Enabling the Process Engineer with PI AF and Data Analytics -A Journey-

Aubyn Chavez

Cornerstone Chemical Company
Building value, together.

©2020 OSIsoft, LLC

Aubyn Chavez

- Digitalization & Process Technology Engineer
- Cornerstone Chemical Co.
- Aubyn.Chavez@cornerstonechemco.com

©2020 OSIsoft, LLC

Cornerstone A safe producer of intermediate chemicals

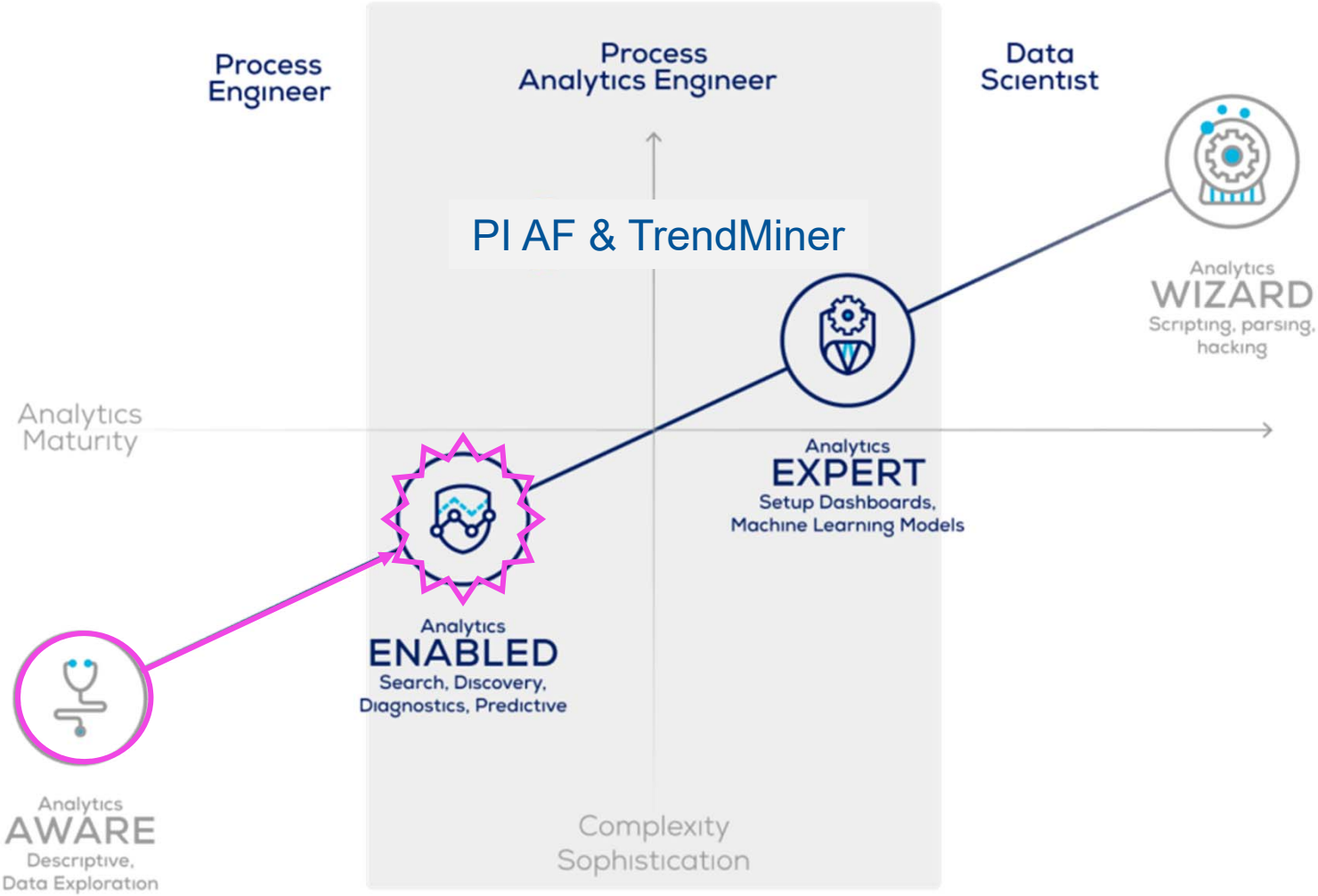
	Acrylonitrile	Melamine	Sulfuric Acid
Leading Industry Position	#2 North America Producer	Sole North American Producer	Leading Producer of Non-Fuming & Regen Acid in the USGC
End Market	• Consumer Products • Water Treatment • Aerospace • Energy • Transport	• Building Products • Consumer Products • Transport • Industrial Products	• Consumer Products • Building Products • Industrial Products • Water Treatment • Transport

©2020 OSIsoft, LLC

Why process engineers?

They are the most intimate with the chemical process.

©2020 OSIsoft, LLC



©2020 OSIsoft, LLC

Analytical Tools

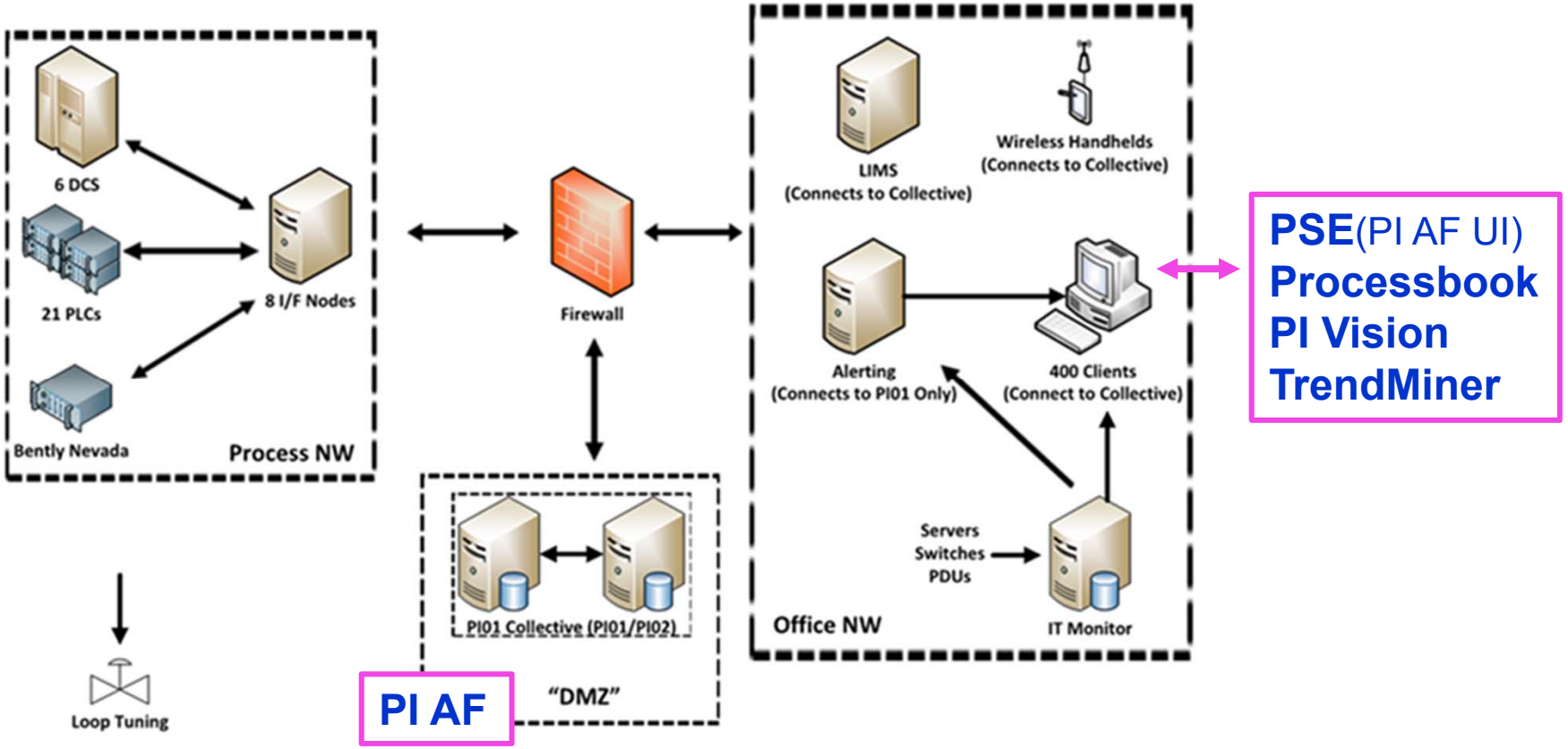
Application · Approach · Obstacles · Synergy

