

Transform Your Static Spreadsheets into Business Analytic Engines

Rick Smith



International Paper

- World's Largest Pulp and Paper Company
 - Founded 1898
 - 52,000+ Employees
 - \$22+ Billion Net Sales (2019)
- OSIsoft Installed Base
 - 38 Facilities (60 PI Servers)
 - US, Brazil, Canada, France, Poland, Russia, Spain
 - 1.9 Million Active PI Tags

Rick's Messages (2007-2019)



- **Do No Harm**

- MVDC: From Proprietary to Standard PI (2007)



- **Capital Projects and Software Development Best Practices**

- Environmental Automation Journey (2012)



- **Build and Demonstrate the Business Case**

- Building the Business Case for PI AF (2015)



- **Keep Scope Small and Focused**

- Best Practices for Implementing PI AF (2017)



- **Systems Need Janitors Just Like They Need Architects**

- Feeding the Machine Learning Monster (2018)



- **Begin with the End in Mind**

- Habits of a Highly Successful Problem Solver (2019)

Reporting Challenge



- MS Excel: Everyone's Favorite Reporting Tool
 - Many Users Run Daily or Shift Reports Manually
 - Many Scheduled via Windows Scheduler
- Issues
 - Multiple People Patch the Spreadsheets Over Time
 - Same Calculated Data Shows on Many Reports

Reporting Challenge

Converting from Competitor Historian to OSIsoft PI System

Pattern #1 – Daily Values + Monthly Totals

Date								
12/1/2018 0:00	811.475327	317.45276	-	39,151	35470.21014	12876.9959	3905.533531	
12/2/2018 0:00	839.83744	284.3352	-	38,986	44435.03423	13130.9427	5226.210792	
12/3/2018 0:00	831.42897	319.95249	-	39,930	48397.66325	13462.4429	6219.72819	
12/4/2018 0:00	839.457797	326.40057	-	40,432	49816.22851	13301.0922	8029.953866	
12/5/2018 0:00	731.436529	411.79121	-	39,647	46614.86219	13176.0537	4516.984959	
12/6/2018 0:00	831.15023	337.60553	-	40,532	49537.55091	13004.9956	6112.801576	
12/24/2018 0:00	828.824213	348.52134	-	40,830	49349.21426	14536.2764	4962.670514	
12/25/2018 0:00	829.2717	345.42517	-	40,738	48041.55373	16041.6573	4596.491412	
12/26/2018 0:00	820.389989	353.14533	-	40,698	47683.29468	16054.3682	3757.724216	
12/27/2018 0:00	812.82979	292.41489	50,313	39,831	38928.52324	14505.1584	3964.347978	
12/28/2018 0:00	805.165998	353.15061	-	40,170	42374.32815	14583.0015	6457.789498	
12/29/2018 0:00	805.101193	338.70094	-	39,667	43788.61424	14808.2468	7456.56571	
12/30/2018 0:00	772.421229	384.80169	-	40,132	42540.29504	14822.5842	8851.54516	
12/31/2018 0:00	733.534709	392.29029	-	39,044	41890.53554	14870.9013	6862.365614	
	826	342.51	7,817.24	1,263,802.84		47.04	14.03	5.42
						35,000.76	10,441.91	4,032.47

Pattern #2 – Calculate/Print (Left) & Read (Right)

TIDE LINE EXCEPTIONS								TIME:	7/19 7:17	7/19 7:17	7/19 7:17	7/19 7:17			
Print Area								Retrieval / Calculation Area							
TAG	DESC	UNITS	CURRENT	Past hr AVG	Past 24 Hr AVG	Past 24 Hr MIN	Past 24 Hr MAX	TAG	DESC	UNITS	CURRENT	Past hr AVG	Past 24 Hr AVG	Past 24 Hr MIN	
			59.44	59.92	60.22	56.52	63.6				59.44	59.92	60.22	56.52	
			-	-	-	-	-				-	-	-	-	
			76.79	76.54	76.80	57.75	99.0				76.79	76.54	76.80	57.75	
			3,218.43	3,104.75	3,003.34	2,791.66	3,446.0				3,218.43	3,104.75	3,003.34	2,791.66	

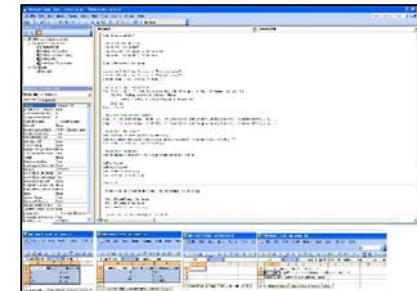
Visualizing Process Data (February 2019)

- ...
- **Rick:** ... Alex was in my training class last week... Pretty Impressive...
- **Engineer:** Yes. She was always much smarter than me.
- **Rick:** I hear she is taking over the Facility Morning Report...
- **Engineer:** Yes... She showed it to me while visiting...
- **Engineer:** Is that the really best way to do morning reports?
- **Rick:** Not really, but what options do we have?
- **Rick:** I will have to think about this...
- ...
- **Rick:** Good talking to you as always... Call me if you need something...
- ...

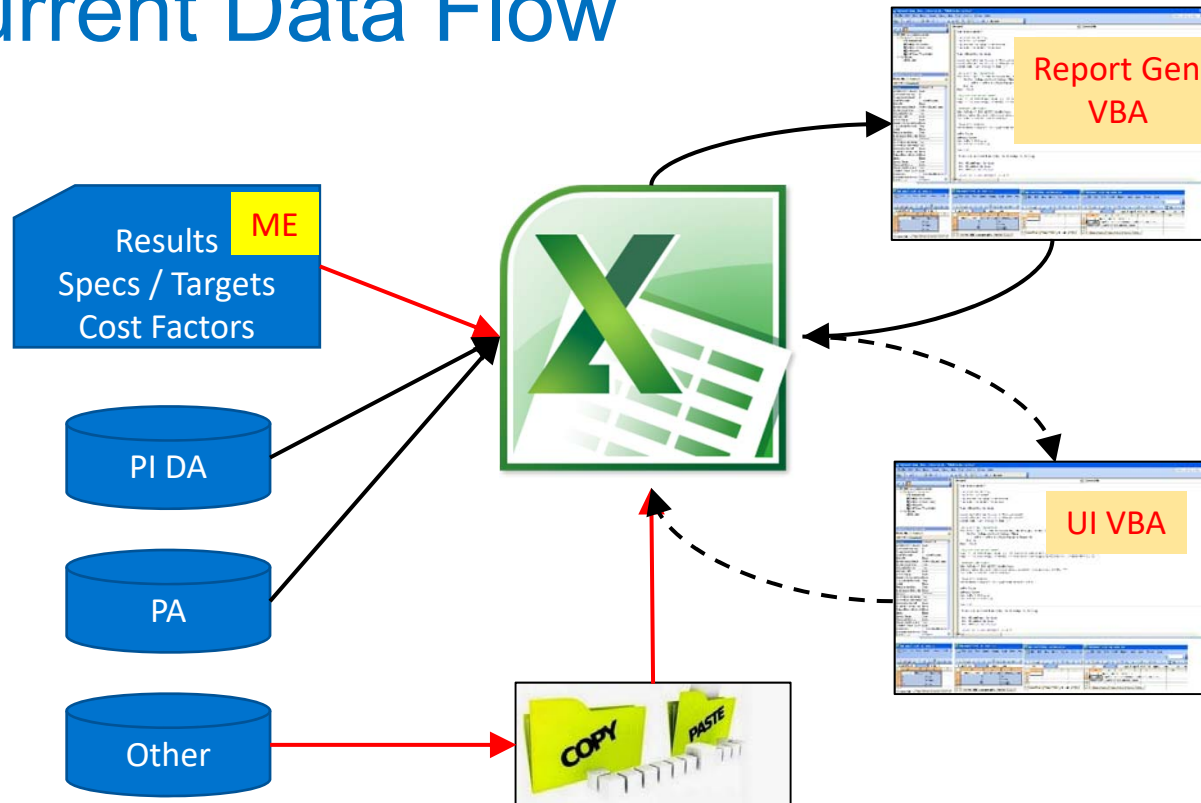


Facility Morning Report

- 12 Visible Worksheets
- **39 Hidden Worksheets**
 - 22 Make PI Data Archive Calls (Many w/ VLOOKUP)
 - Remaining Sheets for Targets & Copy/Paste Reports
- **8 VBA Modules (Direct Cell References)**
- 110+ Named Ranges
- 14 MB

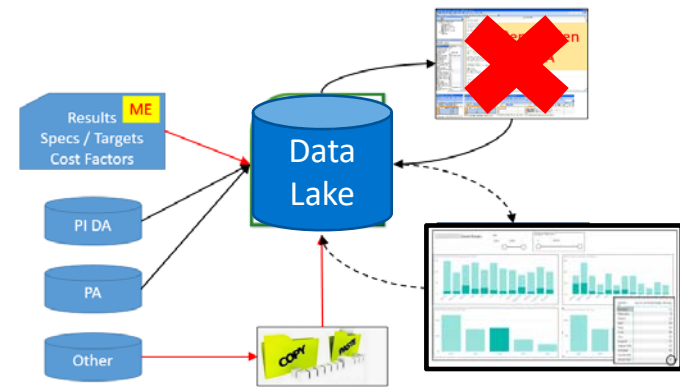


Current Data Flow



Conceptual Data Flow

- **Target BI Tool for Visualization**
- **Target Data Lake for Storage**
- Move Factors to SQL Table
- Move PA Calls to PA Queries
- Move PI DataLink to AF
- Change “Other” Copy/Paste to Queries Outputting to Data Lake



Why Bother?

