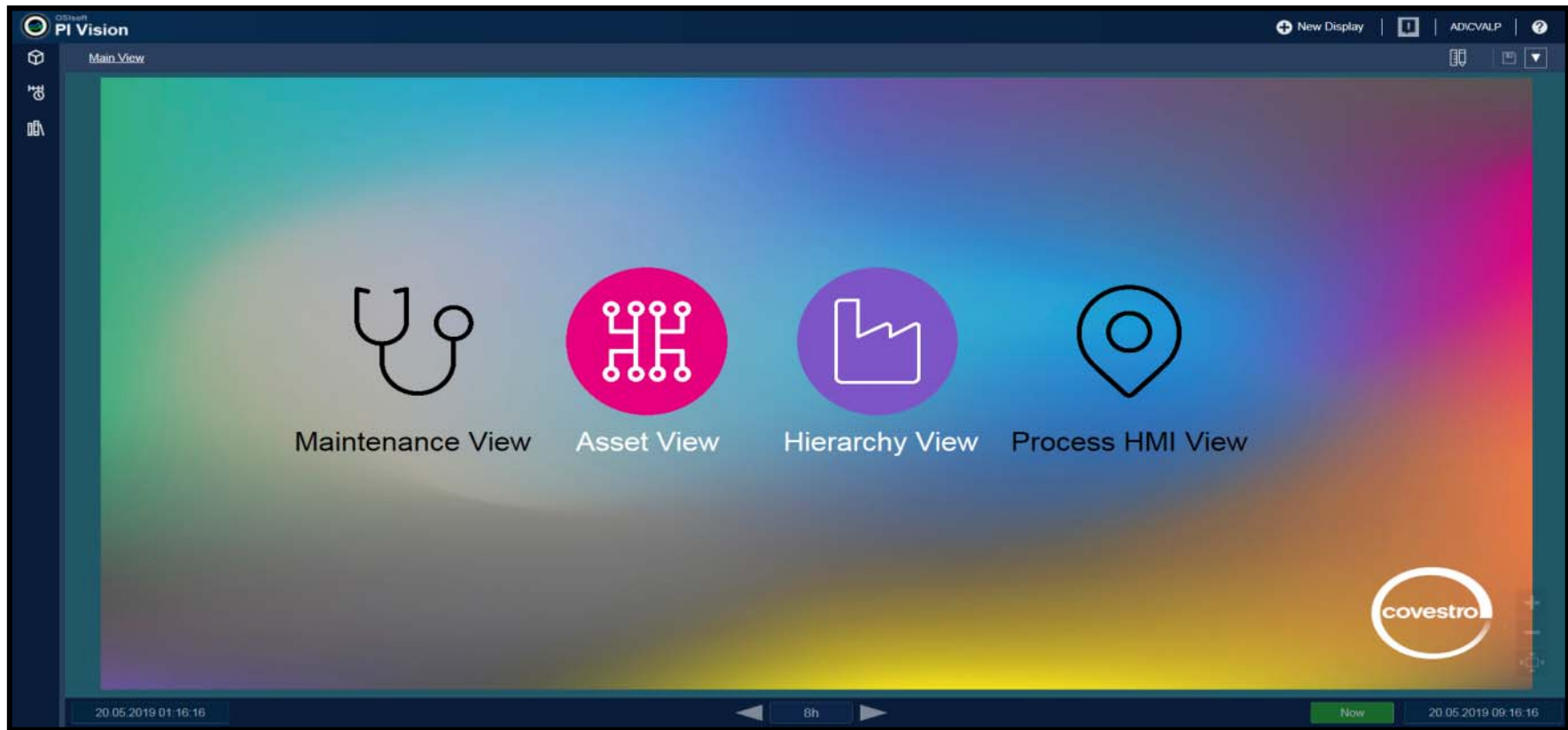
$$U = f(\Delta T_{hot}, \Delta T_{cold}, F)$$

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

Standardized
PI AF Template

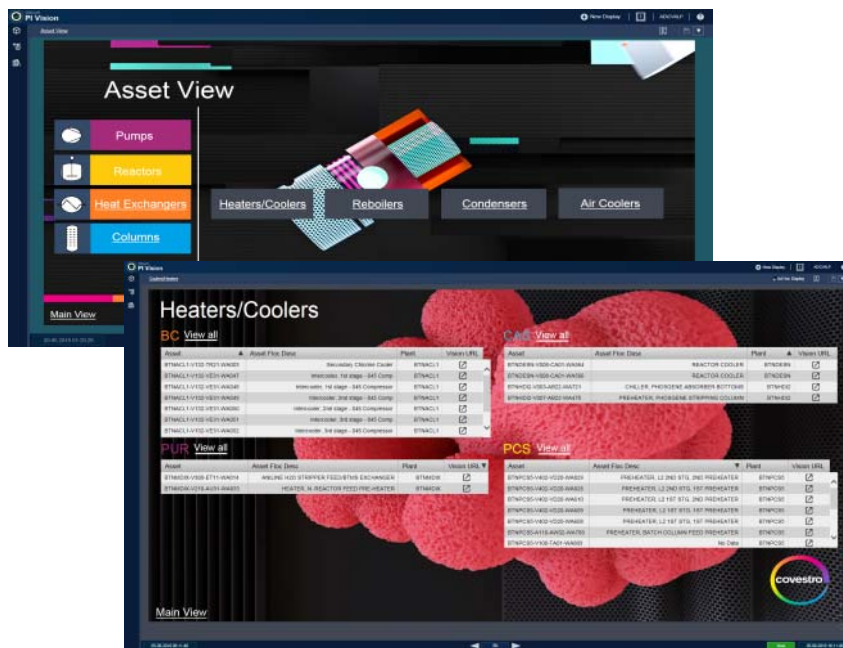
Name	Unit Of Measure
Category: 4 User Specified Process Measurements from PI Points	
Pressure - Steam	rel. pascal
Pressure - Hot Fluid side - Outlet	rel. pascal
Pressure - Hot Fluid side - Inlet	rel. pascal
Pressure - Gas Flow - Volume Meter	rel. pascal
Pressure - Cold Fluid side - Outlet	rel. pascal
Pressure - Cold Fluid side - Inlet	rel. pascal
Flow Rate - Mass Type - Hot Fluid	kilogram per second
Flow Rate - Mass Type - Cold Fluid	kilogram per second
Temperature - Hot Fluid - Outlet	kelvin
Temperature - Hot Fluid - Inlet	kelvin
Temperature - Gas Flow - Volume Meter	kelvin
Temperature - Cold Fluid - Inlet	kelvin
Temperature - Cold Fluid - Outlet	kelvin
Temperature Difference - Hot Fluid - Inlet_min...	delta kelvin
Temperature Difference - Cold Fluid - Outlet_mi...	delta kelvin
Flow Rate - Volume Type - Hot Fluid	cubic meter per se...
Flow Rate - Volume Type - Cold Fluid	cubic meter per se...
Category: 5 Element Configuration Status	
Category: 6 User Specified VTPLAN Results from PI Points	
Category: 7 Calculated Process KPIs	
U - Heat Transfer Coefficient	Watt per square m...
Pressure - Difference - Hot Inlet_minus_Outlet	rel. pascal
Pressure - Difference - Cold Inlet_minus_Outlet	rel. pascal