Examples

Report Automation · KPI Automation · Discovery · Diagnostics

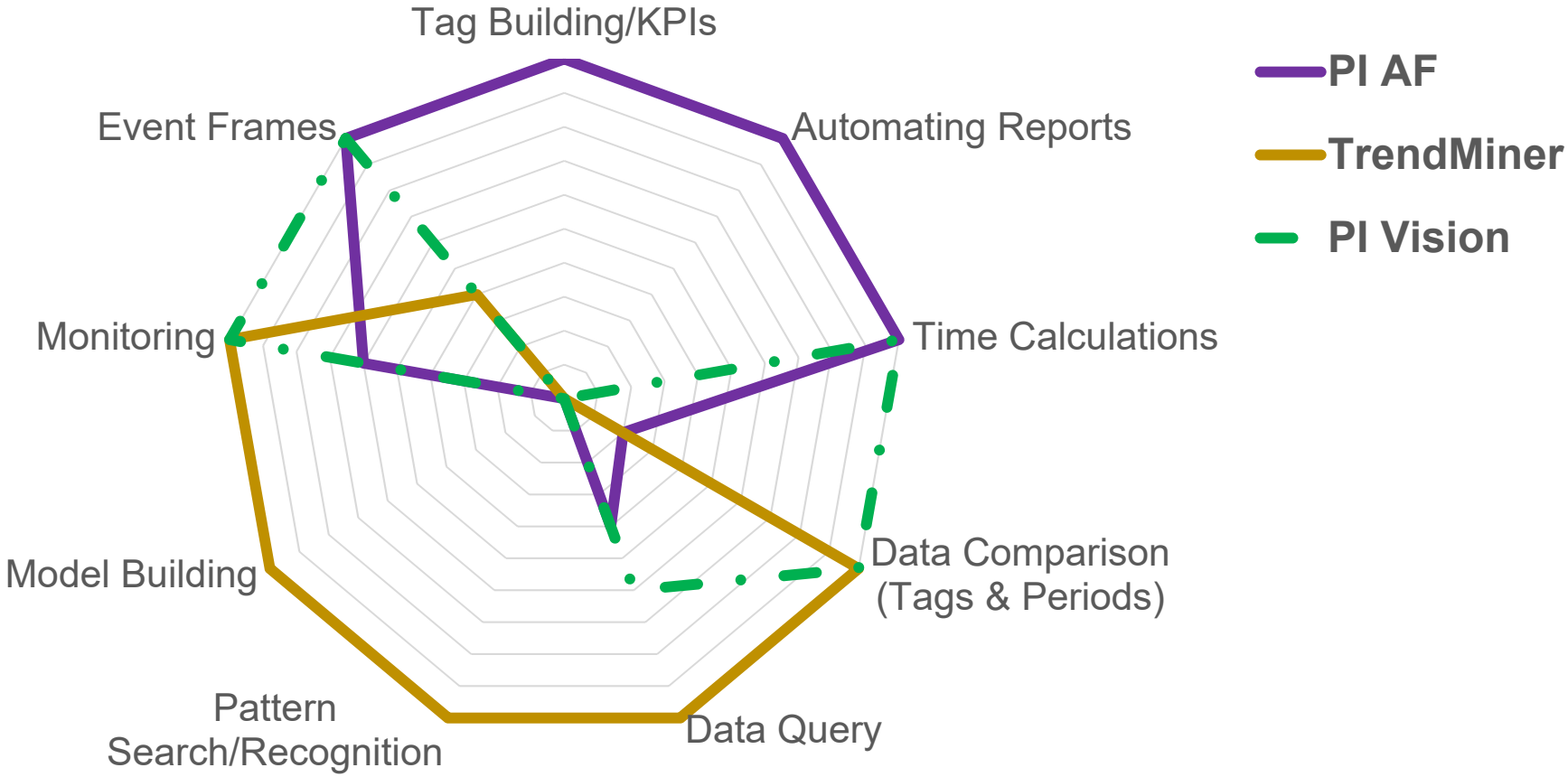
©2020 OSIsoft, LLC

Cornerstone's OT Architecture



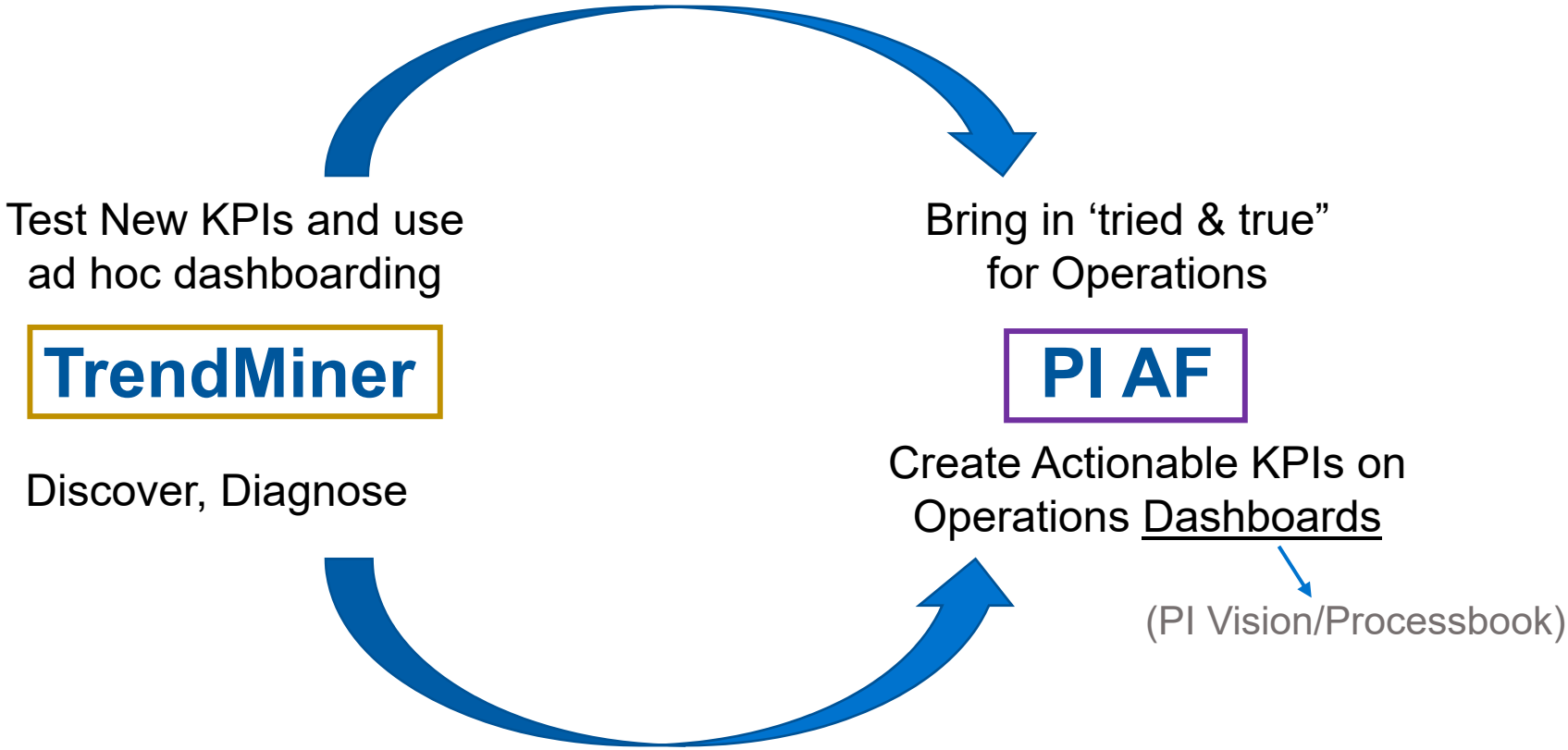
©2020 OSIsoft, LLC

Synergy



©2020 OSIsoft, LLC

PI AF & TrendMiner Synergy



©2020 OSIsoft, LLC

DMAIC and how the tools apply:

Define the problem

Measure – aligned baseline metric

Analyze – find root cause, influences

Improve – implement solutions, verify improvement with metric

Control – sustaining improvement

PI AF

TrendMiner

PI AF,
PI Vision &
TrendMiner

PI AF,
PI Vision &
TrendMiner

©2020 OSIsoft, LLC

‘Measure’ Obstacles

The ‘right’ KPIs	Data Wrangling
How do we measure performance? Are all groups aligned on the calculation?	Does the data exist? Is the data reliable? Avoid: GarbageIn→GarbageOut

©2020 OSIsoft, LLC

Example

The ‘right’ KPIs

Data Wrangling

Raw Material Usage KPIs: NH3 in Melamine Unit

Finance:

$$\left(\frac{UreaTot}{MelTot}\right) * \left(\frac{NH3Tot}{UreaTot} + \frac{NH3Credit}{UreaTot}\right) * \frac{-NH3Credit}{MelTot}$$

Values come from ERP System (not a PI Tag)

Not aligned

Engineers:

$$\frac{NH3Tot - NH3Sold - UreaInv}{MelTot}$$

Unreliable Transmitter for “NH3Sold” variable

©2020 OSIsoft, LLC

Analytical Tools

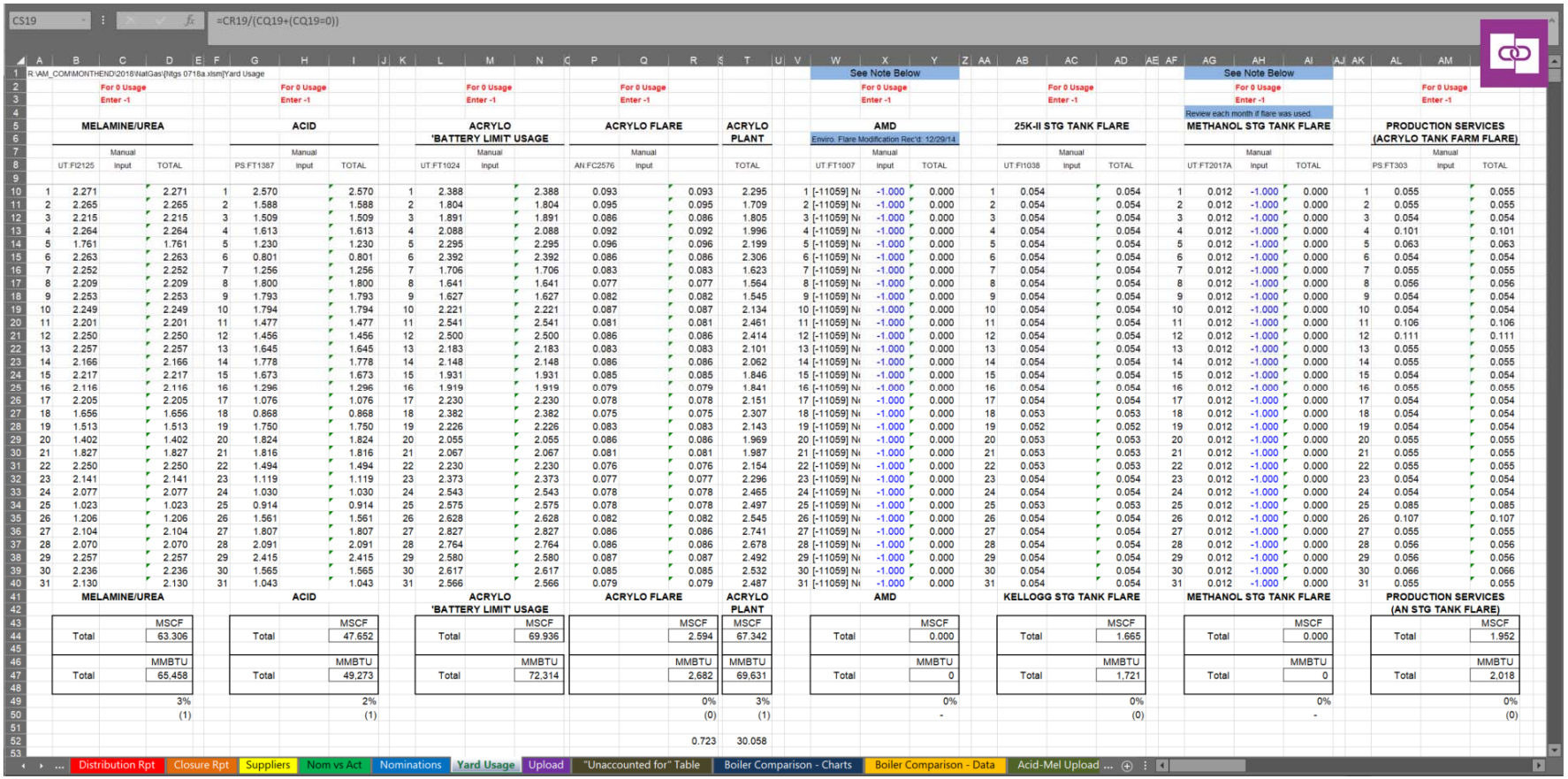
Application · Approach · Obstacles · Synergy