- **Slice and Dice Data w/ Business Analytic Tools**
- Single Version of the Truth
- **Eliminate Scheduled Excel Spreadsheets**
 - Half-Life of Complex Spreadsheets
 - Rework Spreadsheets When Authors Leave
 - Reporting Spreadsheets Show Data at Specific Time
- **Convert PI ProcessBook Displays to PI Vision (VBA & Data Sets)**

What Concerns Do I Have?

1. Protect the Operational Data Store

- PI Data Archive, Quality and MES Databases

2. Protect High Value Calculations

- Environmental, Quality, Execution

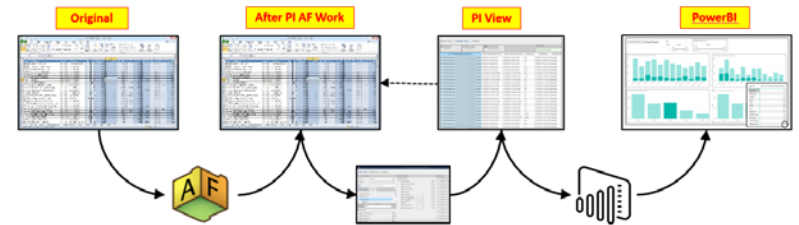
3. Requires IT Resources

• Potential Solutions

- Duplicate Architecture (PI HA, SQL Replication, etc.)
- Data Lakes



Migration Steps:



- **Step 0: Analyze the Spreadsheet**
 - Start with the End in Mind
- **Step 1: Migrate Calculations to AF**
 - Output Results to PI Tags or Event Frames
- **Step 2: Add Required Meta Data to AF**
 - Line, Unit, Shift, Grade, etc.
- Step 3: (Optional) Link AF to External Data Sources
- Step 4: (Optional) Export Data Using PI Integrator for BA
- Step 5: Link BI Tool to New Data Source

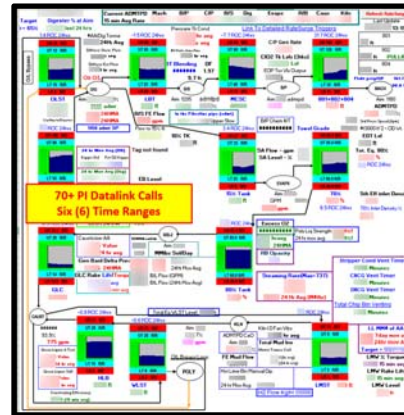
Step 0: Analyze the Spreadsheet

- Understand the Data Sources and Calculations
- What Meta-Data is Assumed and/or Hard-Coded?

Two (2) PI Datalink Calls
Two (2) Time Ranges

Server							
Tag:	4/1/2013 7:00	10/1/2012 7:00					
End Time:	7/1/2013 7:00	1/1/2013 7:00					
TimeStamp	Status	TimeStamp	Status	Base Month	Base Breaks	Eval Month	Eval Break
01-Apr-13 12:36:07	Break	01-Oct-12 10:51:30	Sheet	4	0	10	0
01-Apr-13 20:26:11	Break	01-Oct-12 18:41:37	Sheet	4	0	10	0
01-Apr-13 21:56:00	Sheet	02-Oct-12 00:38:24	Break	4	0	10	1
02-Apr-13 05:46:07	Sheet	02-Oct-12 00:53:36	Sheet	4	0	10	0
02-Apr-13 10:32:01	Break	02-Oct-12 08:43:41	Sheet	4	1	10	0
02-Apr-13 10:40:25	Sheet	02-Oct-12 13:52:08	I/O Timeout	4	0	10	0
02-Apr-13 18:50:34	Sheet	02-Oct-12 13:52:22	Sheet	4	0	10	0
03-Apr-13 02:20:38	Sheet	02-Oct-12 21:42:30	Sheet	4	0	10	0
03-Apr-13 10:10:43	Sheet	03-Oct-12 05:32:41	Sheet	4	0	10	0
03-Apr-13 14:44:56	Break	03-Oct-12 13:22:48	Sheet	4	1	10	0
03-Apr-13 15:02:52	Sheet	03-Oct-12 15:59:31	Break	4	0	10	1
03-Apr-13 22:52:59	Sheet	03-Oct-12 16:15:43	Sheet	4	0	10	0
04-Apr-13 06:43:07	Sheet	04-Oct-12 00:05:44	Sheet	4	0	10	0
04-Apr-13 14:31:14	Sheet	04-Oct-12 07:55:49	Sheet	4	0	10	0
04-Apr-13 22:23:21	Sheet	04-Oct-12 08:06:53	I/O Timeout	4	0	10	0
05-Apr-13 06:13:26	Sheet	04-Oct-12 08:09:36	Sheet	4	0	10	0
05-Apr-13 14:03:31	Sheet	04-Oct-12 14:55:53	I/O Timeout	4	0	10	0
05-Apr-13 21:53:38	Sheet	04-Oct-12 14:55:55	Sheet	4	0	10	0
06-Apr-13 05:43:43	Sheet	04-Oct-12 15:06:58	I/O Timeout	4	0	10	0
06-Apr-13 13:33:49	Sheet	04-Oct-12 15:07:08	Sheet	4	0	10	0
06-Apr-13 21:23:56	Sheet	04-Oct-12 22:57:19	Sheet	4	0	10	0
07-Apr-13 05:14:00	Sheet	05-Oct-12 06:47:27	Sheet	4	0	10	0
07-Apr-13 13:04:10	Sheet	05-Oct-12 14:37:36	Sheet	4	0	10	0

70+ PI Datalink Calls
Six (6) Time Ranges



Step 1: Migrate Calculations to AF

- **Save Copy of Original Spreadsheet**
- **Data Filtering and Data Quality**
 - Status Changes, Negative Values, Switching Valves
 - Some Values Noisy... Consider Filtering to Reduce Noise
 - Consider Writing Filtered Values Back in Time (1/2 Filtering Period)
- **Embedded Spreadsheet Calculations**
 - Production Calculations, Ratios -> Single Version of the Truth
 - Rate of Change Calculations (Tank Level Delta, Flow Ratios, etc.)
 - Look for Shift/Day/Grade Run Summary Statistics
 - Consider Rolling Calculations so Report Can Run Periodically
- **Verify Original Spreadsheet Results to New (AF) Version**

Step 2: Add Required Meta Data to AF

- Meta-Data to Join Other Databases
 - **Production Date**
 - Grade Codes, Batch IDs, Unit Identifier
 - Maintenance Equipment and/or Location
- **Meta-Data for PI Vision Displays**
 - Material
 - Unit Type
- Add Crew/Shift Connection

NOTE: We Could Stop Here...

Step 3: Link AF to External Data Sources

- **Maintenance Location Attribute**
- **Link to External Documents and PI Vision**
- Not Required for Business Analytics Tool
- ... May Be Required for PI Vision Displays Anyway

InterfaceNode	Asset	InterfaceStatus▲	Flat...	HeartB...	Comm...	P...	IO...	Support ...	Support ...	Interface Detail ...
Engineering-PC	AB-RECAUST- OPC-BMS	OK	OK	Run	100	1	0	🔗	🔗	🔗
S234TINY	C1	OK	OK	Run	100	2	25	🔗	🔗	🔗
S234TINY	C2	OK	OK	Run	100	2	612	🔗	🔗	🔗
S234MeasApps01	CLPM	OK	OK	N/A	100	2	0	🔗	🔗	🔗

Step 4: Export Data via PI Integrator for BA

- **Can Change Data Shape for Desired Purpose**
 - Time Ranges, Units, etc.
 - Filter the Data Set
- **Incorporate Calculations Required for Reporting**
 - Rollups, Statistics, etc.