One-Stop-Shop Visualization: Navigation Cockpit

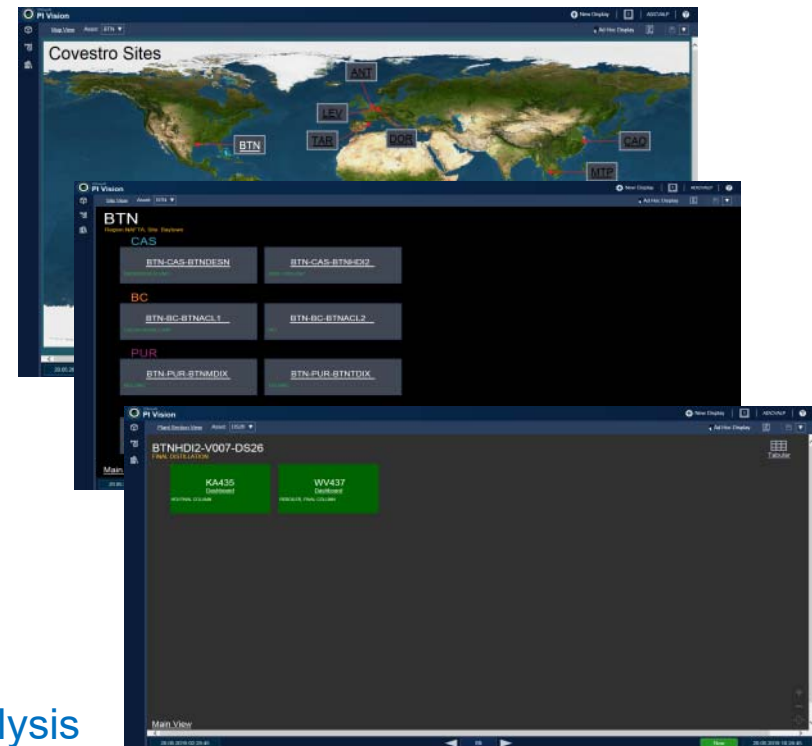


One-Stop-Shop Visualization: Navigation Cockpit

✓ Asset View



✓ Hierarchy View



ProDAVis: Process Data Analysis and Visualization at Covestro

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

The screenshot displays the PI Vision interface for a Heat Exchanger Monitor. The main title is "Heat Exchanger Monitor" for asset "BTN-V002-KF01-WA101" (Condenser). A "Switch Asset" dropdown menu is open, showing a list of assets from "BTN-V002-KF01-WA101" to "BTN-V002-DS02-WA105".

External Analysis (7/10/2018 12:00:00 AM):

- LMTD: 35.123 delta °F
- U - Heat Transfer Coefficient: 52.914 BTU/(h ft² °F)

Status flags (7/10/2018 12:00:00 AM):

- FLOWFLAG: OK
- TEMPERATUREFLAG: 0

Status trends (7/10/2018 12:00:00 AM):

- Cold Fluid inlet Temperature: 97.059 °F
- Cold Fluid outlet Temperature: 103.6 °F
- Hot Fluid inlet Temperature: 143.04 °F
- Hot Fluid outlet Temperature: 133.14 °F
- Cold Fluid flow rate: 24.970 lbh

4. Current Conditions (7/10/2018 12:00:00 AM):

Process diagram showing inlet temperatures of 143.84 °F and 133.14 °F, and outlet temperatures of 103.6 °F and 97.059 °F. A flow rate of 24.970 lbh is indicated.

5. Asset Maintenance History (7/10/2018 12:00:00 AM):

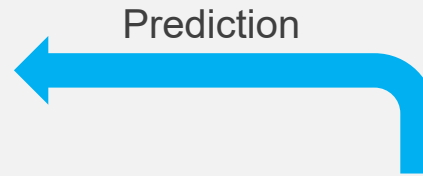
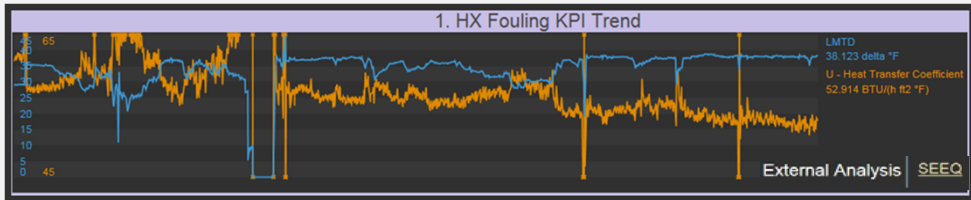
Criticality: 2 - Medium

- 04/30/18—14867440—4—140-564 RX #2 COOLER-SWAP OUT AND CLEAN—COMPLETED
- 04/12/18—14999185—3—140-564 TRIMER RX2 COOLER SPARE-CLEAN—COMPLETED
- 01/04/18—14896252—1—140-564 TRIMER RX2 COOLER SWAPOUT—completed by Maint

Timeline: 6/12/2018 12:00:00 AM to 7/10/2018 12:00:00 AM. Navigation: 28d, Now.

Seamless Integration of Self Service Analytics

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



Seeq 17 Connected

Searching within TESTV2 >

Name contains...

Reset

» BTN DEV » HXFOULING » TESTV2

- BTN-V002-KF01-WA100
- BTN-V002-KF01-WA101**
- BTN-V002-KF01-WA102
- BTN-V002-AL03-WA001
- BTN-V002-AL03-WA002
- BTN-V002-AL03-WA011
- BTN-V002-AL03-WA012
- BTN-V002-AL03-WA013
- BTN-V002-BA01-WA001

»

Seeq 17 Connected

Searching within BTNACL1-V132-VE31-WA047 >

Name contains...