Examples ★

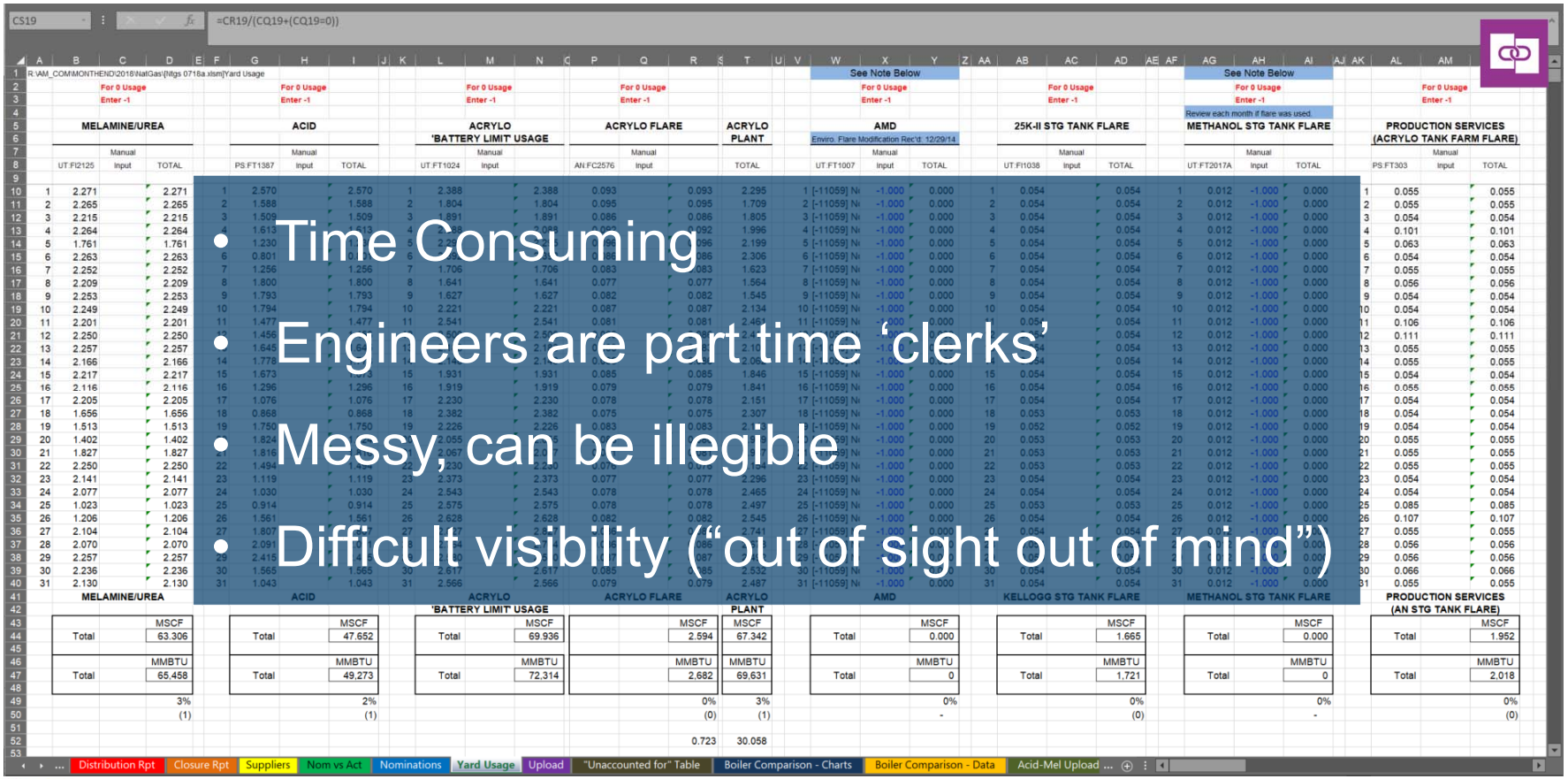
Report Automation · KPI Automation · Discovery · Diagnostics

©2020 OSIsoft, LLC

Manual Reports



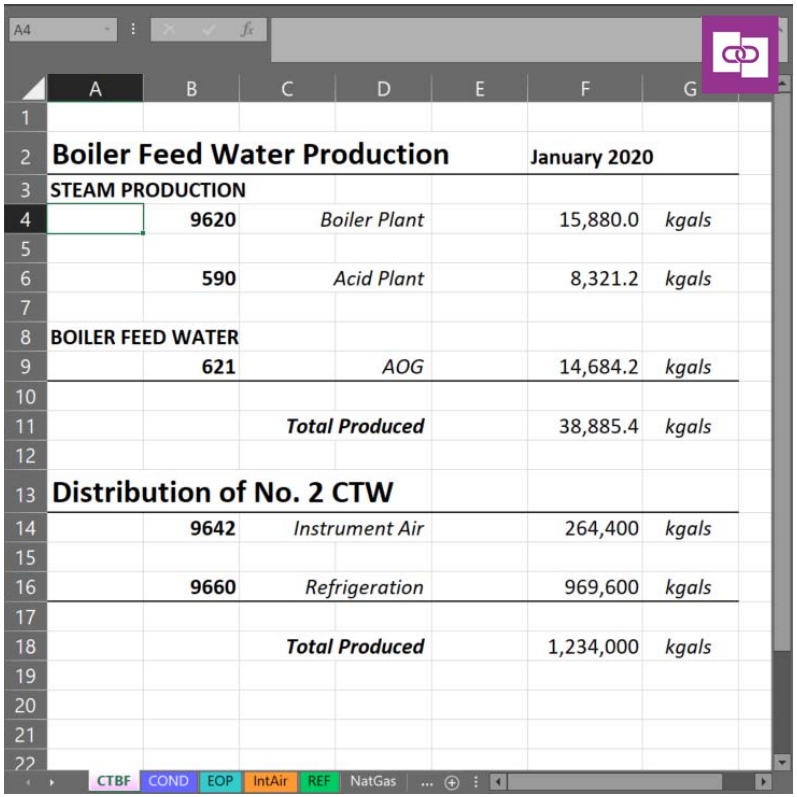
Manual Reports



- Time Consuming
- Engineers are part time ‘clerks’
- Messy, can be illegible
- Difficult visibility (“out of sight out of mind”)