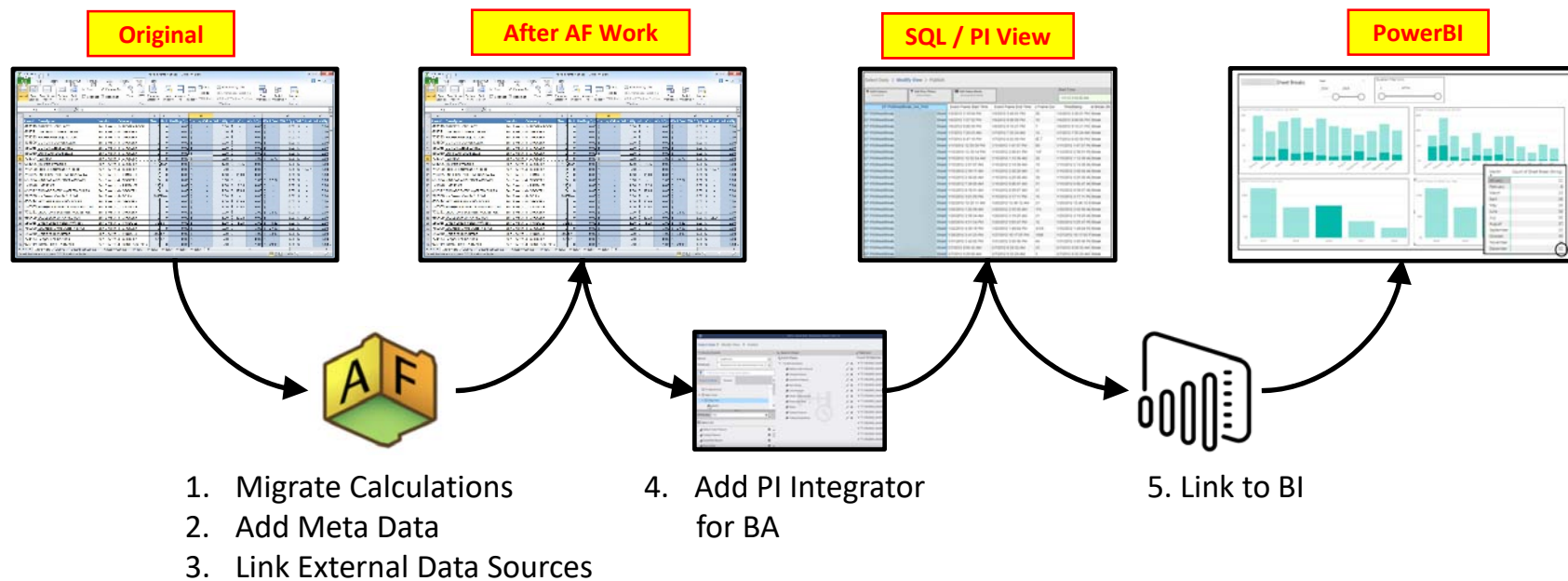
⚠ Not secure | <https://s29epidev01:5443>

My Views						
+ Create Asset View Build a data view starting with your asset hierarchy	+ Create Event View Build a data view starting with your event frame hierarchy	✎ Modify View Modify existing data view	✖ Remove View Remove selected view			
Name	Run Status	Type	Run M...	Start Time	End Time	Last Run Time
Heat Exchanger	Scheduled	Asset	Continuous	*-30d	*	Aug 5, 2018 11:03:33 AM
	Scheduled	Event	Continuous	12/1/17 12:00:00 AM	*	Aug 5, 2018 10:37:54 AM
	Scheduled	Event	Continuous	1/1/17 12:00 AM	*	Aug 5, 2018 10:30:04 AM
	Published	Asset	Once	1/1/2018	2/1/2018	Feb 16, 2018 10:13:18 PM
	Scheduled	Asset	Continuous	7/31/18 12:00:00 AM	*	Aug 5, 2018 10:56:29 AM
	Not Yet Published	Event	Once	7/18/18 1:23:00 AM	*	Never
REACH-Exercise 2-...	Published	Event	Once	1/1/12 5:59:00 AM	1/1/14 12:00:00 AM	Aug 5, 2018 11:23:26 AM

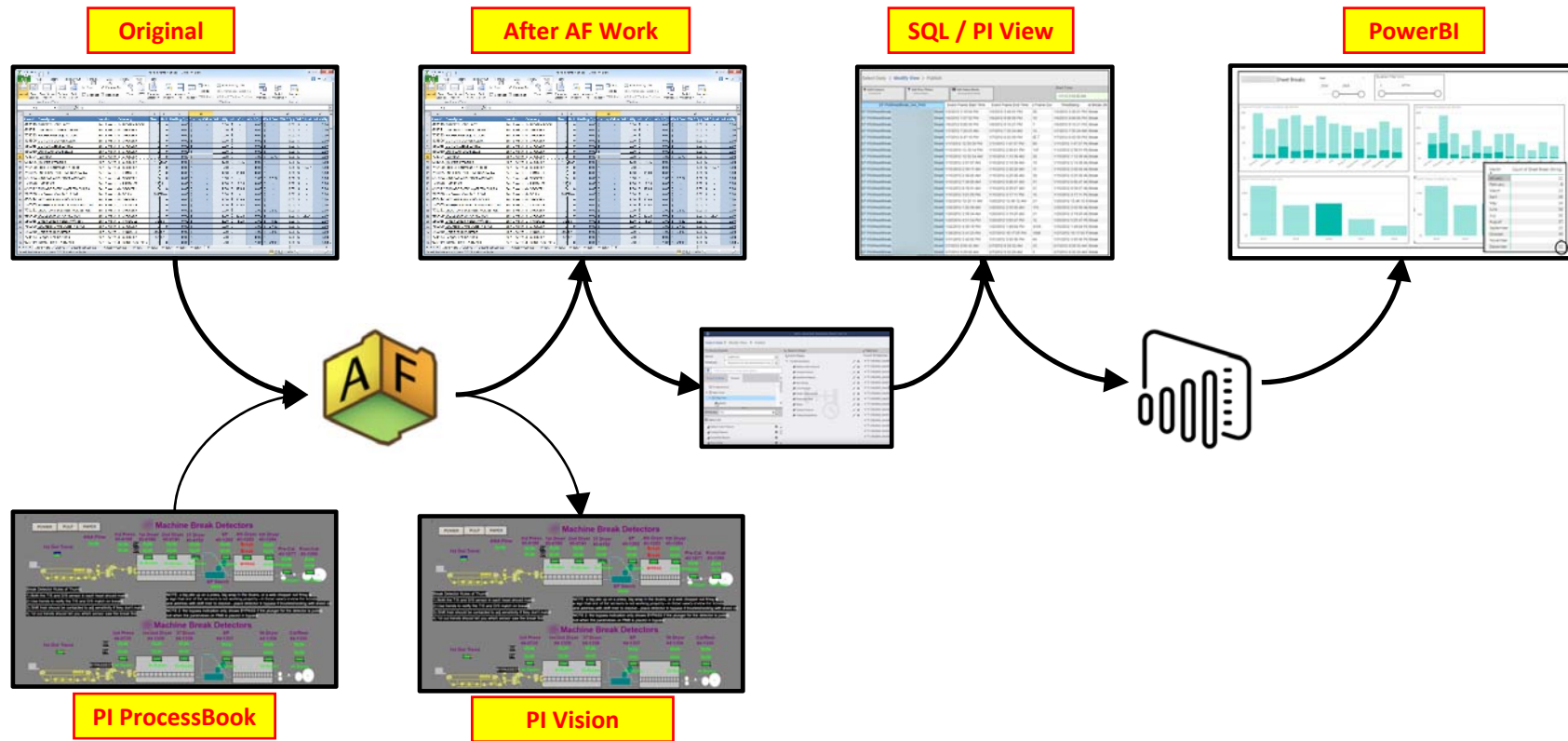
Step 5: Link Business Analytics Tool to Data

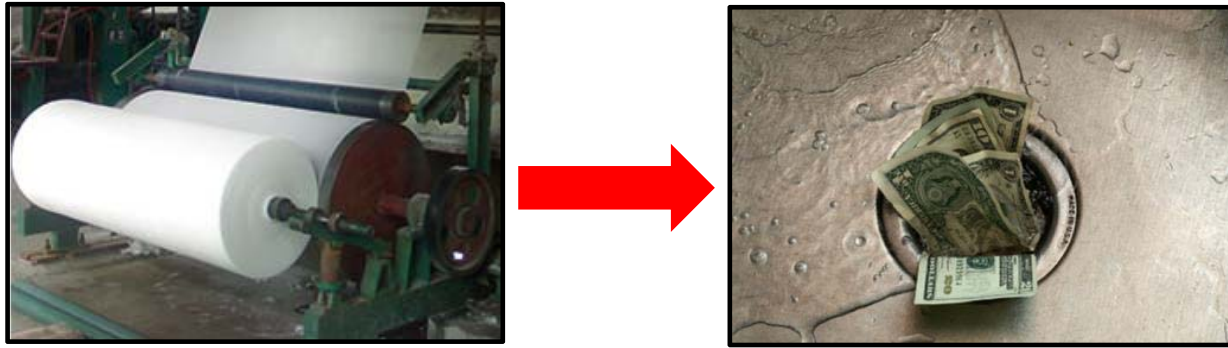
- PI Data Archive -> PI DataLink, PI OLEDB, PI ODBC
- Asset Framework -> PI OLEDB
- PI Integrator for BA -> PI OLEDB

Migration Steps:



PI ProcessBook to PI Vision Considerations





Simple Example

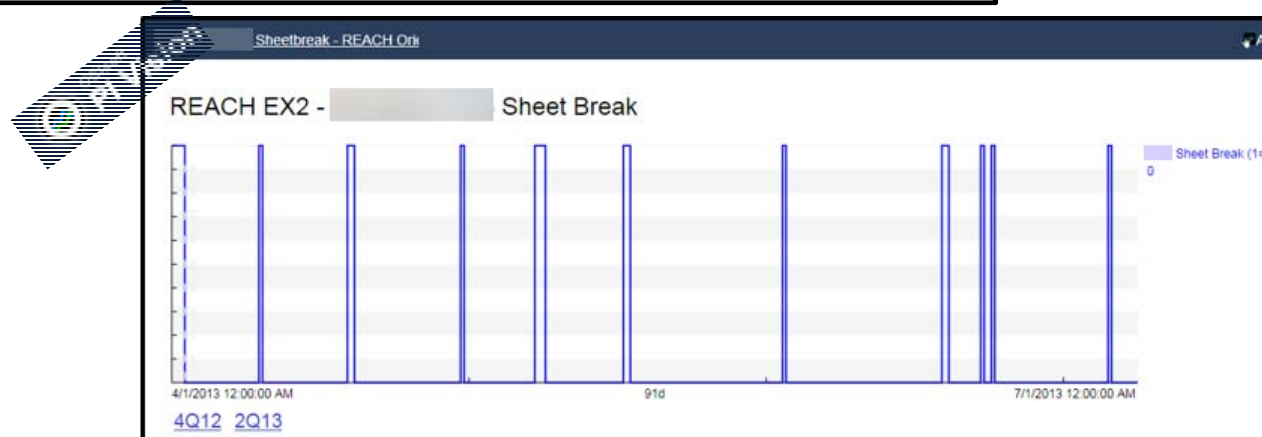
Sheet Break Report (New Engineer Training)

What Does Sheet Break Data Look Like?