Reset

» BTN DEV » HXFOULING » TESTV2 >

BTN-V002-KF01-WA101

- Hot Fluid flow rate (lb/h)
- Hot Fluid flow rate CORRECTED (lb/h)
- Hot Fluid inlet Temperature (°F)
- Hot Fluid Inlet Temperature corrected (°F)
- Hot Fluid outlet Temperature (°F)
- Hot Fluid Outlet Temperature corrected (°F)
- TEMPERATUREFLAG
[0 = OK; 1 = INLET issue; 2 = OUT issue; 3 = BOTH issue]
- U - Heat Transfer Coefficient**

»

Seeq 17 Connected

Heat Exchanger Fouling - 1

U - calculated from PI-AF

U ... linear prediction in SEEQ

U - threshold before cleaning

~ 4 months to cleaning

9/18/2017 2:04 PM CDT

11/29/2015

Details

Name	Unit
ib-C/min UA s/d filtered	ib-C/min UA s/d filtered
ib-C/min UA prediction	ib-C/min UA prediction
ua threshold	ua threshold

Covestro Pump Health Monitor



FLOC Desc	Pump1 AKZ	Criticality	OST % Period1	Pump1 Impeller power Non-Compliance				Pump2 AKZ	OST % Period1	Pump2 Impeller power Non-Compliance				Dual Pump Flag	
				Last 180 d	Last 30 d	Last 7 d	Last 1 d			Last 180 d	Last 30 d	Last 7 d	Last 1 d		
Pump A clmn btm	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 btm	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 btm	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

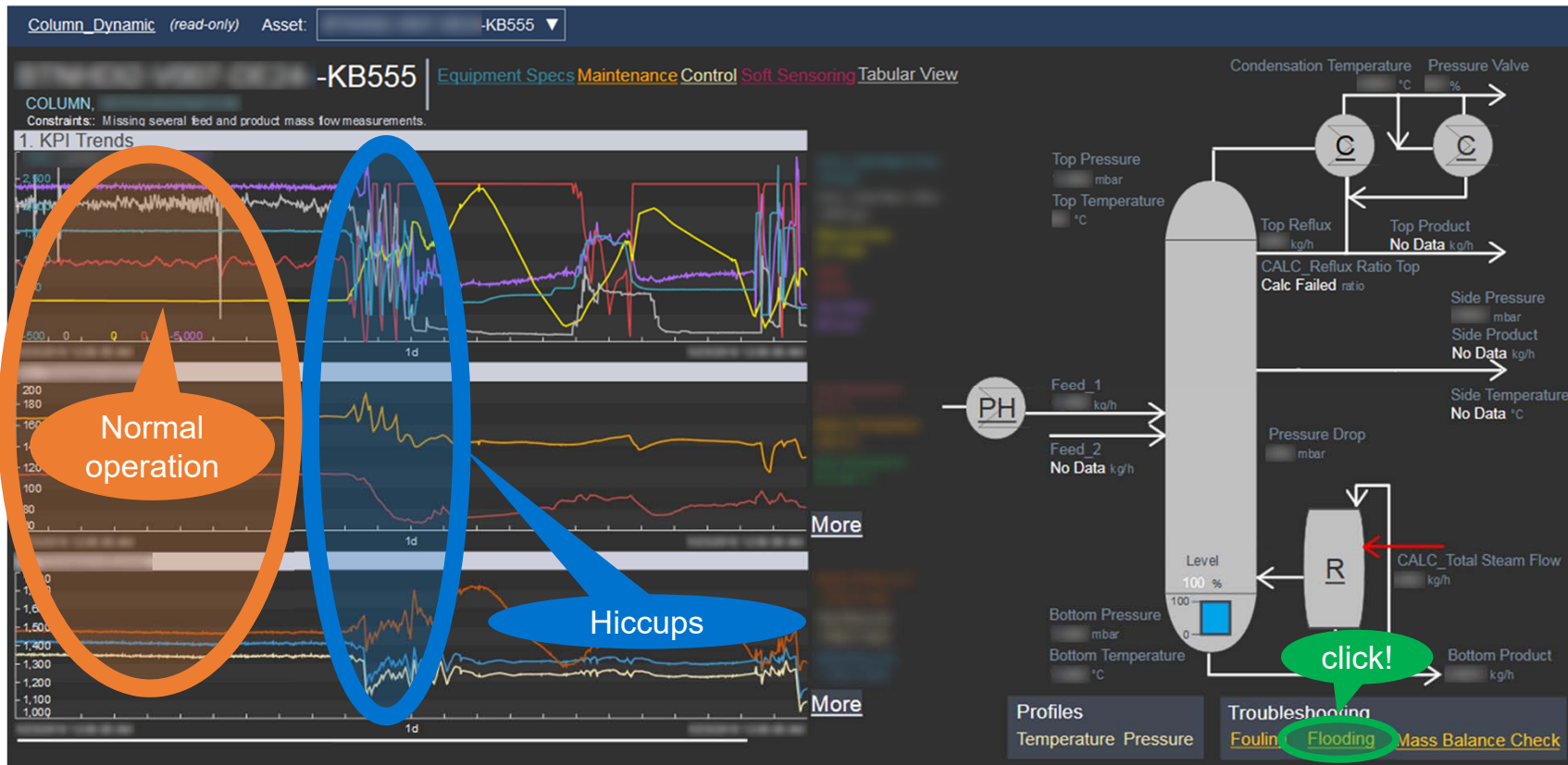
Dual Pump Operation > 60 min in Last 30 Days

10/9/2019 5:06:54 AM

8h

Now

One-Stop-Shop Visualization: Asset Monitors



Digitalization = Augmented Intelligence

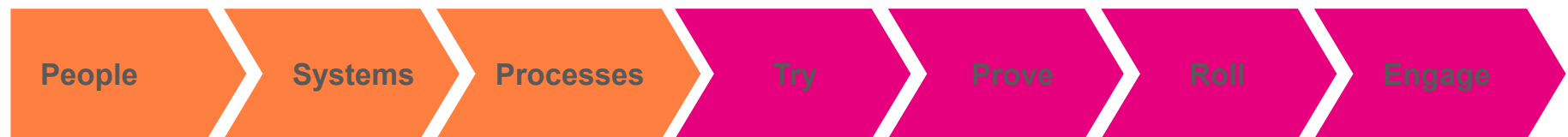
We want to get all information available to humans to decide on path forward.

The machines give recommendations, the humans pick and choose.



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.