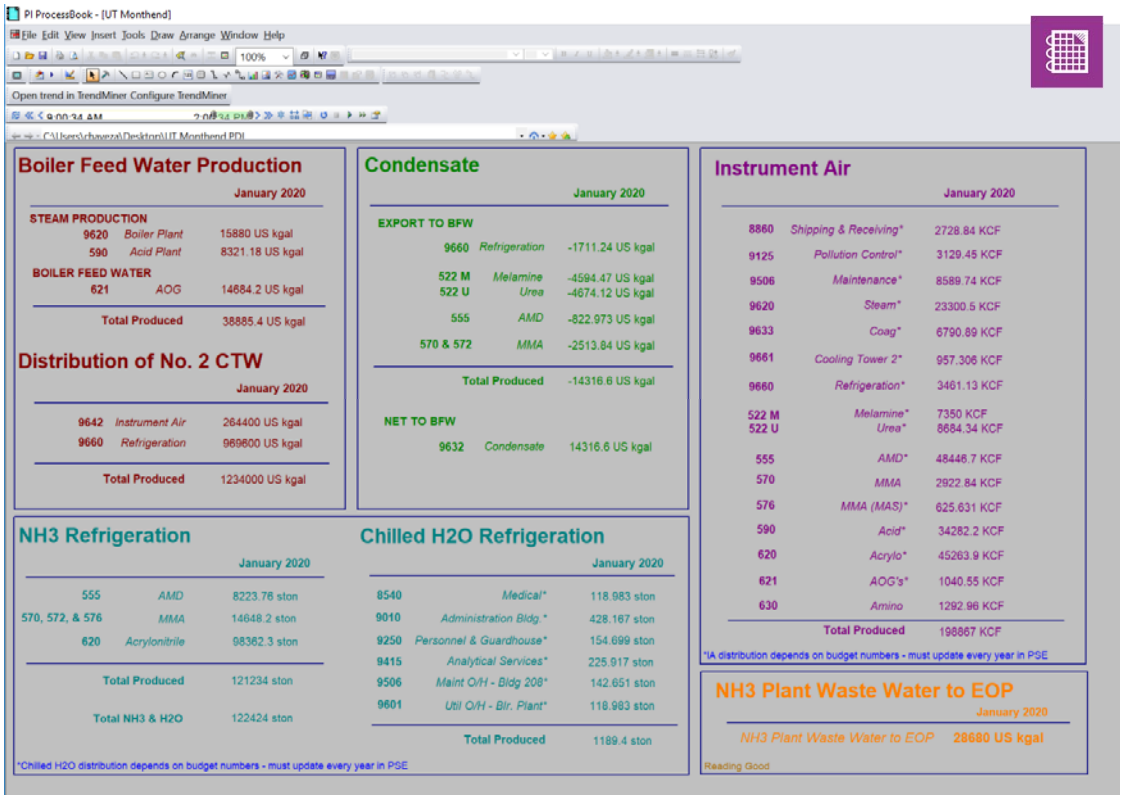
©2020 OSIsoft, LLC

PI AF – automate excel reporting



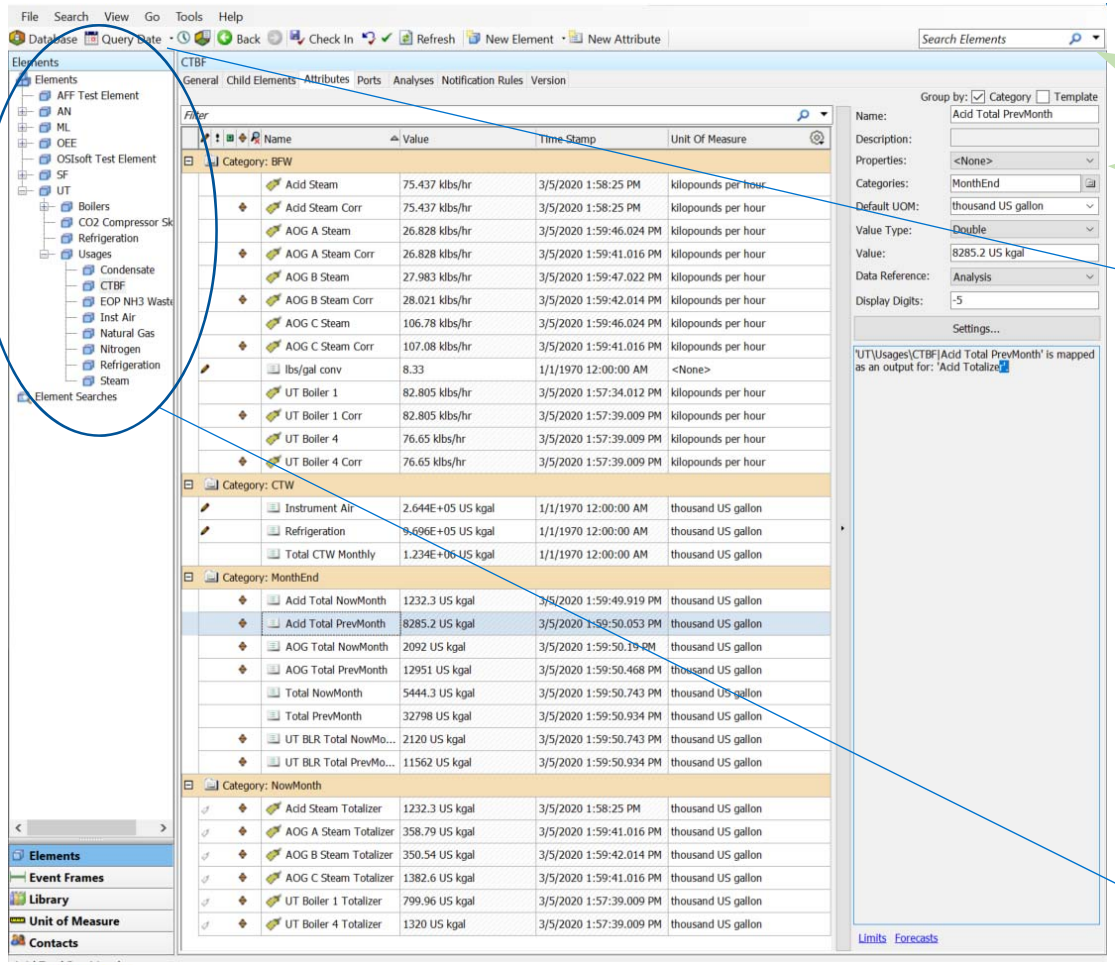
1					
2	**Boiler Feed Water Production**			**January 2020**	
3	**STEAM PRODUCTION**				
4		**9620**	*Boiler Plant*	15,880.0	*kgals*
5					
6		**590**	*Acid Plant*	8,321.2	*kgals*
7					
8	**BOILER FEED WATER**				
9		**621**	*AOG*	14,684.2	*kgals*
10					
11			***Total Produced***	38,885.4	*kgals*
12					
13	**Distribution of No. 2 CTW**				
14		**9642**	*Instrument Air*	264,400	*kgals*
15					
16		**9660**	*Refrigeration*	969,600	*kgals*
17					
18			***Total Produced***	1,234,000	*kgals*
19					
20					
21					
22					

CTBF | COND | EOP | IntAir | REF | NatGas

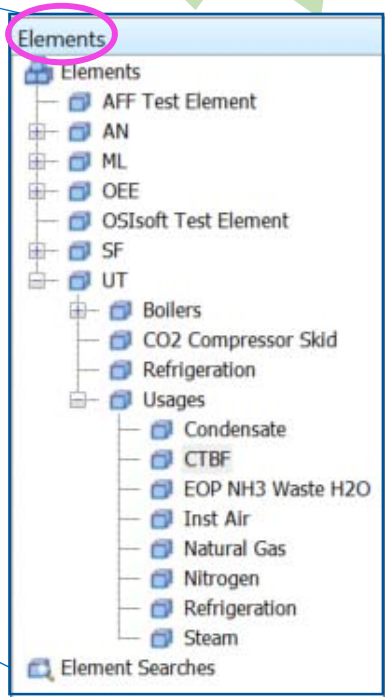


Automate desired values and visualize in excel or a dashboard.

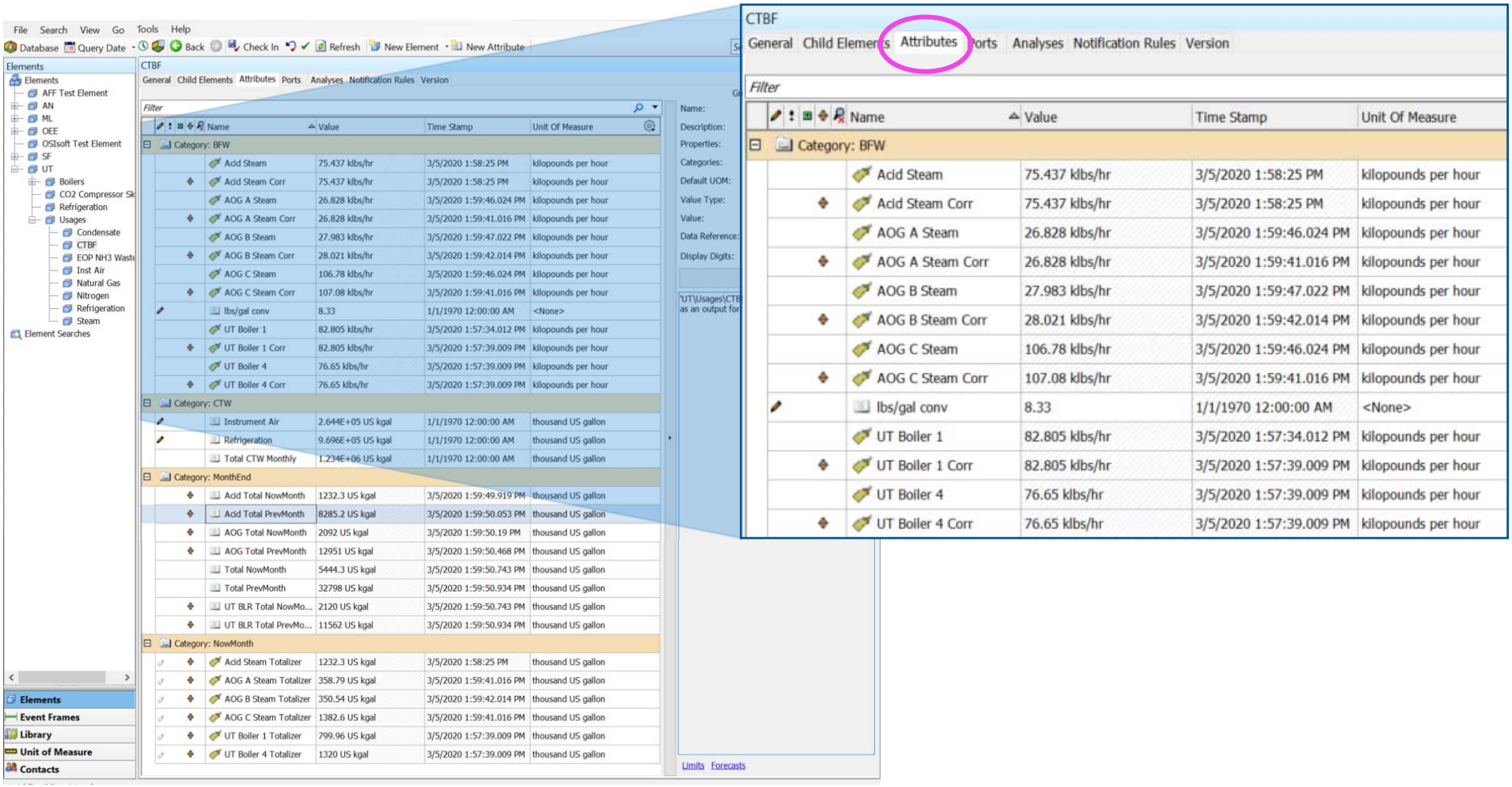
©2020 OSIsoft, LLC



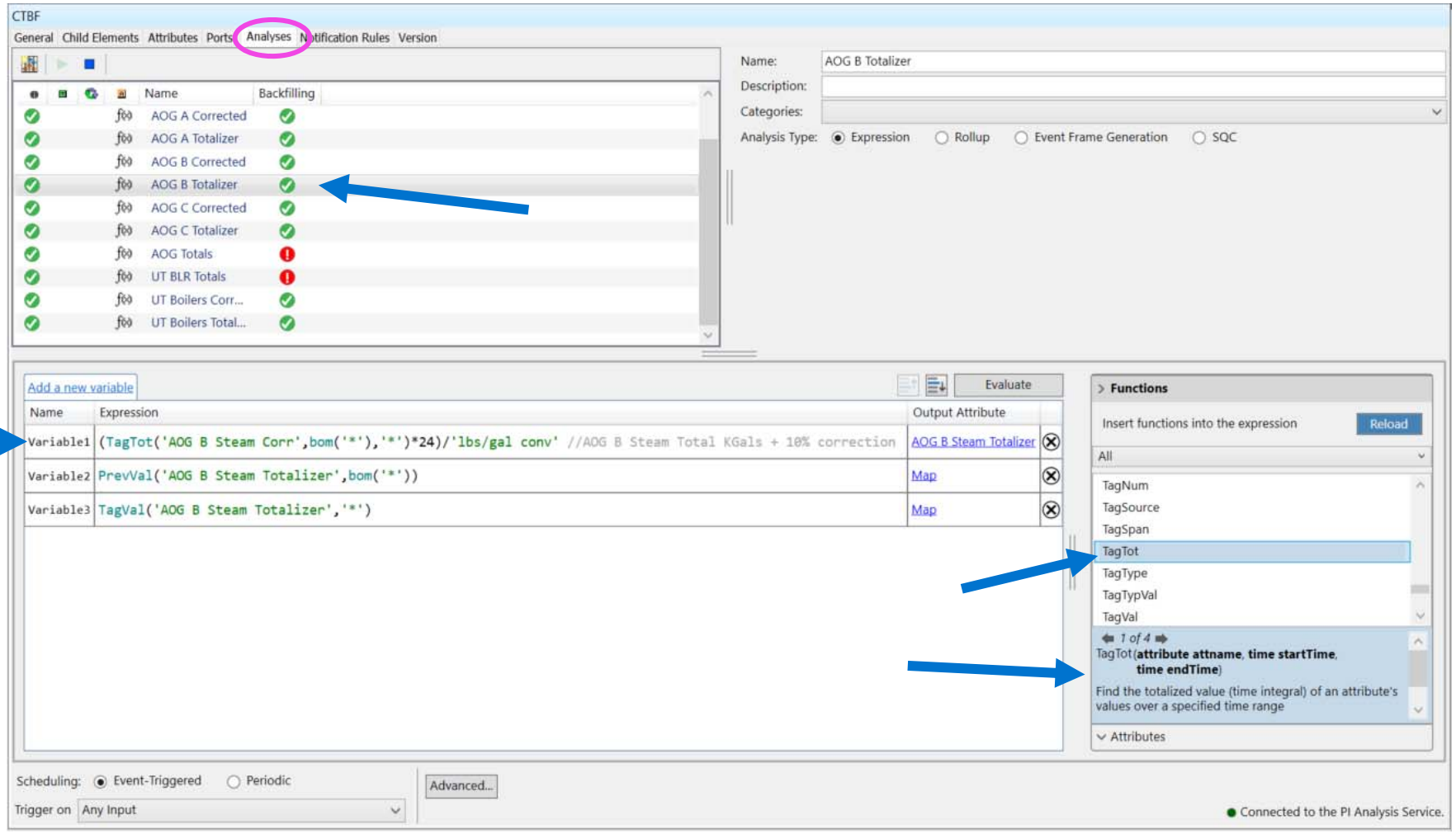
How did we get from messy spreadsheet to simple & automated dashboard?