1 = Break

0 = Sheet



What Does Sheet Break Data Look Like?

Number of Values:	475
01-Oct-12 10:51:30	Sheet
01-Oct-12 18:41:37	Sheet
02-Oct-12 00:38:24	Break
02-Oct-12 00:53:36	Sheet
02-Oct-12 08:43:41	Sheet
02-Oct-12 13:52:08	I/O Timeout
02-Oct-12 13:52:22	Sheet
02-Oct-12 21:42:30	Sheet
03-Oct-12 05:32:41	Sheet
03-Oct-12 13:22:48	Sheet
03-Oct-12 15:59:31	Break
03-Oct-12 16:15:41	Sheet
04-Oct-12 00:05:44	Sheet
04-Oct-12 07:55:49	Sheet
04-Oct-12 08:06:53	I/O Timeout
04-Oct-12 08:09:36	Sheet
04-Oct-12 14:55:53	I/O Timeout
04-Oct-12 14:55:55	Sheet
04-Oct-12 15:06:58	I/O Timeout
04-Oct-12 15:07:08	Sheet
04-Oct-12 22:57:19	Sheet

1. Data Stored on Change...
2. And Periodically w/o Change (~8 hours) ...
3. And Sometimes with Error Information ...

The screenshot shows the 'Classic' tab of the OSISOFT configuration window. It includes settings for 'Typical Value', 'Zero', and 'Span'. Below these are sections for 'Scan', 'Archiving', 'Step', 'Shutdown', and 'Compressing', each with 'On' and 'Off' radio buttons. The 'Exception Deviation' and 'Compression Deviation' sections show '0' in 'Eng. Units'. At the bottom, there are time settings for 'Min. Time' and 'Max. Time' in 'Day Hr Min Sec' format. A red box highlights the 'Max. Time' settings, with a red arrow pointing to the 'Hr' field, which is set to '8'.

New Engineer Training: Example 2

- **Background**

- Today is July 5, 2013.
- The Paper Machine Project Team Finished Implementing their Final Recommendations to Reduce Wet-End Sheet Breaks.
- **Compare 4Q12 to 2Q13; Mill Day Begins at 7AM**

- **Goal Results**

- PI Compressed Data
 - Base Period: Oct/Nov/Dec 2012 (475 Values)
 - Comparison Period: Apr/May/Jun 2013 (413 Values)
- PI Sampled Data (1-Min -> 131,040 Values)

PI Compressed Data

{=PICompDat('PI-Compressed'!\$B\$2,'PI-Compressed'!\$B\$3,'PI-Compressed'!\$B\$4,1,'PI-Compressed'!\$B\$1,"inside")}

Server							
TAG:							
Start Time:	4/1/2013 7:00		10/1/2012 7:00				
End Time:	7/1/2013 7:00		1/1/2013 7:00				

Number of Values:	417	Number of Values:	475	Base Month	Base Breaks	Eval Month	Eval Breaks
01-Apr-13 12:36:07	Break	01-Oct-12 10:51:30	Sheet	4	0	10	0
01-Apr-13 20:26:11	Break	01-Oct-12 18:41:37	Sheet	4	0	10	0
01-Apr-13 21:56:00	Sheet	02-Oct-12 08:38:24	Break	4	10	1	1
02-Apr-13 05:46:07	Sheet	02-Oct-12 03:36	Sheet	4	10	0	0
02-Apr-13 10:32:01	Break	02-Oct-12 08:43:41	Sheet	4	10	0	0
02-Apr-13 10:40:25	Sheet	02-Oct-12 13:52:08	I/O Timeout	4	0	10	0
02-Apr-13 18:30:34	Sheet	02-Oct-12 13:52:22	Sheet	4	0	10	0
03-Apr-13 02:20:38	Sheet	02-Oct-12 21:42:30	Sheet	4	0	10	0
03-Apr-13 10:10:43	Sheet	03-Oct-12 05:32:41	Sheet	4	0	10	0
03-Apr-13 14:44:56	Break	03-Oct-12 13:22:48	Sheet	4	1	10	0
03-Apr-13 15:02:52	Sheet	03-Oct-12 15:59:31	Break	4	0	10	1
03-Apr-13 22:52:59	Sheet	03-Oct-12 16:15:41	Sheet	4	0	10	0
04-Apr-13 06:43:07	Sheet	04-Oct-12 00:05:44	Sheet	4	0	10	0
04-Apr-13 14:33:14	Sheet	04-Oct-12 07:55:49	Sheet	4	0	10	0
04-Apr-13 22:23:21	Sheet	04-Oct-12 08:06:53	I/O Timeout	4	0	10	1
05-Apr-13 06:13:26	Sheet	04-Oct-12 08:09:36	Sheet	4	0	10	0
05-Apr-13 14:03:31	Sheet	04-Oct-12 14:55:53	I/O Timeout	4	0	10	1
05-Apr-13 21:53:38	Sheet	04-Oct-12 14:55:55	Sheet	4	0	10	1
06-Apr-13 05:43:43	Sheet	04-Oct-12 15:06:58	I/O Timeout	4	0	10	1
06-Apr-13 13:33:49	Sheet	04-Oct-12 15:07:08	Sheet	4	0	10	1
06-Apr-13 21:23:56	Sheet	04-Oct-12 22:57:19	Sheet	4	0	10	1
07-Apr-13 05:14:00	Sheet	05-Oct-12 06:47:27	Sheet	4	0	10	1
07-Apr-13 13:04:10	Sheet	05-Oct-12 14:37:36	Sheet	4	0	10	1
07-Apr-13 20:54:14	Sheet	05-Oct-12 22:27:42	Sheet	4	0	10	1
08-Apr-13 04:44:19	Sheet	06-Oct-12 06:17:50	Sheet	4	0	10	0
08-Apr-13 07:08:18	Break	06-Oct-12 14:07:55	Sheet	4	1	10	0

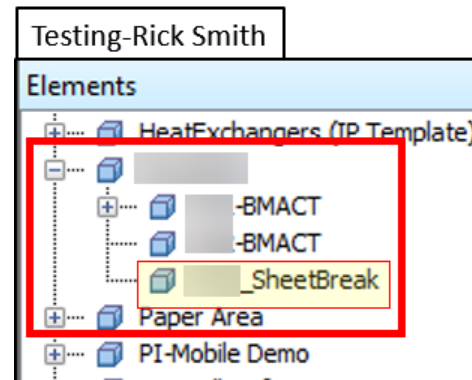
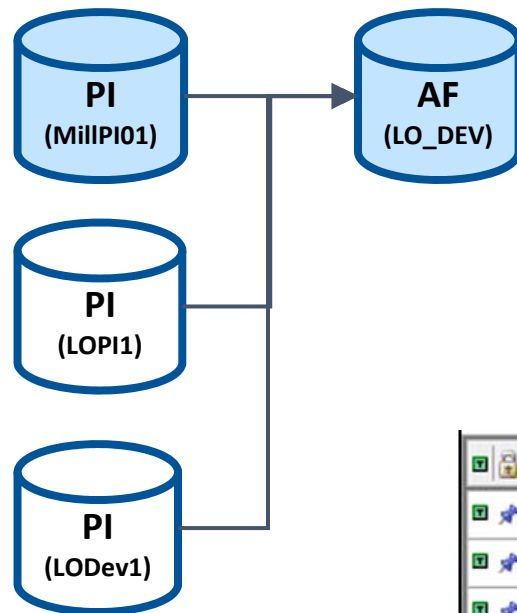
	Base (4Q12)	Eval (1Q13)
M1	39	20
M2	36	29
M3	32	22
Total	107	71

=SUMIF(I\$7:I\$501,"=10",J\$7:J\$501)

=IF(AND(B16="Break",B15="Sheet")=TRUE(),1,0)

1. Configuration
2. Compressed Data (Evaluation Period)
3. Compressed Data (Baseline Period)
4. Date -> Month and Determine Break Counts
5. Summarize Break Count by Month

Sheet Break Event Frames



Name			1 [41.23:05:04]	Duration
	EF:PMSheetBreak_	...		0:06:58
	EF:PMSheetBreak_	...		1:05:54
	EF:PMSheetBreak_	...		2:31:14
	EF:PMSheetBreak_	...		0:19:29
	EF:PMSheetBreak_	...		0:16:45

Event Frames Configuration

The screenshot displays the OSIsoft PI Event Frames Configuration tool. On the left, a list of elements is shown, with 'SheetBreak' highlighted. The central pane shows the configuration for 'PM3_SheetBreak'. The right pane shows the 'Event Frame Template' configuration for 'EF:PMSheetBreak_MA_PM3'.