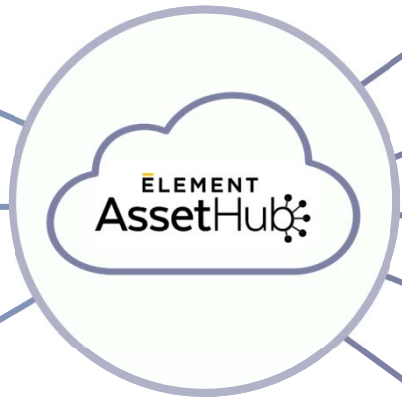
Enabling One-Stop Shop at Covestro

Meta Data Producing Systems


 **OSIsoft.**
PI Tag Configuration


 **SAP**
Asset List

 **HEXAGON**
Asset List




Application and Consuming Analytics Systems

 OSIsoft instrumentation
AF compliant with
German AKZ standard

 Sensor Diagnostics bad
PI data reporting

 **Seeq**
Asset Health for:
- Pumps
- Carbon Filters
- Mixed bed Exchangers
- Anion & Cation Exchangers

 **Power BI**
Asset Health – Pumps, Heat
Exchangers, Columns,
Extruders,
Reactors, and Reboiler

 **Power BI**
Inconsistent Units of
Measurement and Current
Values Report

The Journey

Today

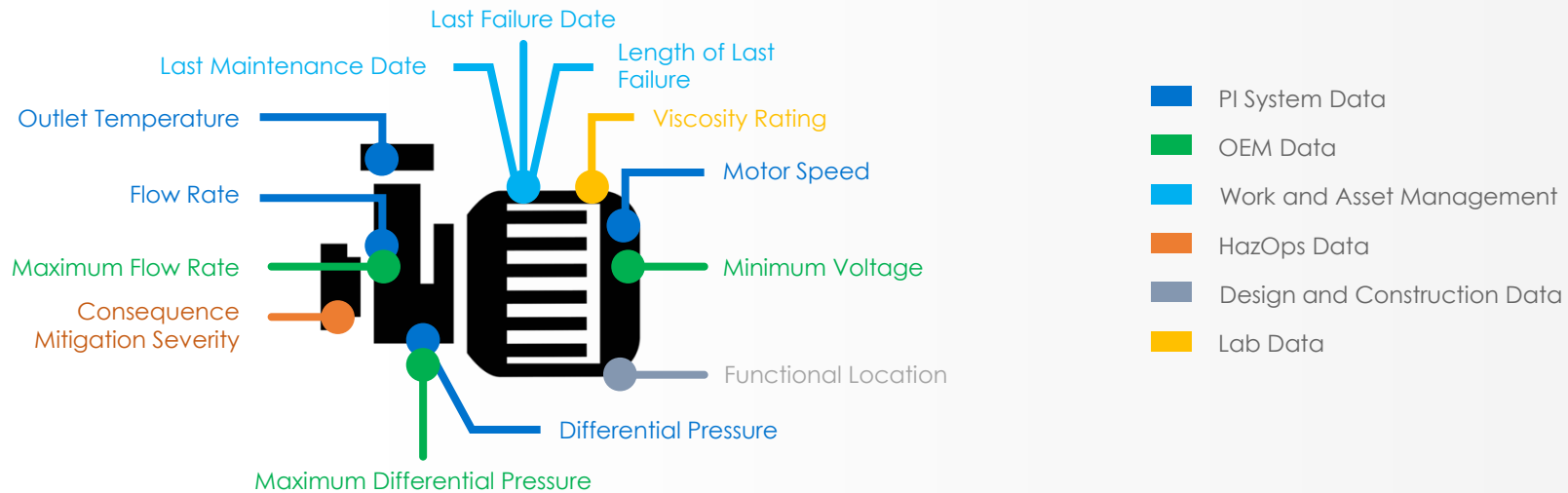
- AF Build
- AKZ tag renaming
- Sensor Diagnostics

Work in Progress

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

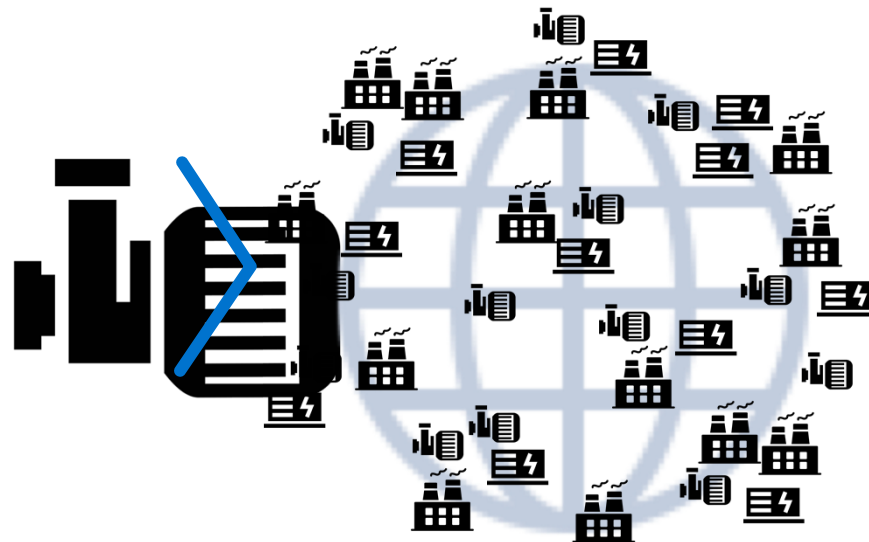
Industrial Asset Data Is Messy and Complex

One Pump: Hard to Process, Multifaceted Data



At Enterprise Scale, It's Unmanageable

1,000
pumps and
across
50
production sites



RESULTS IN

Virtual Blind Spots in
Decision Making

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 enrich 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.

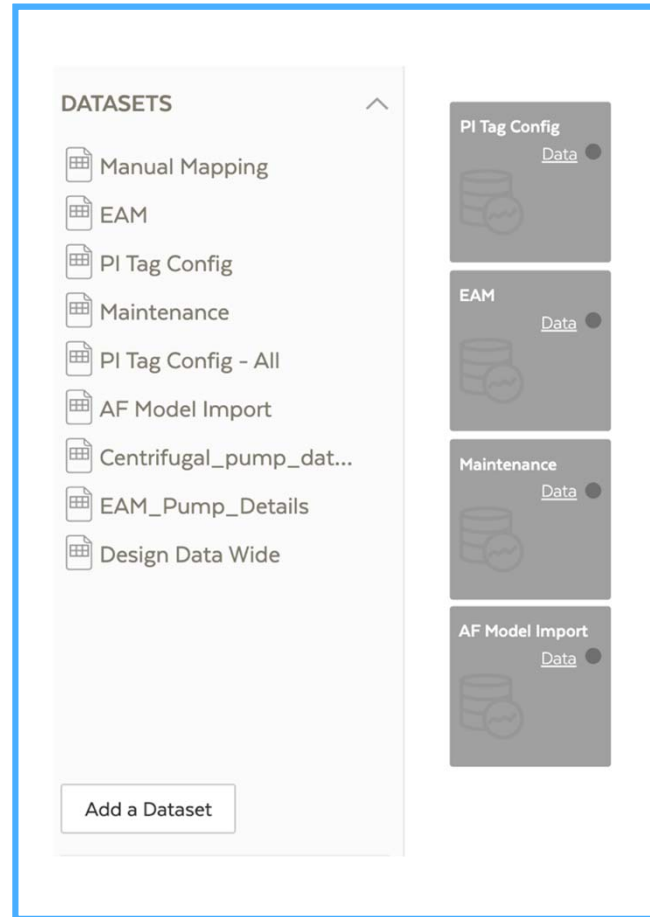


AssetHub

Purpose-Built for Industrial Data



Across data silos



Features

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

AssetHub

Purpose-Built for Industrial Data



Across data silos

	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
20	BYTN_04TI1792.PV	STG1 COND E116 CWR	Float32	DEG F	R	3188