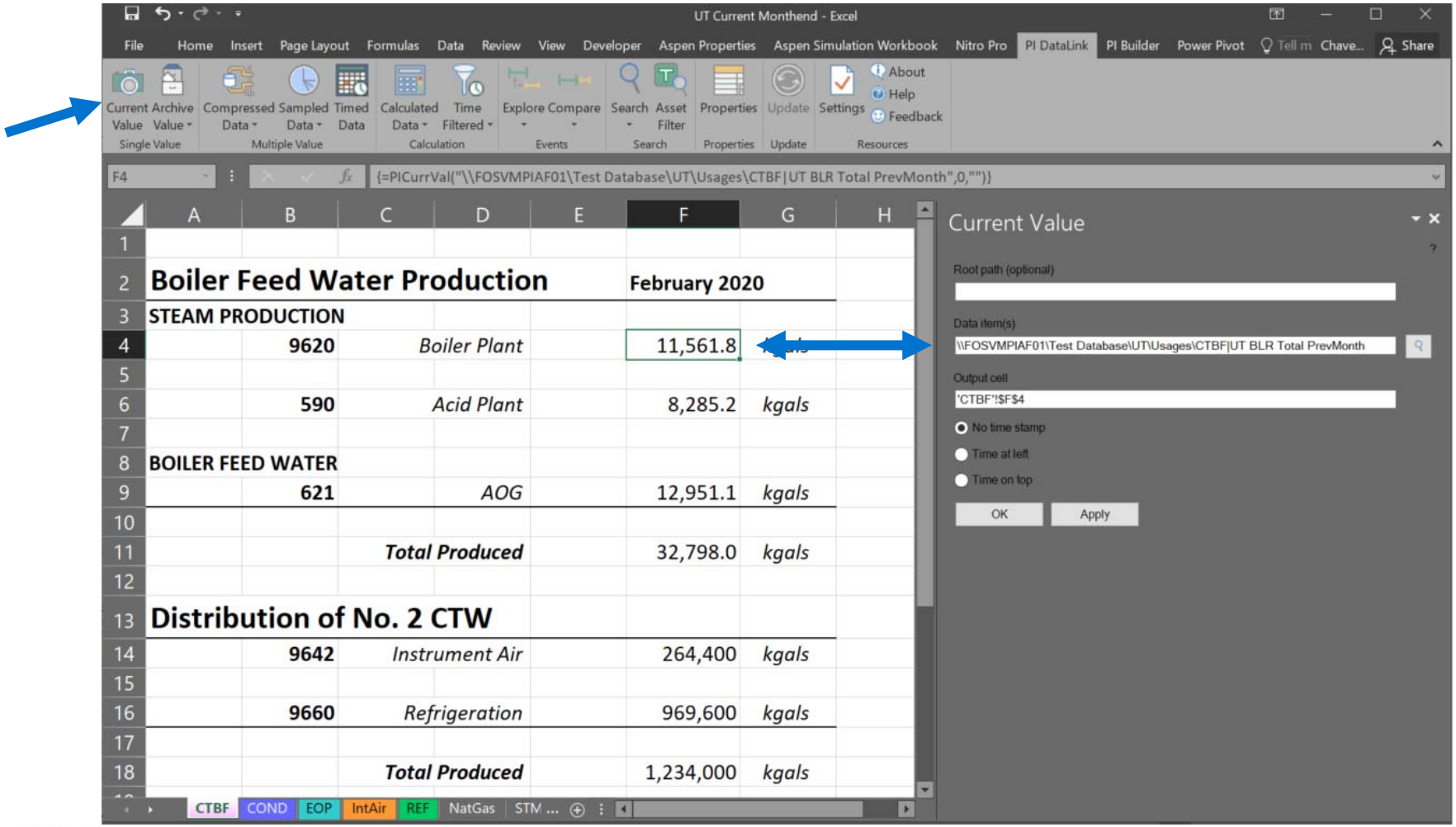
©2020 OSIsoft, LLC



©2020 OSIsoft, LLC



 ©2020 OSIsoft, LLC



©2020 OSIsoft, LLC

Real-Time KPIs

- Raw Material Usage is a common KPI used in the industry to help drive optimization and lower costs.

- Our Melamine unit had a difficult year with Ammonia (NH3) usage and so it was requested that we automate an [NH3 consumed/Melamine produced] calculation to create more visibility and enable us to be more agile.

$$= \frac{NH3\ Consumed\ [lbs]}{Melamine\ Produced\ [lbs]}$$

©2020 OSIsoft, LLC

Recall the example from earlier:

The 'right' KPIs | **Data Wrangling**

Raw Material Usage KPIs: NH3 in Melamine Unit

Finance:

$$\left(\frac{UreaTot}{MelTot}\right) * \left(\frac{NH3Tot}{UreaTot} + \frac{NH3Credit}{UreaTot}\right) * \frac{-NH3Credit}{MelTot}$$

← Values come from ERP System (not a PI Tag)

↕ Not aligned

Engineers:

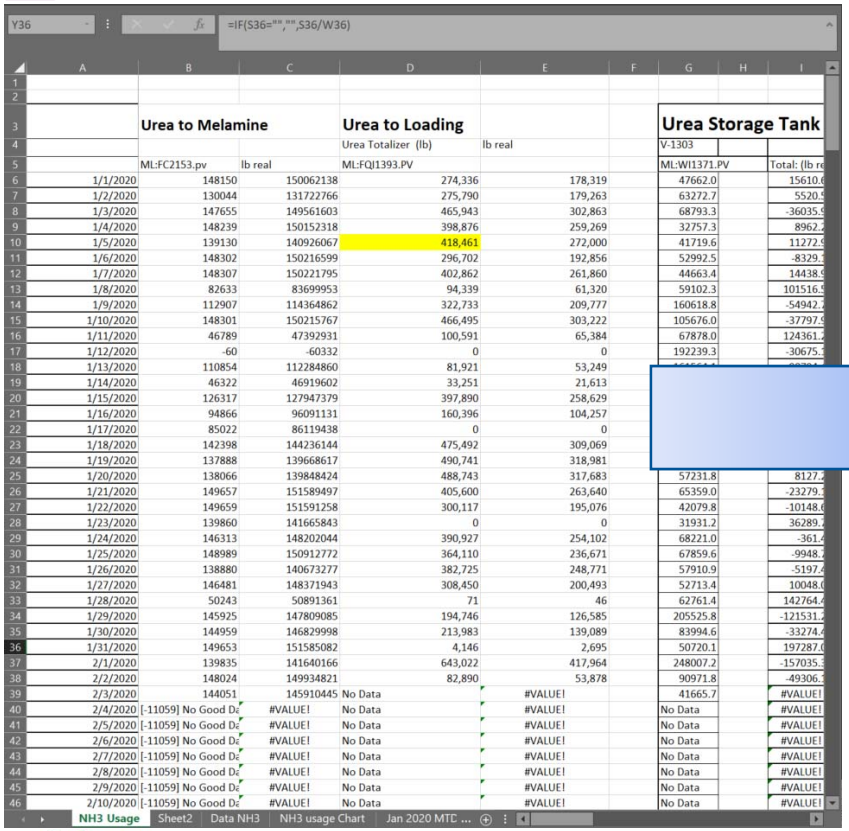
$$\frac{NH3Tot - NH3Sold - UreaInv}{MelTot}$$