Event Frame Template Configuration:

Name	Expression	True for
Start triggers		
StartTrigger	'Sheet Break (String)' = "Break"	30 seconds
End trigger		
EndTrigger	'Sheet Break (String)' = "Sheet"	

Scheduling: Event-Triggered (selected), Periodic

Trigger on: Any Input

Event Frame Template: EF:PMSheetBreak_MA_PM3

Analysis Type: Event Frame Generation (selected)

Categories: SheetBreak_

Description:

Name: SheetBreak_

Backfilling: (checked)

Analysis Type: Expression, Rollup, **Event Frame Generation**, SQC

Event Frame Template: EF:PMSheetBreak_MA_PM3

Start triggers

StartTrigger 'Sheet Break (String)' = "Break" 30 seconds

End trigger

EndTrigger 'Sheet Break (String)' = "Sheet"

Evaluation Time: 2/13/2017 9:05:17 AM **Last Trigger Time:** 2/13/2017 9:01:45 AM

Scheduling: Event-Triggered (selected), Periodic

Trigger on: Any Input

Connected to the PI Analysis Service.

Event Frames Results

Stop Here?

```
{=PIEFDat('PI-EventFrame'!$E$1,'PI-EventFrame'!$B$1,'PI-EventFrame'!$B$2,0,"","EF:PMSheetBreak",,,,,"starting in range",,,,,"{EN},{ST},{ET},{DU},{EFT},{PE},Sheet Break (String)",,,,0,0)}
```

Start Date	10/1/2012		Database	\\Loveland Dev\Testing-Rick Smith
End Date	7/1/2013		Event	EF:PMSheetBreak
Event name	Start time	End time	Duration	Event template
EF:PMSheetBreak	02-Oct-12 01:38:24	02-Oct-12 01:53:36	0 0:15:12	EF:PMSheetBreak
EF:PMSheetBreak	03-Oct-12 16:59:31	03-Oct-12 17:15:41	0 0:16:10	EF:PMSheetBreak
EF:PMSheetBreak	07-Oct-12 00:02:49	07-Oct-12 00:17:29	0 0:14:40	EF:PMSheetBreak
EF:PMSheetBreak	07-Oct-12 00:20:03	07-Oct-12 00:35:43	0 0:15:40	EF:PMSheetBreak
EF:PMSheetBreak	09-Oct-12 18:07:29	09-Oct-12 18:17:35	0 0:10:06	EF:PMSheetBreak
EF:PMSheetBreak	11-Oct-12 23:49:37	12-Oct-12 01:23:33	0 1:33:56	EF:PMSheetBreak
EF:PMSheetBreak	13-Oct-12 23:06:58	13-Oct-12 23:19:00	0 0:12:02	EF:PMSheetBreak
EF:PMSheetBreak	14-Oct-12 17:48:33	14-Oct-12 17:57:34	0 0:09:01	EF:PMSheetBreak
EF:PMSheetBreak	16-Oct-12 08:13:42	16-Oct-12 08:38:05	0 0:24:23	EF:PMSheetBreak
EF:PMSheetBreak	16-Oct-12 08:45:18	16-Oct-12 09:33:41	0 0:48:23	EF:PMSheetBreak
EF:PMSheetBreak	16-Oct-12 09:36:38	16-Oct-12 09:38:22	0 0:01:44	EF:PMSheetBreak
EF:PMSheetBreak	17-Oct-12 09:52:29	17-Oct-12 10:12:52	0 0:20:23	EF:PMSheetBreak
EF:PMSheetBreak	17-Oct-12 10:16:11	17-Oct-12 10:20:01	0 0:03:50	EF:PMSheetBreak
EF:PMSheetBreak	17-Oct-12 22:55:30	17-Oct-12 23:04:58	0 0:09:28	EF:PMSheetBreak
EF:PMSheetBreak	17-Oct-12 23:05:06	17-Oct-12 23:10:28	0 0:05:22	EF:PMSheetBreak
EF:PMSheetBreak	18-Oct-12 15:33:58	18-Oct-12 16:03:56	0 0:29:58	EF:PMSheetBreak
EF:PMSheetBreak	18-Oct-12 16:04:04	18-Oct-12 16:07:16	0 0:03:12	EF:PMSheetBreak
EF:PMSheetBreak	18-Oct-12 16:07:26	18-Oct-12 16:10:38	0 0:03:12	EF:PMSheetBreak
EF:PMSheetBreak	18-Oct-12 16:11:41	18-Oct-12 16:41:07	0 0:29:26	EF:PMSheetBreak
Grand Total			260	0 01:53:03

Explore Events

Database: P:\DL-EF\ES\$1

Search start: P:\DL-EF\ES\$1

Search end: P:\DL-EF\ES\$2

☐ Limit to database level

☐ More search options

Event category: *

Minimum duration:

Maximum duration:

Event name: *

Event template: EF:PMSheetBreak

Element name: *

Element template: *

Search mode: starting in range

Sort order: start time ascending

Severity: *

Row Labels

2012

Oct

Nov

Dec

2013

Jan

Feb

Mar

Apr

May

Jun

22

0 01:37:33

1. Configuration

2. PI Explore Events

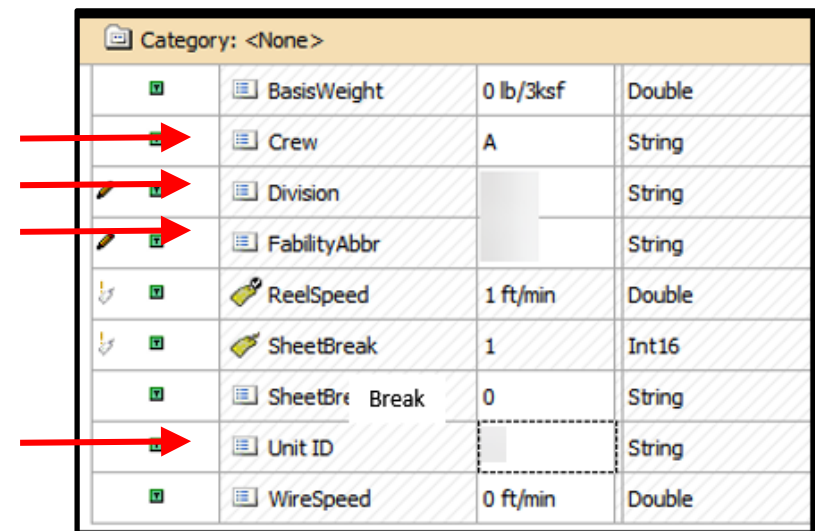
3. Summarize by Month

PowerBI (PI DataLink Event Frames) Stop Here?



What Else Would a Data Scientist Want?

- What Crew is Working?
- What Facility?
- What Unit ID?
- What Division?
- Process Parameters
- Duration Filters
- Grade Information



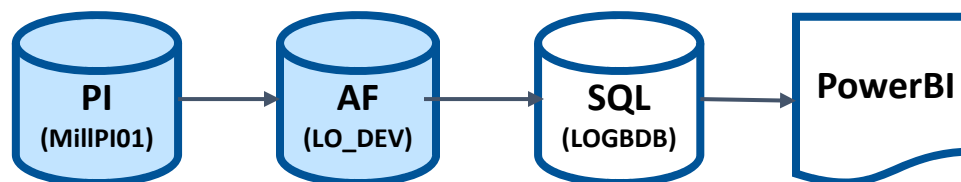
A screenshot of a data table interface. The table has a header row with the text 'Category: <None>'. Below the header, there are several rows of data. Red arrows point to the following rows: 'Crew', 'Division', 'FacilityAbbr', and 'Unit ID'. The table columns are: a checkbox column, a name column, a value column, and a data type column.