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

Template Library

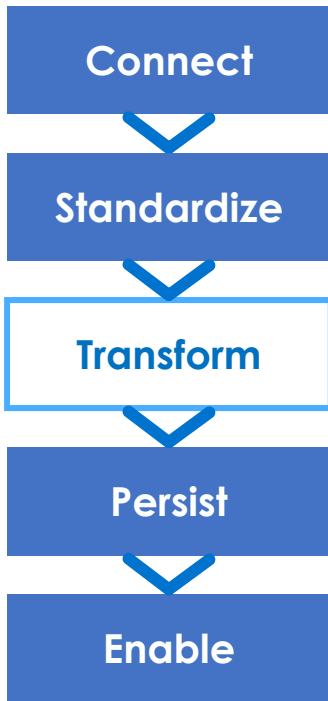
Standardized class definitions



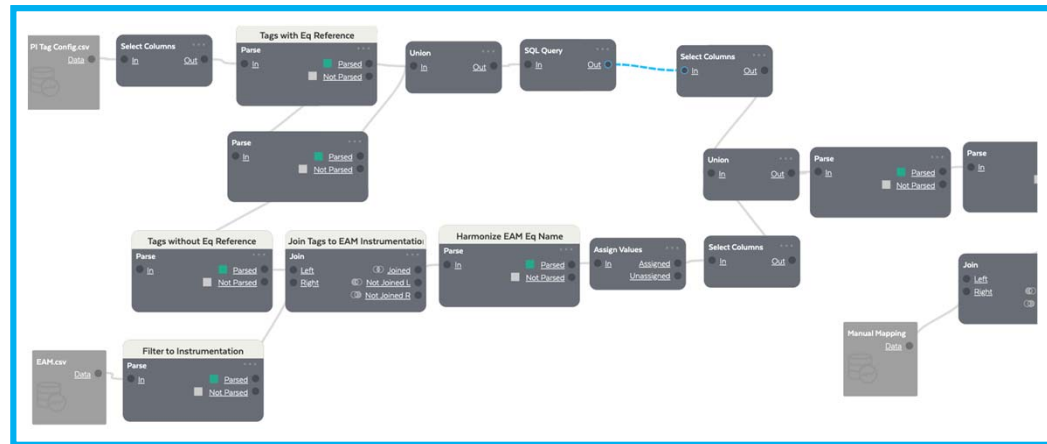
Template Name	Total Attributes	Important	Last Updated By	Last Updated
Agitator (Element)	8	Current	Element Admin	05/21/2019 10:49am
Air Dryer (Element)	2		Element Admin	05/21/2019 10:49am
Area	3		Element Admin	02/13/2020 6:33pm
Axial Compressor (Element)	74	Power, Reference Temperature	Element Admin	05/21/2019 10:49am

Asset Pipeline

Transform, cleanse, and integrate data sources



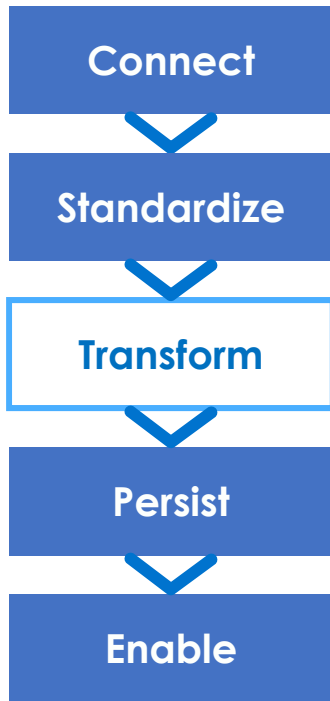
- No code / model driven development
- Orchestration and persistence
- Encode business knowledge
- Regular Expressions
- Fuzzy Logic
- Asset standardization



description	desc_parsed_a	Equipment Code Parsed	description-3	description-4
Inlet Vol Flow Rate	Inlet Vol Flow Rat	e		
Suct Press	Suct Pres	s		
rot speed	rot spee	d		
Vol Flow Rate at Suct C223	Vol Flow Rate at Suct	C		
Disch Temp	Disch Tem	p		
V-349valve opening	V-349valve openin	g		
V-325Valve Diff Press	V-325Valve Diff Pres	s		
Disch Press C-367	Disch Press	C	-	
Diff Press P-264	Diff Press	P	-	
rot speed P282	rot speed	P		
Out valve opening	Out valve openin	g		
Disch Press	Disch Pres	s		
Out Temp	Out Tem	p		
Power	Power	r		
Suct Temp C-258	Suct Temp	C	-	
Out valve opening	Out valve openin	g		
Inlet valve opening T-210	Inlet valve opening	T	-	
Mass Flow Rate	Mass Flow Rat	e		