← Unreliable Transmitter for "NH3Sold" variable

©2020 OSIsoft, LLC

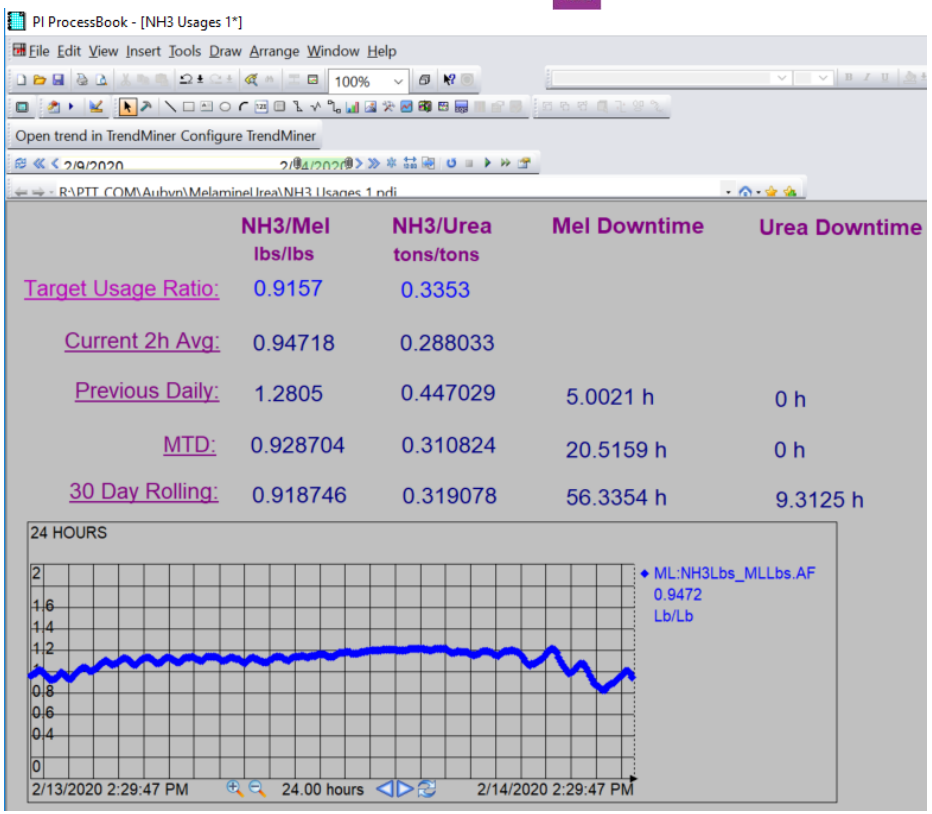
PI AF – Real-time KPIs

PI DataLink



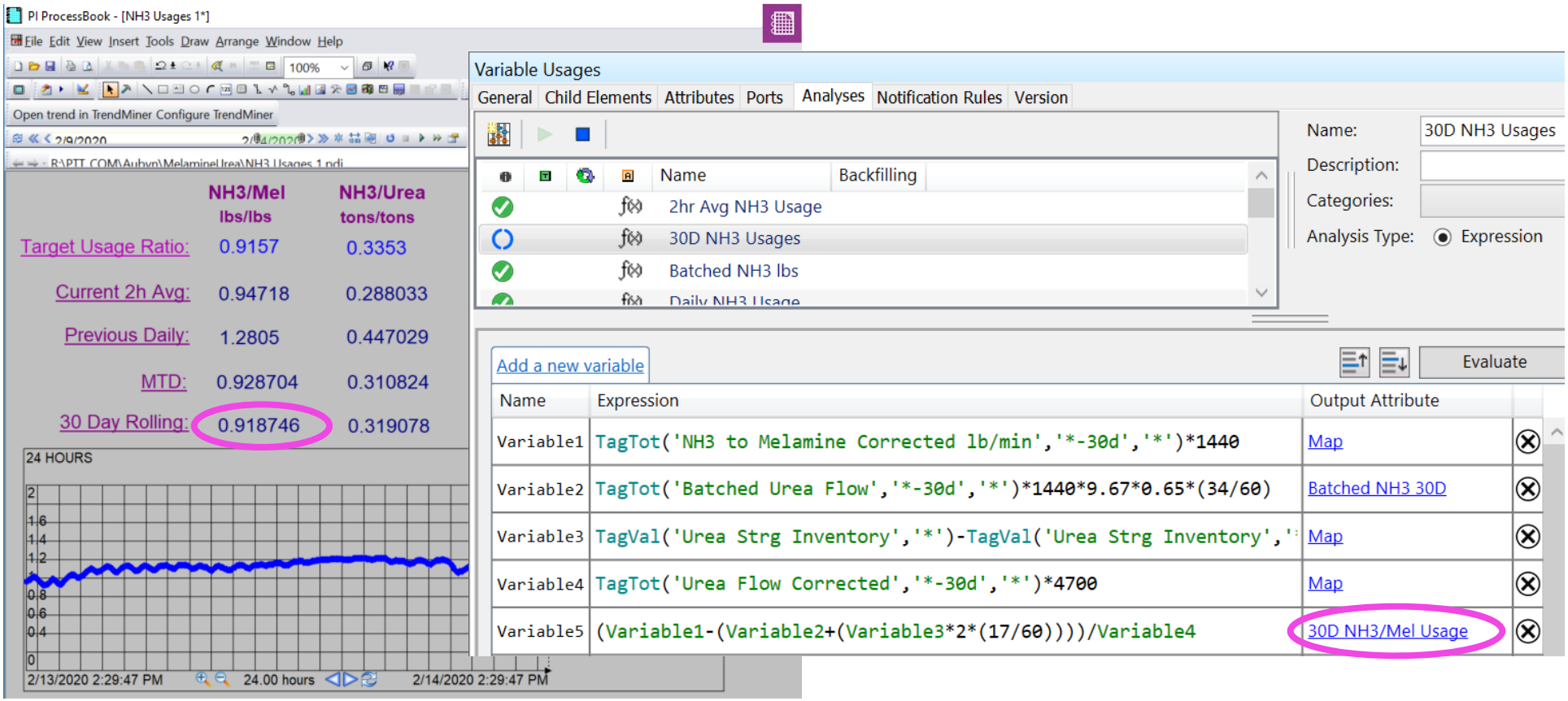
	Urea to Melamine		Urea to Loading		Urea Storage Tank	
			Urea Totalizer (lb)	lb real	V-1303	
	ML:FC2153.pv	lb real	ML:FQI1393.PV		ML:WI1371.PV	Total: (lb re
1/1/2020	148150	150062138	274,336	178,319	47662.0	15610.(
1/2/2020	130044	131722766	275,790	179,263	63272.7	5520.5
1/3/2020	147655	149561603	465,943	302,863	68793.3	-36035.5
1/4/2020	148239	150152318	398,876	259,269	32757.3	8962.2
1/5/2020	139130	140926067	418,461	272,000	41719.6	11272.5
1/6/2020	148302	150216599	296,702	192,856	52992.5	-8329.(
1/7/2020	148307	150221795	402,862	261,860	44663.4	14438.(
1/8/2020	82633	83699953	94,339	61,320	59102.3	101516.5
1/9/2020	112907	114364862	322,733	209,777	160618.8	-54942.2
1/10/2020	148301	150215767	466,495	303,222	105676.0	-37797.9
1/11/2020	46789	47392931	100,591	65,384	67878.0	124361.2
1/12/2020	-60	-60332	0	0	192239.3	-30675.1
1/13/2020	110854	112284860	81,921	53,249		
1/14/2020	46322	46919602	33,251	21,613		
1/15/2020	126317	127947379	397,890	258,629		
1/16/2020	94866	96091131	160,396	104,257		
1/17/2020	85022	86119438	0	0		
1/18/2020	142398	144236144	475,492	309,069		
1/19/2020	137888	139668617	490,741	318,981		
1/20/2020	138066	139848424	488,743	317,683	57231.8	8127.(
1/21/2020	149657	151589497	405,600	263,640	65359.0	-23279.3
1/22/2020	149659	151591258	300,117	195,076	42079.8	-10148.(
1/23/2020	139860	141665843	0	0	31931.2	36289.2
1/24/2020	146313	148202044	390,927	254,102	68221.0	-361.(
1/25/2020	148989	150912772	364,110	236,671	67859.6	-9948.2
1/26/2020	138880	140673277	382,725	248,771	57910.9	-5197.(
1/27/2020	146481	148371943	308,450	200,493	52713.4	10048.(
1/28/2020	50243	50891361	71	46	62761.4	142764.4
1/29/2020	145925	147809085	194,746	126,585	205525.8	-121531.2
1/30/2020	144959	146829998	213,983	139,089	83994.6	-33274.4
1/31/2020	149653	151585082	4,146	2,695	50720.1	197287.(
2/1/2020	139835	141640166	643,022	417,964	248007.2	-157035.3
2/2/2020	148024	149934821	82,890	53,878	90971.8	-49306.2
2/3/2020	144051	145910445	No Data	#VALUE!	41665.7	#VALUE!
2/4/2020	[-11059] No Good Da	#VALUE!	No Data	#VALUE!	No Data	#VALUE!
2/5/2020	[-11059] No Good Da	#VALUE!	No Data	#VALUE!	No Data	#VALUE!
2/6/2020	[-11059] No Good Da	#VALUE!	No Data	#VALUE!	No Data	#VALUE!
2/7/2020	[-11059] No Good Da	#VALUE!	No Data	#VALUE!	No Data	#VALUE!
2/8/2020	[-11059] No Good Da	#VALUE!	No Data	#VALUE!	No Data	#VALUE!
2/9/2020	[-11059] No Good Da	#VALUE!	No Data	#VALUE!	No Data	#VALUE!
2/10/2020	[-11059] No Good Da	#VALUE!	No Data	#VALUE!	No Data	#VALUE!