Category: <None>			
☒	BasisWeight	0 lb/3ksf	Double
☒	Crew	A	String
☒	Division		String
☒	FacilityAbbr		String
☒	ReelSpeed	1 ft/min	Double
☒	SheetBreak	1	Int16
☒	SheetBreak	0	String
☒	Unit ID		String
☒	WireSpeed	0 ft/min	Double

PI Integrator for Business Analytics

⚠ Not secure | <https://s29epidev01:5443>

My Views						
+ Create Asset View Build a data view starting with your asset hierarchy		+ Create Event View Build a data view starting with your event frame hierarchy		✓ Modify View Modify existing data view	✗ Remove View Remove selected view	
Name	Run Status	Type	Run M...	Start Time	End Time	Last Run Time
Heat Exchanger	Scheduled	Asset	Continuous	*-30d	*	Aug 5, 2018 11:03:33 AM
	Scheduled	Event	Continuous	12/1/17 12:00:00 AM	*	Aug 5, 2018 10:37:54 AM
	Scheduled	Event	Continuous	1/1/17 12:00 AM	*	Aug 5, 2018 10:30:04 AM
	Published	Asset	Once	1/1/2018	2/1/2018	Feb 16, 2018 10:13:18 PM
	Scheduled	Asset	Continuous	7/31/18 12:00:00 AM	*	Aug 5, 2018 10:56:29 AM
	Not Yet Published	Event	Once	7/18/18 1:23:00 AM	*	Never
REACH-Exercise 2-...	Published	Event	Once	1/1/12 5:59:00 AM	1/1/14 12:00:00 AM	Aug 5, 2018 11:23:26 AM



PI View - Data Looks Similar to Excel

Select Data > **Modify View** > Publish

+ Add Column
6 columns

Edit Row Filters
0 Row Filters

Edit Value Mode
Summarized Values

Start Time
1/1/12 5:59:00 AM

EF.PMSheetBreak		Event Frame Start Time	Event Frame End Time	Event Frame Dur	TimeStamp	Event Break (St
EF.PMSheetBreak	Sheet	1/5/2012 3:19:04 PM	1/5/2012 3:45:01 PM	26	1/5/2012 3:45:01 PM	Break
EF.PMSheetBreak	Sheet	1/6/2012 7:57:52 PM	1/6/2012 8:08:08 PM	10	1/6/2012 8:08:08 PM	Break
EF.PMSheetBreak	Sheet	1/6/2012 8:08:39 PM	1/6/2012 8:15:21 PM	7	1/6/2012 8:15:21 PM	Break
EF.PMSheetBreak	Sheet	1/7/2012 7:20:53 AM	1/7/2012 7:32:24 AM	12	1/7/2012 7:32:24 AM	Break
EF.PMSheetBreak	Sheet	1/7/2012 6:47:10 PM	1/7/2012 6:52:59 PM	61.7	1/7/2012 6:52:59 PM	Break
EF.PMSheetBreak	Sheet	1/11/2012 12:39:39 PM	1/11/2012 1:47:57 PM	68	1/11/2012 1:47:57 PM	Break
EF.PMSheetBreak	Sheet	1/12/2012 12:10:14 PM	1/12/2012 2:36:51 PM	147	1/12/2012 2:36:51 PM	Break
EF.PMSheetBreak	Sheet	1/15/2012 12:52:54 AM	1/15/2012 1:12:38 AM	20	1/15/2012 1:12:38 AM	Break
EF.PMSheetBreak	Sheet	1/15/2012 2:01:07 AM	1/15/2012 2:14:30 AM	13	1/15/2012 2:14:30 AM	Break
EF.PMSheetBreak	Sheet	1/15/2012 2:39:17 AM	1/15/2012 2:50:28 AM	11	1/15/2012 2:50:28 AM	Break
EF.PMSheetBreak	Sheet	1/15/2012 2:56:05 AM	1/15/2012 3:25:30 AM	29	1/15/2012 3:25:30 AM	Break
EF.PMSheetBreak	Sheet	1/15/2012 7:36:05 AM	1/15/2012 8:06:47 AM	31	1/15/2012 8:06:47 AM	Break
EF.PMSheetBreak	Sheet	1/15/2012 8:18:51 AM	1/15/2012 8:39:57 AM	21	1/15/2012 8:39:57 AM	Break
EF.PMSheetBreak	Sheet	1/15/2012 3:01:59 PM	1/15/2012 3:17:11 PM	15	1/15/2012 3:17:11 PM	Break
EF.PMSheetBreak	Sheet	1/20/2012 12:25:11 AM	1/20/2012 12:46:12 AM	21	1/20/2012 12:46:12 AM	Break
EF.PMSheetBreak	Sheet	1/20/2012 1:02:59 AM	1/20/2012 2:55:50 AM	113	1/20/2012 2:55:50 AM	Break
EF.PMSheetBreak	Sheet	1/20/2012 2:58:34 AM	1/20/2012 3:19:25 AM	21	1/20/2012 3:19:25 AM	Break
EF.PMSheetBreak	Sheet	1/20/2012 4:51:54 PM	1/20/2012 5:03:47 PM	12	1/20/2012 5:03:47 PM	Break
EF.PMSheetBreak	Sheet	1/22/2012 4:30:19 PM	1/25/2012 1:49:04 PM	4159	1/25/2012 1:49:04 PM	Break
EF.PMSheetBreak	Sheet	1/26/2012 2:41:23 PM	1/27/2012 10:17:05 PM	1896	1/27/2012 10:17:05 PM	Break
EF.PMSheetBreak	Sheet	1/31/2012 2:42:02 PM	1/31/2012 3:45:36 PM	64	1/31/2012 3:45:36 PM	Break
EF.PMSheetBreak	Sheet	2/7/2012 8:05:42 AM	2/7/2012 8:28:32 AM	23	2/7/2012 8:28:32 AM	Break
EF.PMSheetBreak	Sheet	2/7/2012 8:29:00 AM	2/7/2012 8:32:29 AM	3	2/7/2012 8:32:29 AM	Break

PowerBI (PI Integrator for Business Analytics)



What Holds Back Adoption?



- **Spreadsheets**
 - **Users Have Full Control and Can Work Independently**
 - Users Can See Interim Calculations
- **AF -> Data Lake**
 - Requires Trust in Methodology... No Back-Tracking Tools
- **Convincing Users Requires...**
 - Single Version of the Truth is a Good Thing
 - Fighting Inertia... Breaking Old Habits is Hard to Do
 - **Remove Hurdles (More Training, Back-Tracking Tools, etc.)**
 - **Solve Some Difficult Problems**
 - Timing Problems, Batch Oriented Analysis
 - Handle non-Reporting Times

Give Users Reason to Convert

Filter Negative Values and Segregate Shared Meters

Identify Batches from MS Excel

- **Calculate Efficiency**
 - Totalize Inlet Flow
 - Totalize Outlet Flow
 - Calculate Inlet Mass Flow
 - Calculate Outlet Mass Flow
- 2Q19: 100,000+ Rows
 - 117 Batches
 - 3 Days of Analysis

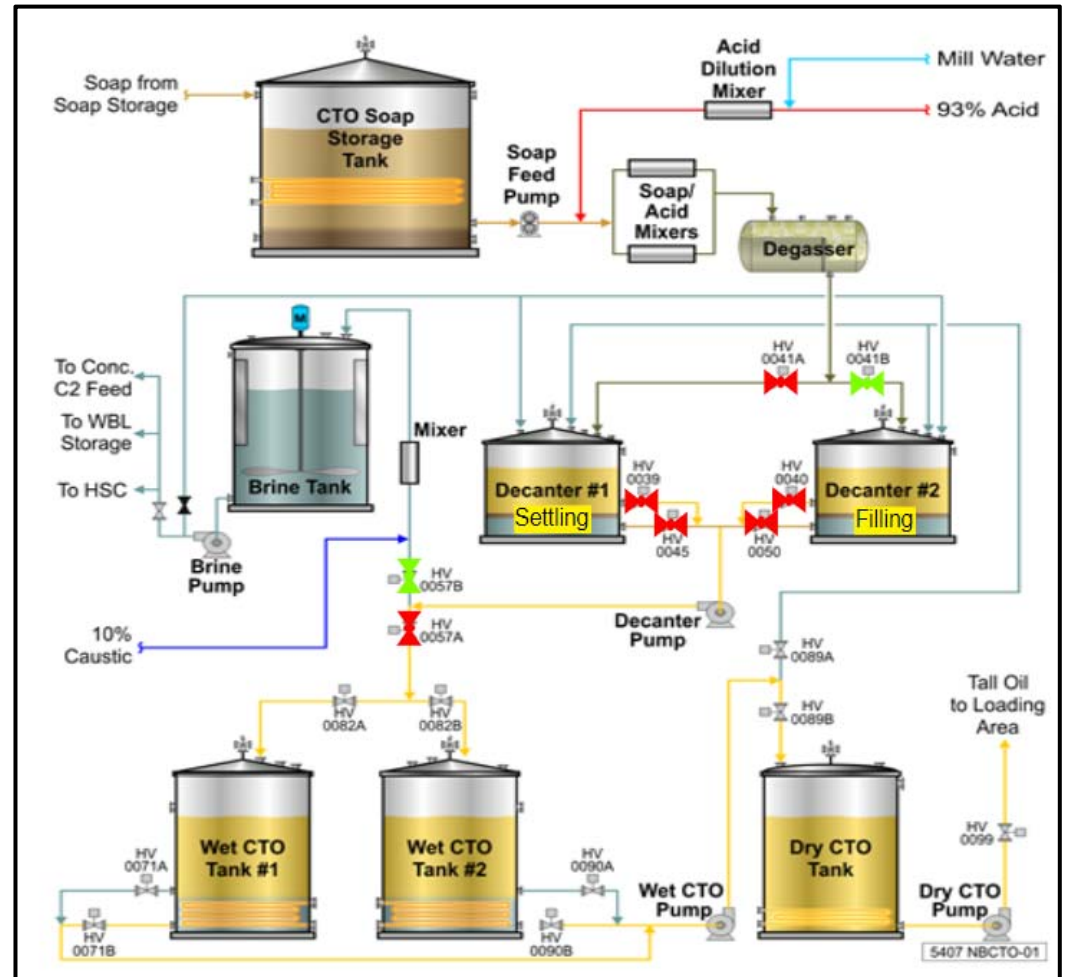
SS.PI.T818823-1, LPI.T818884-1, S.PI.T818810YH SS.PI.T818823 SS.PI.T818884 SS.PI.T882CT8YH												
Batch #	Flow	Rate	Results 1 Totals Qty	Results 1 Totals Mol CTS	Results 1 CTY Qty	Results 2 Totals Qty	Results 2 Totals Mol CTS	Results 2 Totals CTY	Results 3 CTY			
78	W-1 CT	0000000000	67284.97	38244.18	34.66	00198.83	0.00	0.00				
78	W-1 CT	0000000000	67284.97	38257.78	38.38	00198.83	0.00	0.00				
78	W-1 CT	0000000000	67284.97	31211.41	31.83	00198.83	0.00	0.00				
78	W-1 CT	0000000000	67284.97	31698.86	31.71	00198.83	0.00	0.00				
78	W-1 CT	0000000000	67284.97	32184.89	32.34	00198.83	0.00	0.00				
78	W-1 CT	0000000000	67284.97	32824.34	32.88	00198.83	0.00	0.00				
78	W-1 CT	0000000000	67284.97	32867.67	32.76	00198.83	0.00	0.00				
78	W-1 CT	0000000000	67284.97	32364.18	34.44	00198.83	0.00	0.00				
78	W-1 CT	0000000000	67284.97	32412.89	34.76	00198.83	0.00	0.00				
78	W-1 CT0	0000000000	67284.97	32414.48	34.76	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32414.41	34.76	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32418.41	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32418.42	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32418.43	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32418.44	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32417.48	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32417.48	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32418.46	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32418.47	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32419.48	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32419.48	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32420.49	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32421.81	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32422.82	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32422.82	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32422.82	34.77	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32422.84	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32424.88	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32424.88	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32428.86	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32428.87	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32428.88	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32428.89	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32427.18	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32427.68	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32428.11	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32428.62	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32429.12	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32429.62	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32428.14	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32428.68	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32421.16	34.78	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32421.67	34.74	00198.83	0.00	0.00				
78	Drain	0000000000	67284.97	32422.17	34.74	00198.83	0.02	0.00				
78	Drain	0000000000	67284.97	32422.68	34.74	00198.83	0.77	0.01				
78	Drain	0000000000	67284.97	32422.19	34.74	00198.83	1.92	0.01				
78	Drain	0000000000	67284.97	32422.78	34.74	00198.83	3.84	0.03				
78	Drain	0000000000	67284.97	32424.31	34.74	00198.83	4.28	0.03				