Asset Pipeline

Transform, cleanse, and integrate data sources

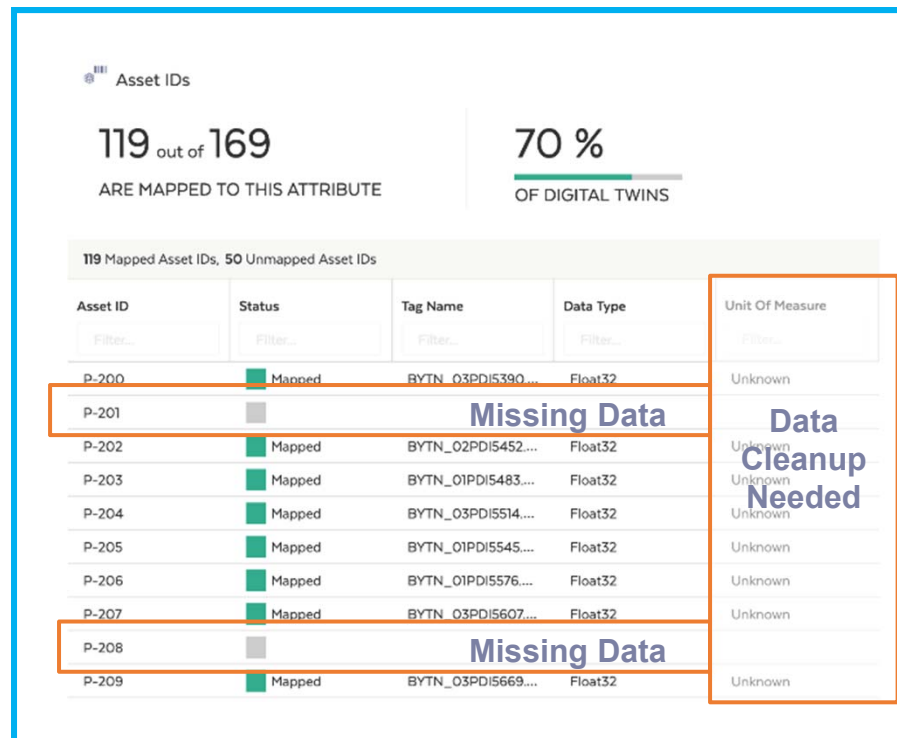
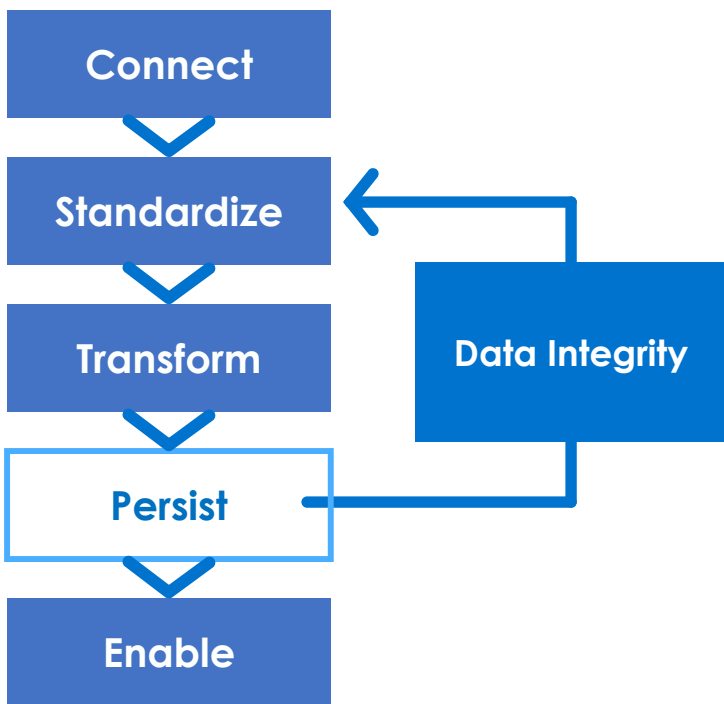


- No code / model driven development
- Orchestration and persistence
- Encode business knowledge
- Regular Expressions
- Fuzzy Logic
- Asset standardization

Search	Match	Accuracy
<input type="text" value="Filter..."/>	<input type="text" value="Filter..."/>	<input type="text" value="Filter..."/>
Valve	VLV	100
Valve	viv	100
Valve	VALVE	100
Valve	Valve	100
Valve	Vlv	100
Valve	VLVS	100
Valve	VALVES	100
Valve	vivS	100
Valve	valve	100
Valve	Val	80
Valve	vl	80
Valve	Value	80

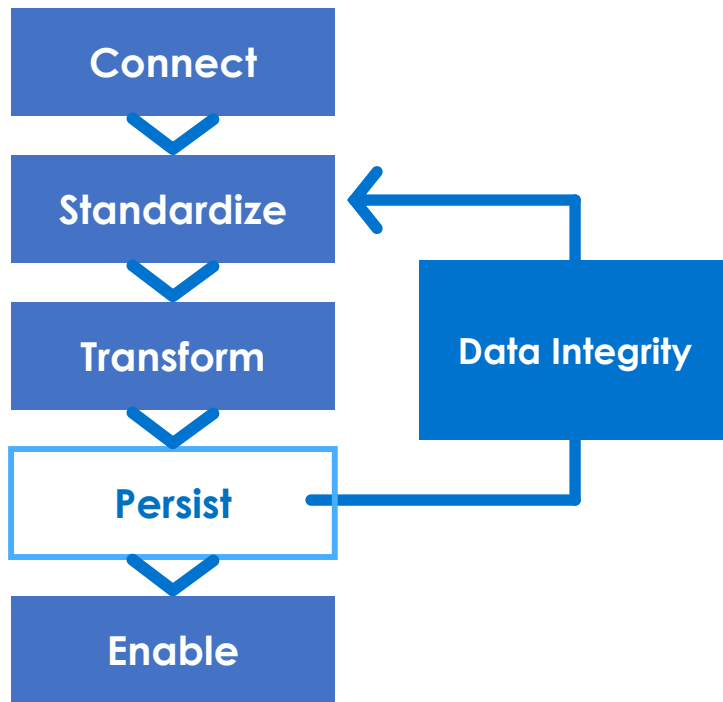
Asset Integrity Report Card

Identify model gaps to ensure trusted applications



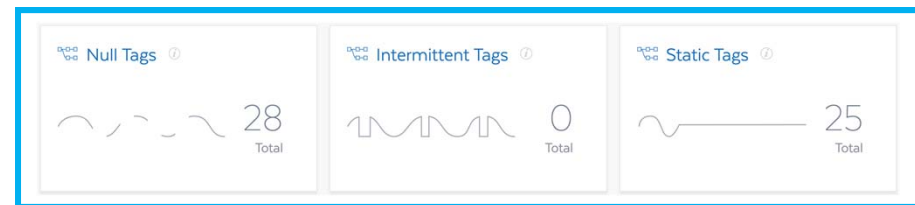
Sensor Diagnostics

Identify tags reporting bad data



Features

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



Problem Tags

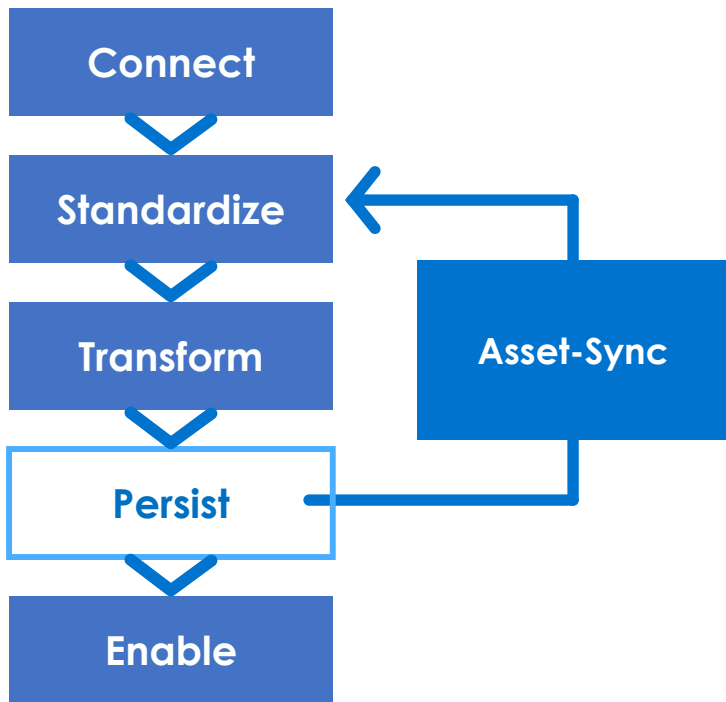
Asset Template: Compressor, Centrifugal (Element)