PI ProcessBook



©2020 OSIsoft, LLC

PI AF – Real-time KPIs



©2020 OSIsoft, LLC

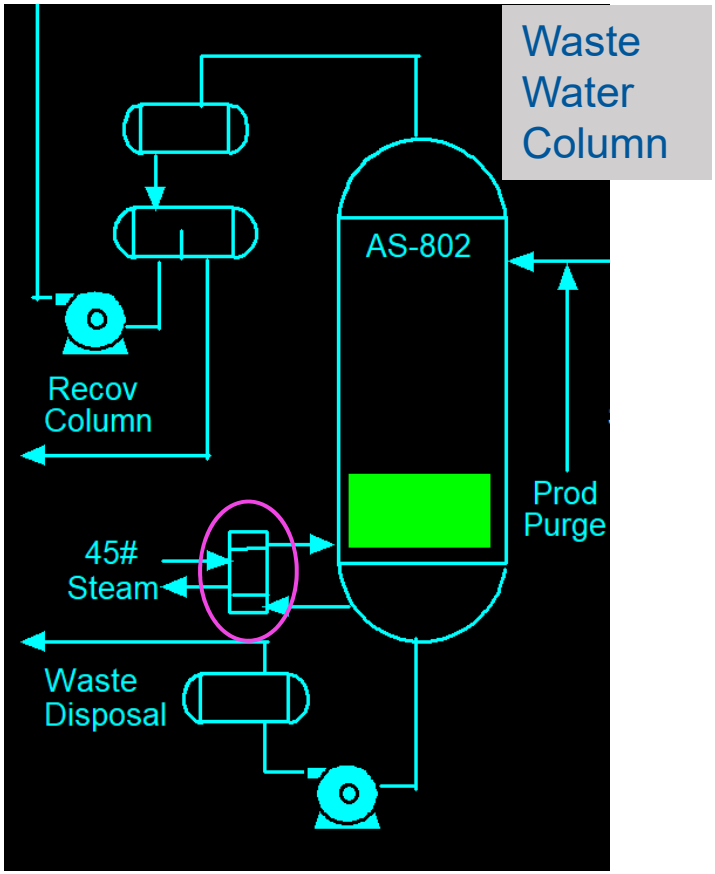
Discovery/Diagnostics - TrendMiner

Unit: Acrylonitrile

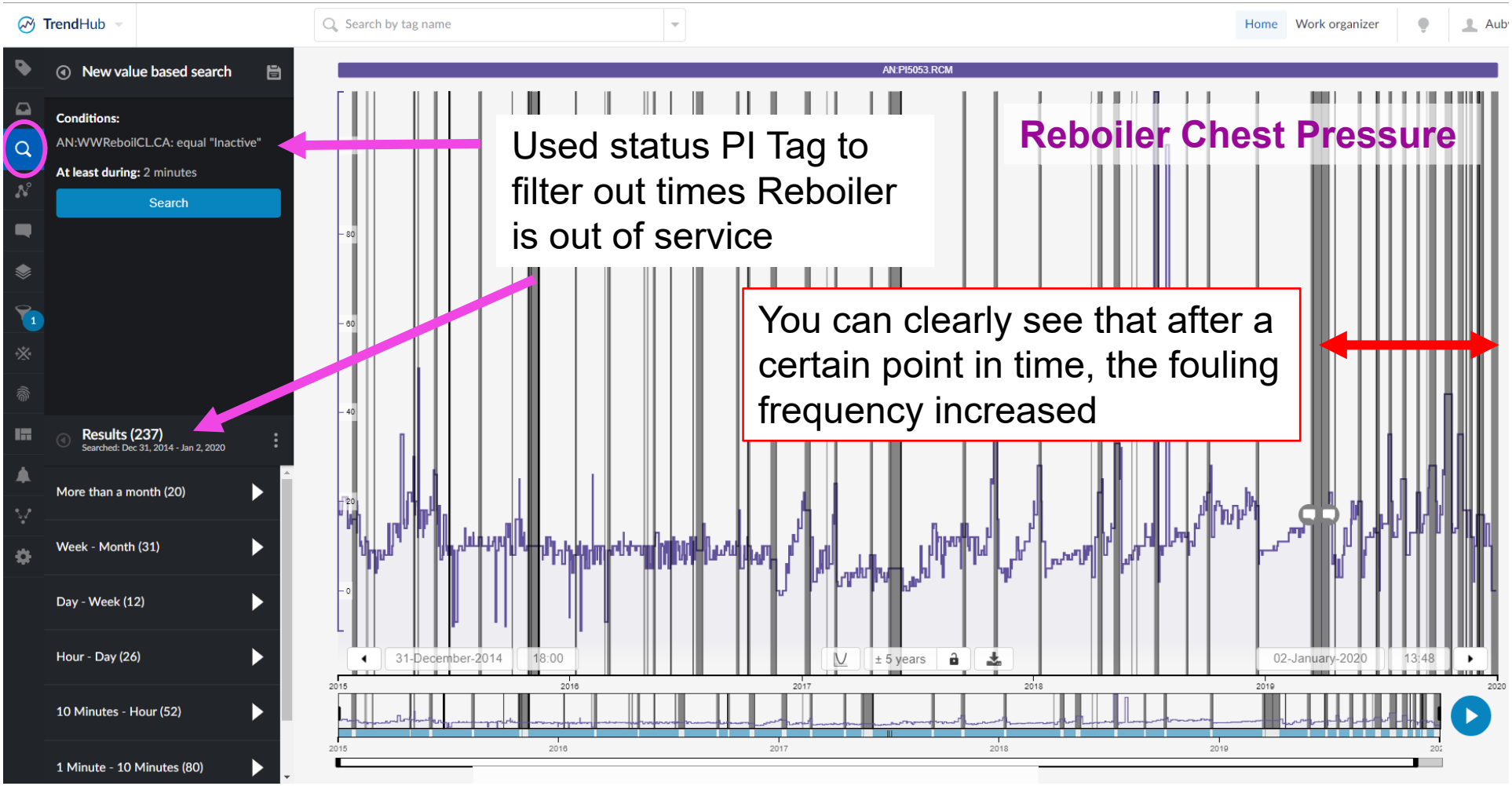
Equip: Reboiler on Waste Water Column

Problem: Reboiler is fouling more frequently as of late, causing it to have to be taken out of service for cleaning more often. This is very costly.

Hypothesis: Catalyst carry over from reactors is causing the fouling.