Identify Batches from CTO Trends

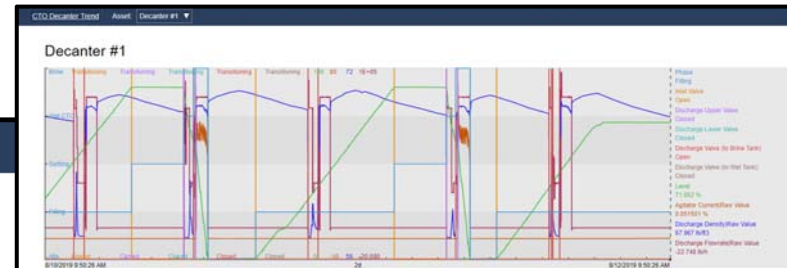
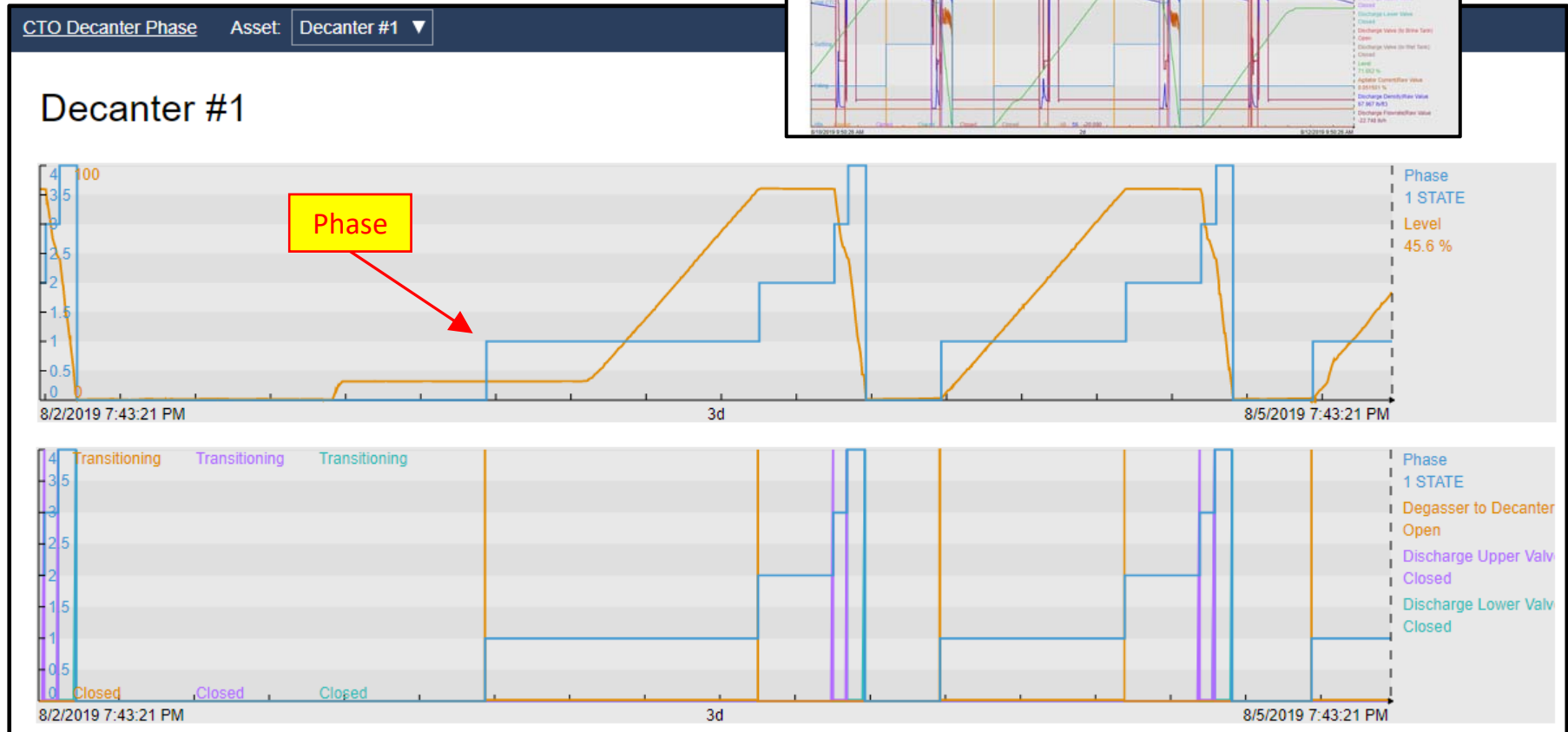