53 Tags

Issue Type	Tag Name	Sensor Name	Descriptor	Eng Units	Last Value	Consecutive Days	Equipment Name	Criticality
Null Sensor	43JI6980.PV	Power	POWER C-43452	KW		97	Centrifugal Comp...	1
Static Sensor	46EI5517.PV	Voltage	VOLT C-46283	V		97	Centrifugal Comp...	1
Static Sensor	46FI5521.PV	Flow Rate	FLOW C-46283	m3/min		97	Centrifugal Comp...	1
Null Sensor	44PI7831.PV	Discharge Pressure	DISC PRESS C-4...	psi		97	Centrifugal Comp...	1
Null Sensor	44FI7834.PV	Flow Rate	FLOW C-44625	m3/min		97	Centrifugal Comp...	1
Static Sensor	43PDI5269.PV	Differential Press...	DIFF PRESS C-43...	psi		97	Centrifugal Comp...	1
Null Sensor	43JI8140.PV	Power	POWER C-43368	KW		97	Centrifugal Comp...	1

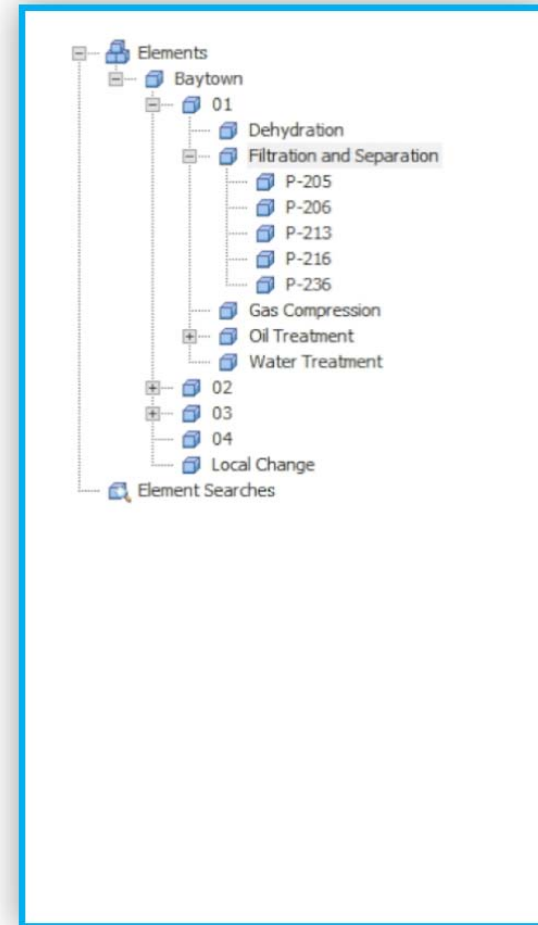
Asset-Sync

Evergreen models to stay in sync with physical asset changes



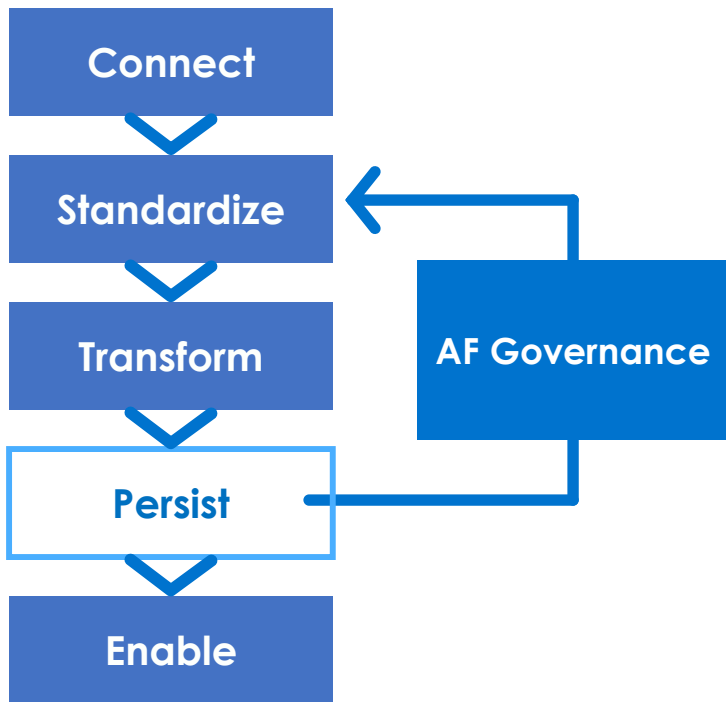
Features

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



AF Governance

Empower sites and ensure corporate standards



Features

- Identify / address ungoverned local changes
- Centrally manage AF models

Corporate Cross-fleet templates

Baytown

- 01
- 02
- 03

Filteration and Separat

- P-207
- P-209
- P-217
- P-221
- P-222
- P-228
- P-229
- P-230
- P-231
- P-234
- P-243
- P-244
- P-252

Baytown Site-specific hierarchy and analytics

Baytown

- 01

Filteration and Separation

- P-205
- P-206
- P-213
- P-216
- P-236
- P-238

Port Arthur Site-specific hierarchy and analytics

Baytown

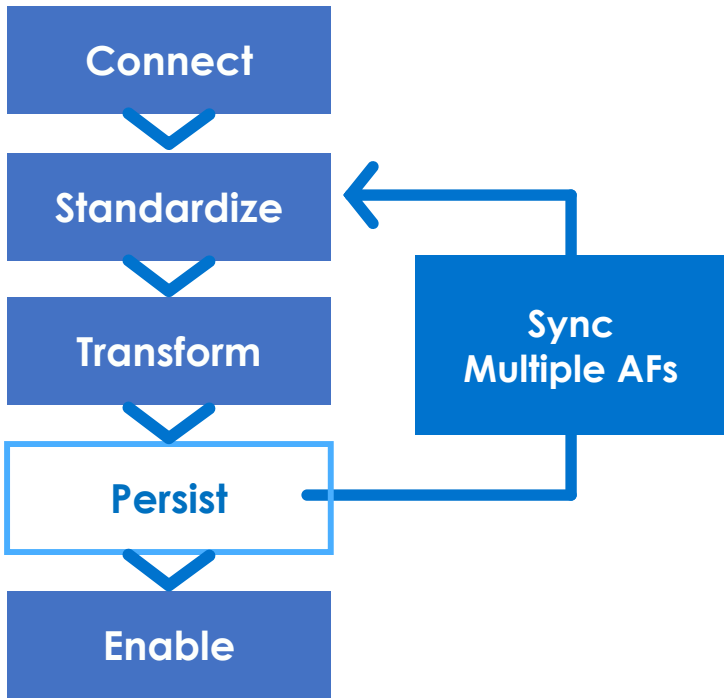
- 01
- 02
- 023
- 0234

Filteration and Se

- P-201
- P-202
- P-212
- P-214
- P-215
- P-220
- P-223
- P-224
- P-226
- P-233

AF Synchronization

Keep multiple AFs in sync



Features

- Sync multiple AFs associated with same assets

Sandbox Testing and design

Baytown

- 01
- 02
- 03
- Filtration and Separat
 - P-207
 - P-209
 - P-217
 - P-221
 - P-222
 - P-228
 - P-229
 - P-230
 - P-231
 - P-234
 - P-243
 - P-244
 - P-252