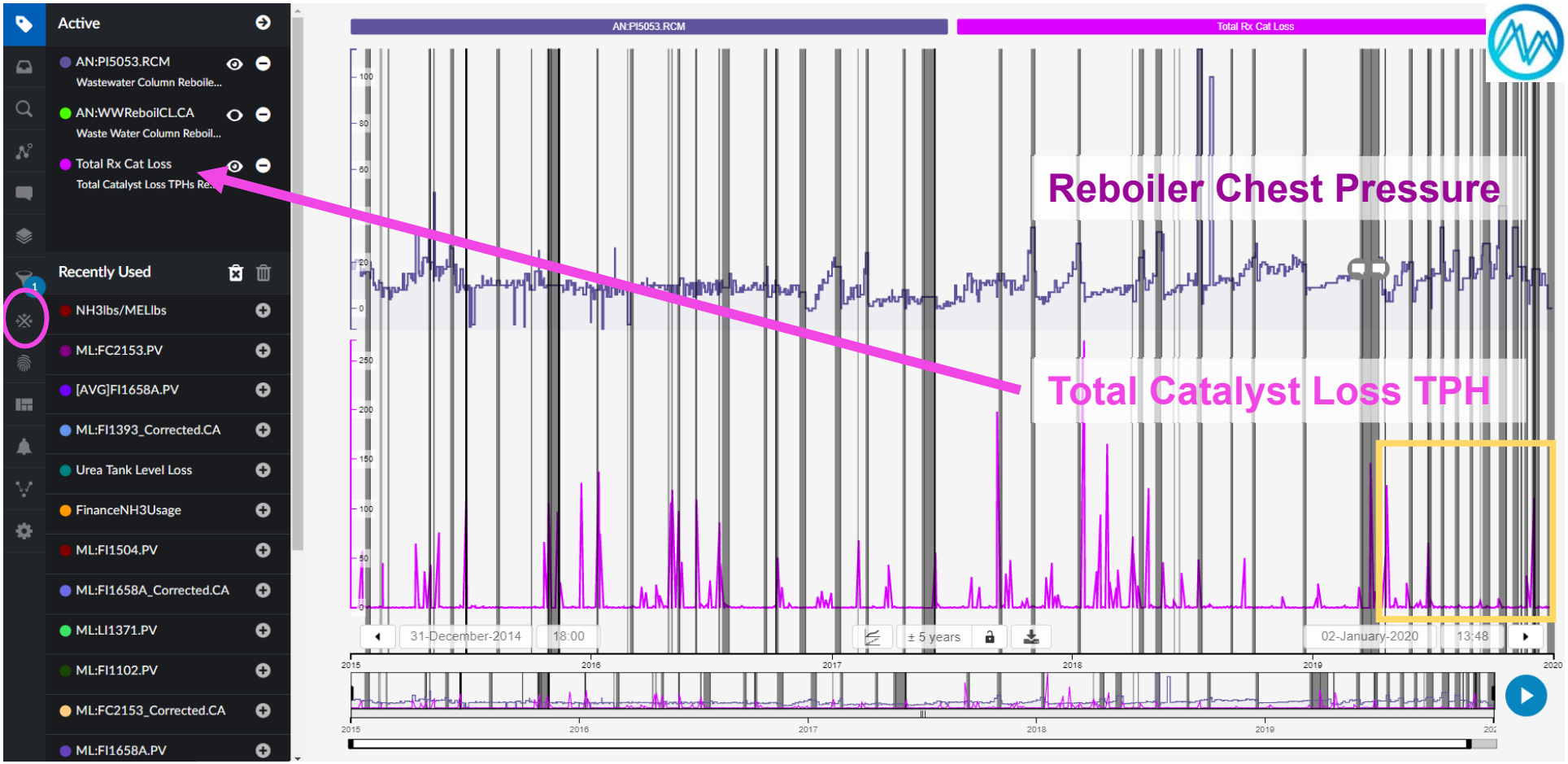


©2020 OSIsoft, LLC



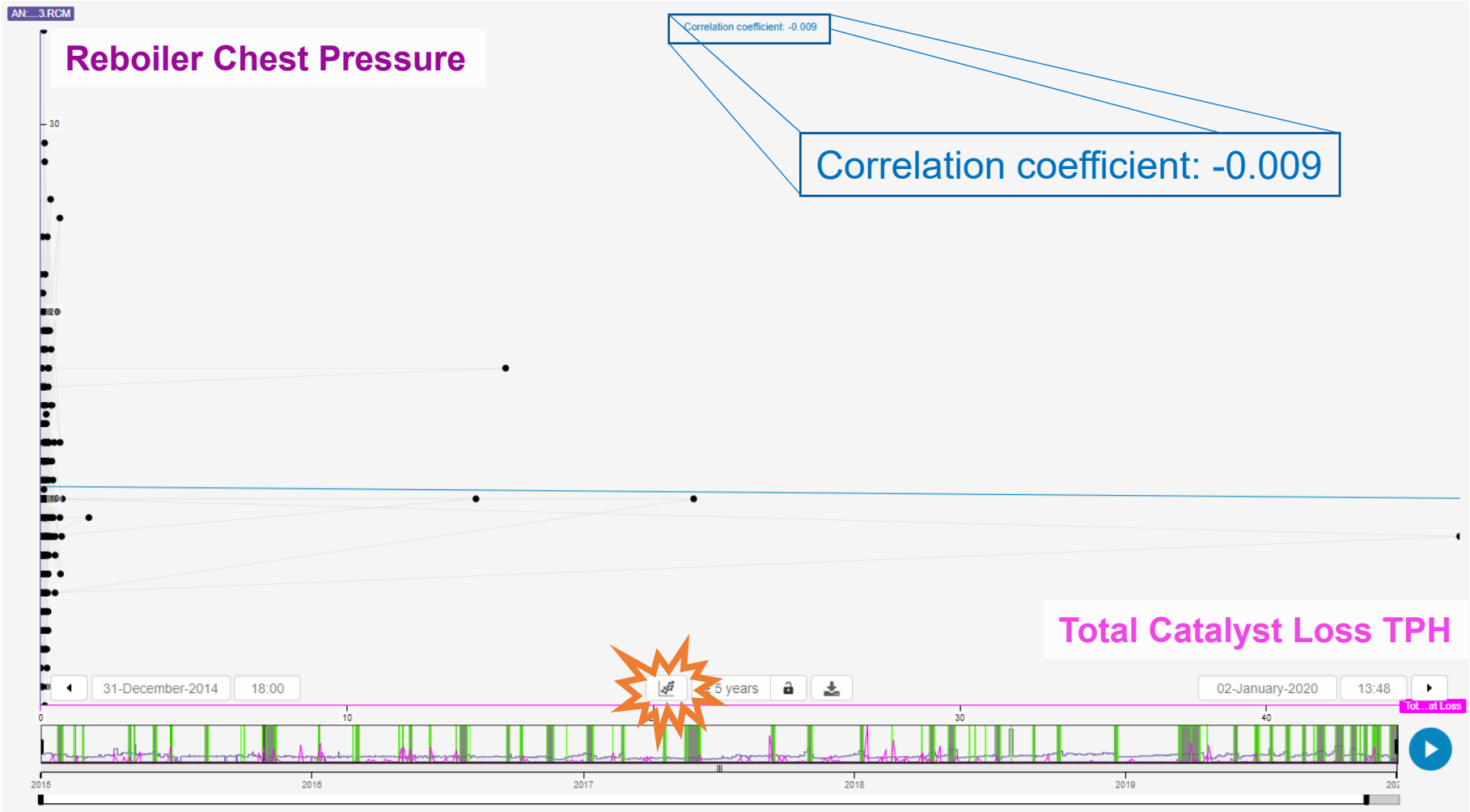
TrendMiner – Discovery

©2020 OSIsoft, LLC

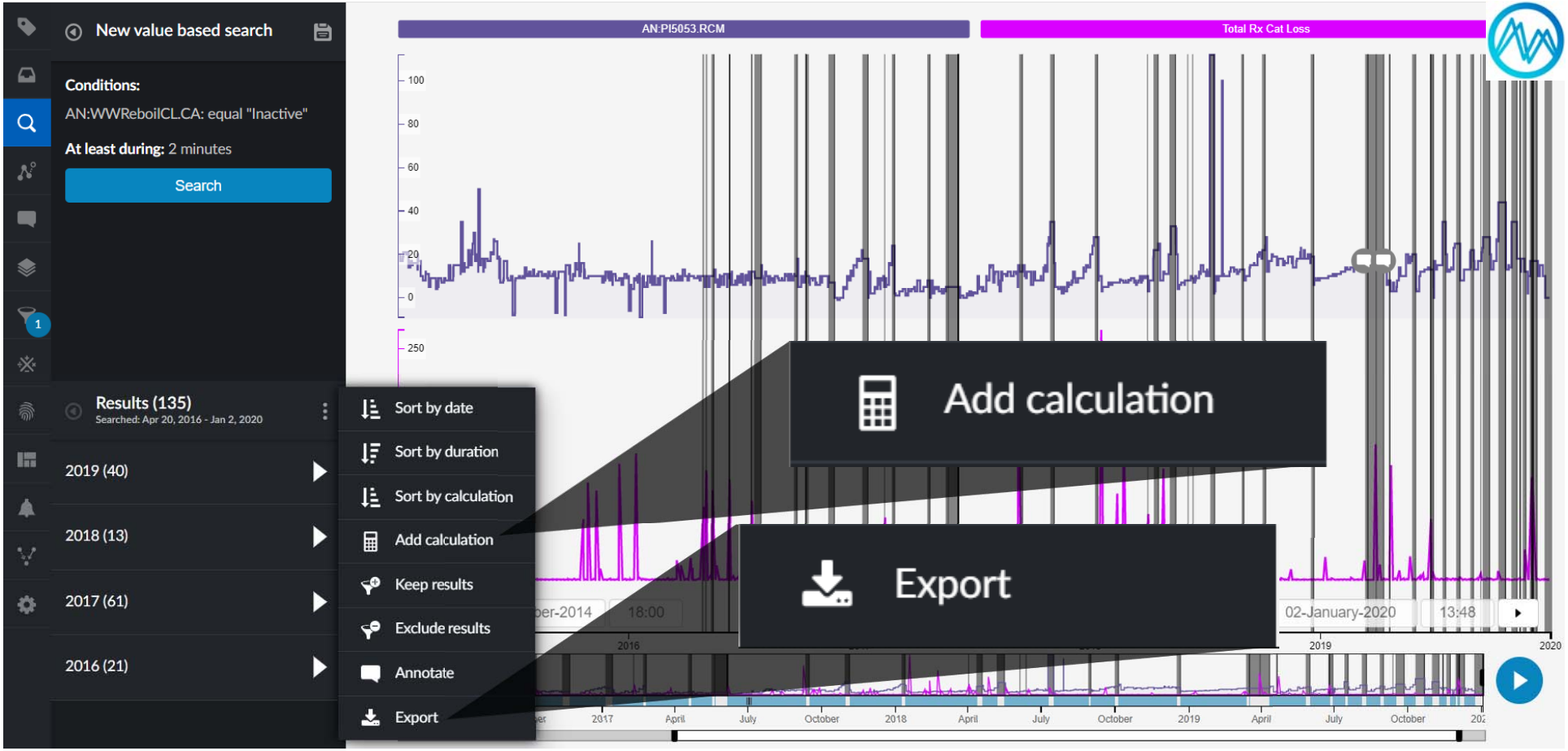


TrendMiner – Diagnostics – Catalyst Loss Hypothesis

©2020 OSIsoft, LLC

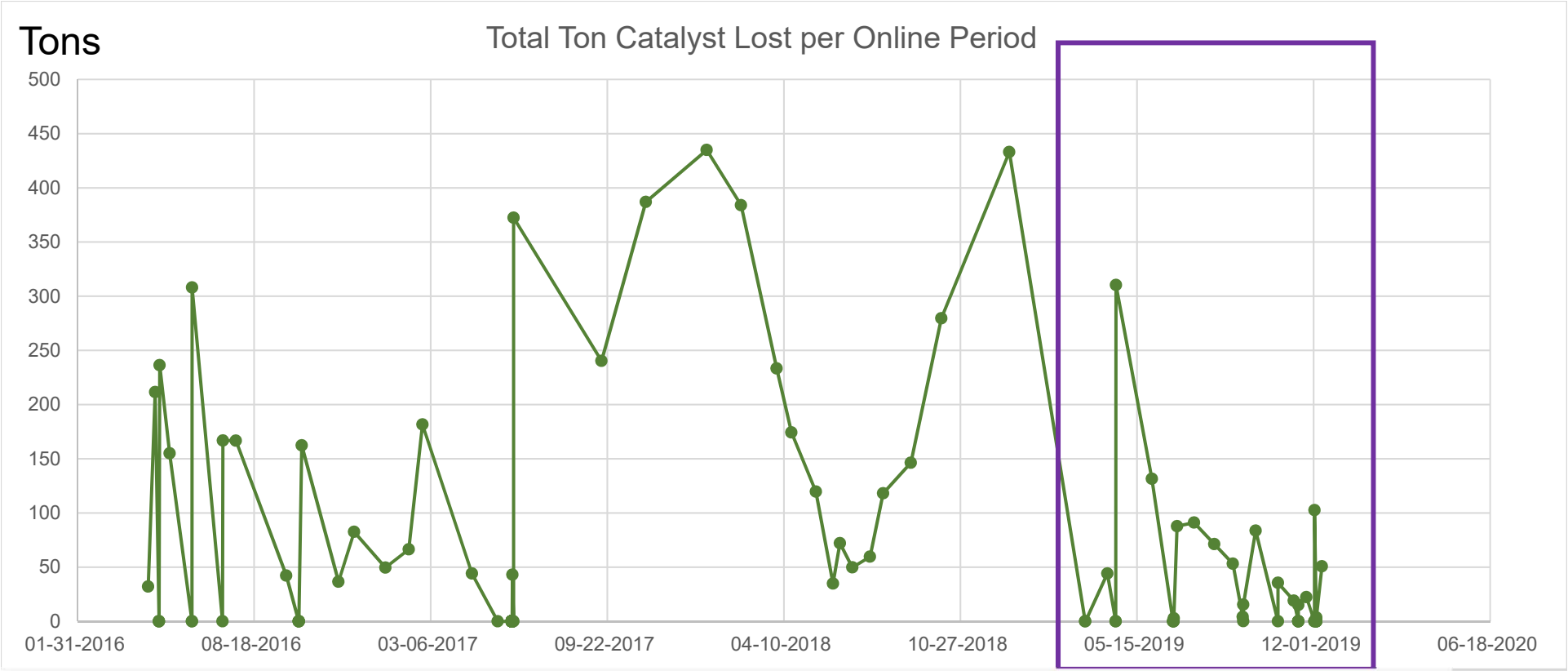


©2020 OSIsoft, LLC



TrendMiner – Diagnostics

©2020 OSIsoft, LLC



By adding an integral calculation to TPH Catalyst Loss and exporting to Excel – we can disprove the catalyst hypothesis.

©2020 OSIsoft, LLC

Next Steps! → Optimization

D M A I C

©2020 OSIsoft, LLC

Recommendations based on my journey

1) Establish relationship with PI Admin & IT

2) Align prioritized KPIs & Use Cases with Management

3) Get reliability/equipment specialists involved for a CBM & Predictive Maint initiative.

4) Become a champion. Push for training. Schedule 1-on-1 time with engineers.

5) Don’t wait for others to run with it & don’t get discouraged.

©2020 OSIsoft, LLC

PI AF & Data Analytics

Cornerstone Chemical Company
Building value, together.

CHALLENGES

- Manual burdensome tasks
- KPIs
- Discovery, Diagnostics, Optimization
- Technical Obstacles
- Adaptation Obstacles

SOLUTION

- Using PI AF & TrendMiner, Cornerstone has progressively become more data driven.
- Aligning with management & becoming a champion helps to overcome obstacles along the way.

BENEFITS

- Process engineers utilizing their talents effectively and becoming more **collaborative** to start tackling problems that were previously too time-demanding or difficult.

©2020 OSIsoft, LLC

Questions?

Please wait for
the **microphone**

State your
name & company

Save the Date...

AMSTERDAM
October 26-29, 2020

OSIsoft. PI World

©2020 OSIsoft, LLC

©2020 OSIsoft, LLC