Development

Baytown

- 01
- Filtration and Separation
 - P-205
 - P-206
 - P-213
 - P-216
 - P-236
 - P-238

Production

Baytown

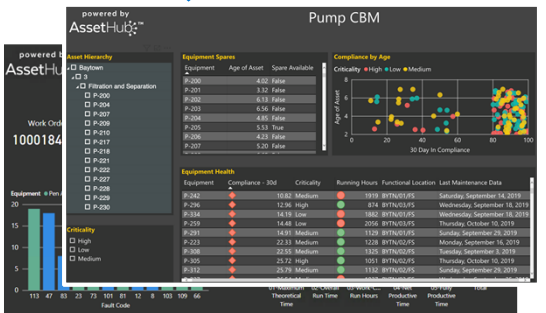
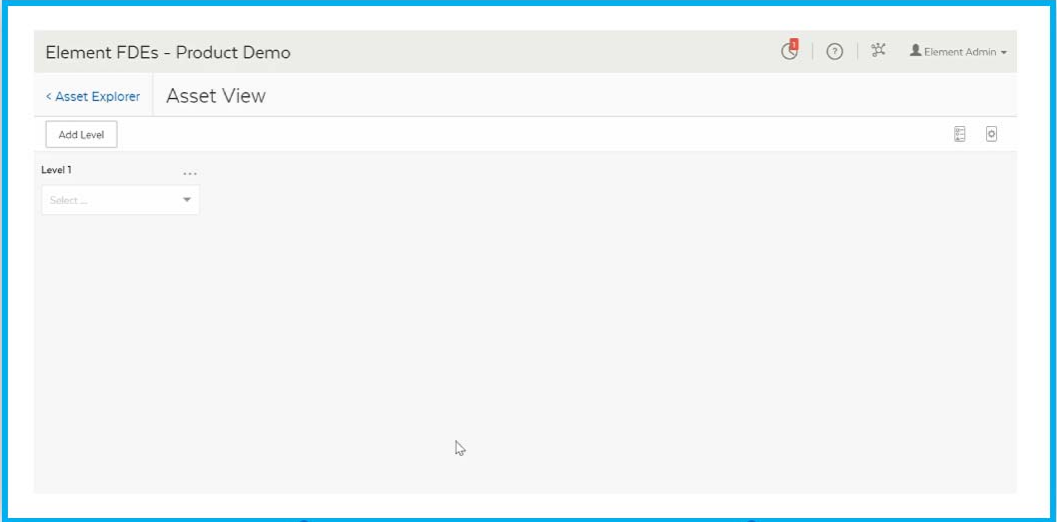
- 01
- 02
- 023
- 0234
- Filtration and Se
 - P-201
 - P-202
 - P-212
 - P-214
 - P-215
 - P-220
 - P-223
 - P-224
 - P-226
 - P-233

Asset Explorer

Rapidly create new AFs



Unlimited use case and personas



Benefits:

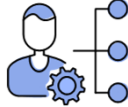
Scale Organized Data to Infinite Use cases

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



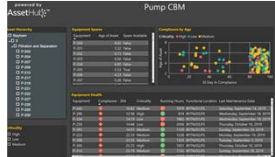
Maintenance




- 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




Instrumentation SMEs




- Ensure process safety

Applications

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




Data Science



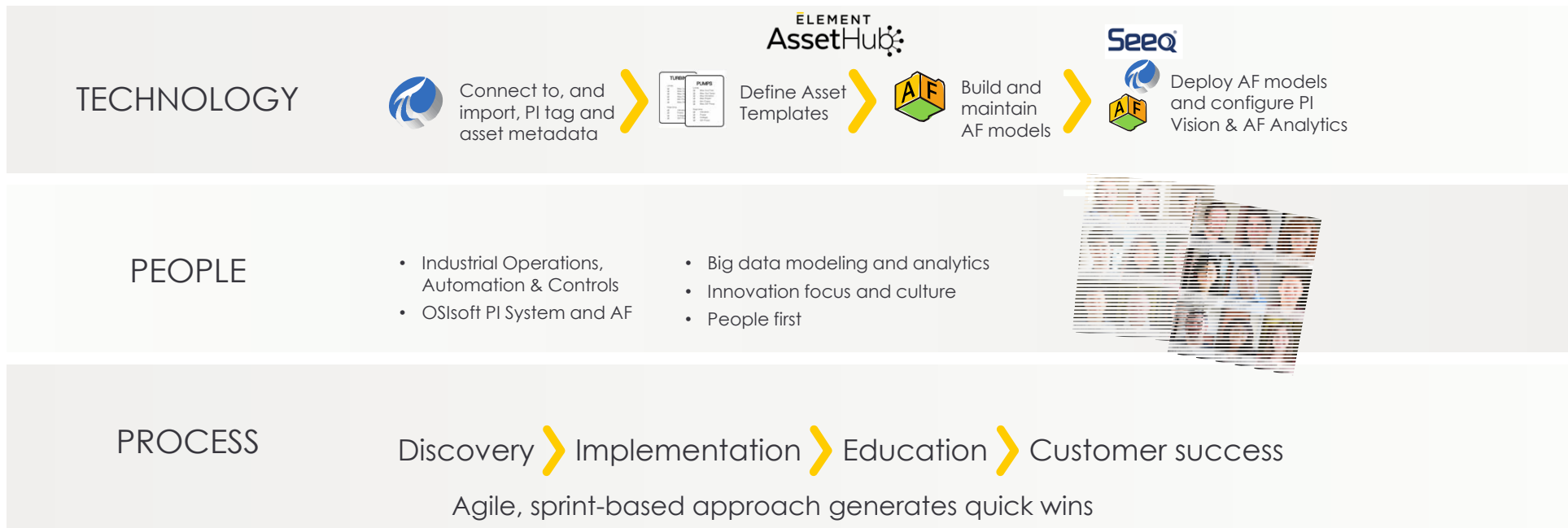
- Unlock silos of data
- Think big, model once, go fast
- Reduce redundant work

Applications

- Advanced analytics
- R/Python
- Data Lake



Orchestrating People, Process & Technology



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.