CTO Process Flow

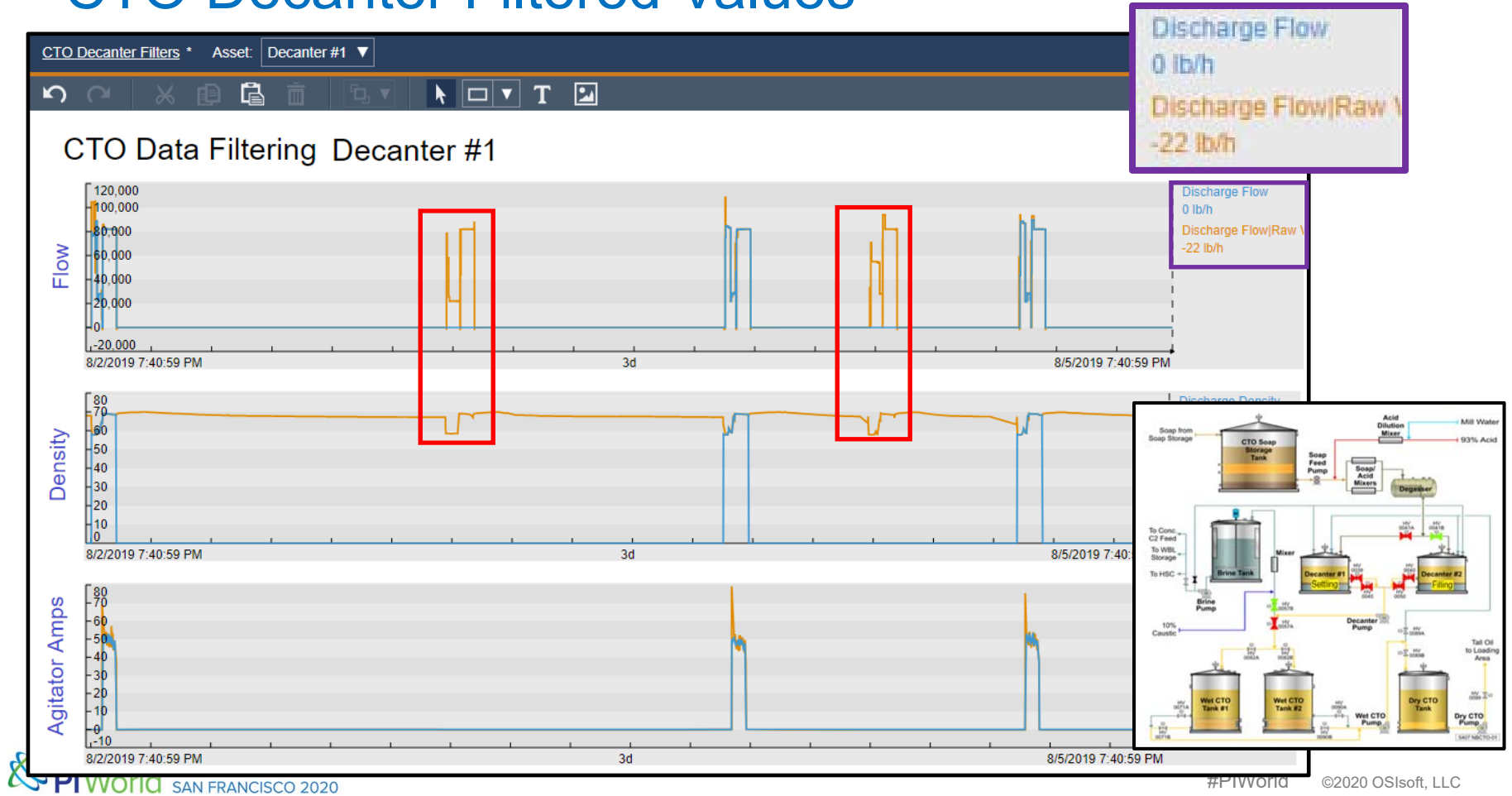
1. Filling
 - Inlet Valve Open (HV 41A/B)
 - Previous Phase = "Idle"
2. Settling
 - Inlet Valve Closed (HV 41A/B)
 - Previous Phase = "Filling"
3. Wet CTO
 - Upper Discharge Open (HV 39/40)
 - To CTO Valve Open (HV 57A)
4. Brine
 - Lower Discharge Open (HV 45/50)
 - To Brine Valve Open (HV 57B)
 - To CTO Valve Not Open (HV 57A)
5. Idle
 - Level <= Low Limit



CTO Decanter Phase



CTO Decanter Filtered Values



Retrieve Event Frames Data

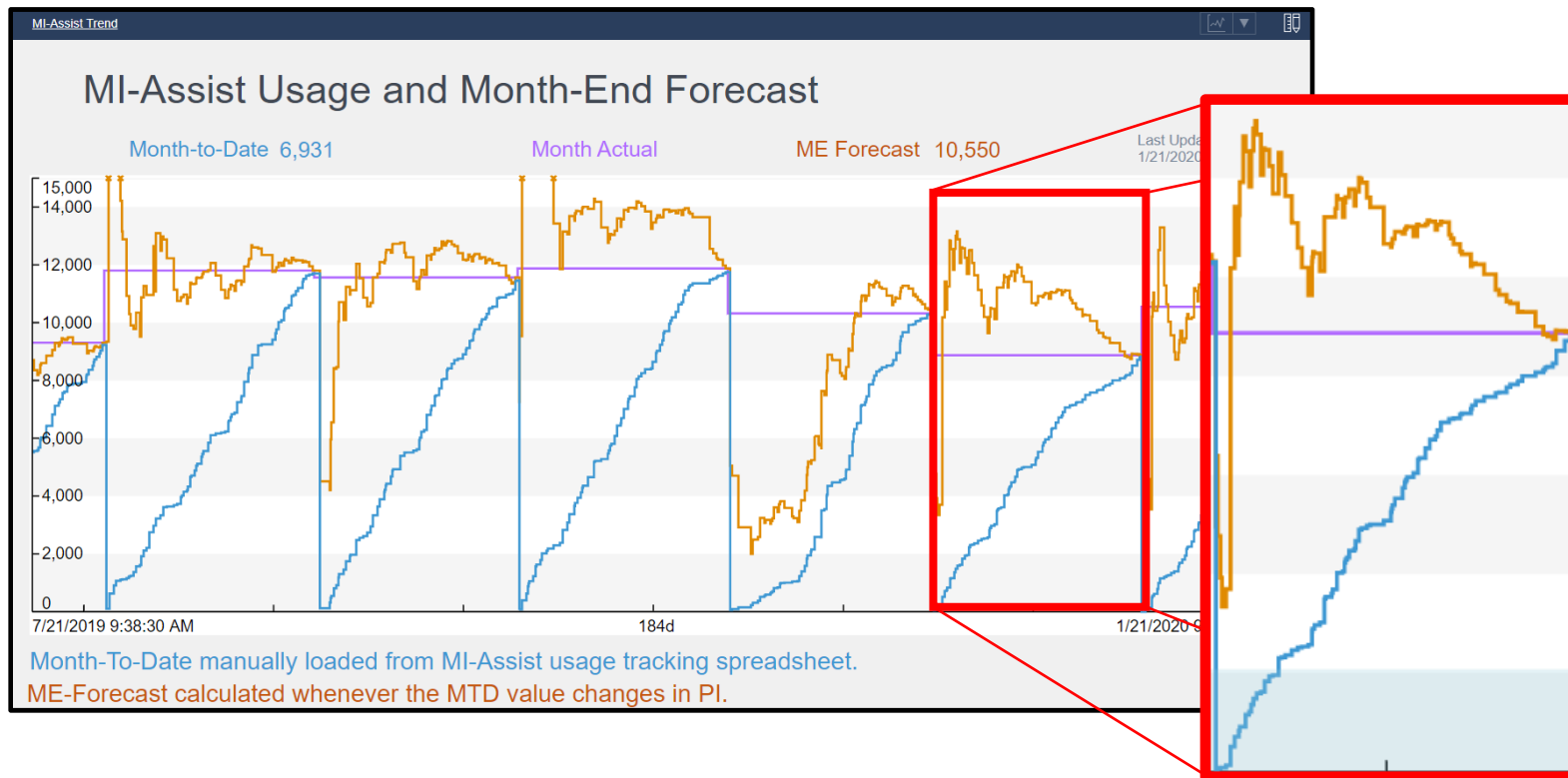
- Manual Process
 - 117 Batches & 3 Days
- AF Configuration
 - Asset: 2-Hours
 - Phase Determination: 1-Hour
 - Event Frame Generation: 1-Hour
 - Revisions: 1-Day
- PI Vision Configuration: 1-Hours
- MS Excel Report: 1-Hour
 - Refresh Data: 20 Seconds

Stop Here?

Average Delta -> -0.03				
Inlet Mass- Total	Wet CTO Mass-Total	Brine Mass- Total	Wet CTO Efficiency	Delta
				-0.16
				-0.75
				-0.78
				0.55
Average Delta ->				-0.03
				-0.65
				1.20
				-5.24
				0.75
				1.17
				-0.07
				-0.21
				0.45
				0.28
				0.15
				0.15
				2.50
				2.47
				0.57
				0.53

Simplify Using Summary Statistics

Simplify Finding Shift/Daily/Monthly Values



Use BOM('*') for Monthly Value Timestamp

The screenshot shows the MI-Assist configuration window for 'MI-Assist: Monthly Value'. The 'General' tab is active, displaying a list of variables and their expressions. The 'vDTOutput' variable is highlighted with a red box, and its expression 'Bom('*')' is also highlighted. A red arrow points from the 'vDTOutput' variable to a callout box that says 'vDTOutput Bom('*')'. Another red arrow points from the 'Advanced...' button in the 'Output time stamp override' section to the same callout box. The 'Functions' panel on the right shows the 'Abs' function. The 'Scheduling' section at the bottom is set to 'Event-Triggered' with a trigger on 'Any Input'.

Name	Expression	Value at Evaluation	Value at Last Trigg	Output Attribute
vActMTD	'Activations-ME-Forecast'	10550	10550	Map
vDTOutput	Bom('*')	1/1/2020 12:00:00	1/1/2020 12:00:00	Map
vOutput	vActMTD		10550	Activations-Month

Advanced...
Output time stamp override: vDTOutput

Calculate Month-End Value

MI-Assist

General Child Elements Attributes Ports Analyses Notification Rules Version

Name: MI-Assist: Month-End-Forecast

Description:

Categories:

Analysis Type: ☒ Expression ☐ Rollup ☐ Event Frame Generation ☐ SQC

Name	Backfilling
MI-Assist: Month-End-Forecast	✓
MI-Assist: Monthly Value	✓
MI-Assist: Zero Month-to-Date	✓

Add a new variable

Name	Expression	Value at Evaluation	Value at Last Trigg	Output Attribute
actDT	// get the timestamp of the most recent stored TimeStamp('Activations-MTD')			
actCnt	'Activations-MTD'			
monFrac	// fraction of month to now ('*' - Bom('*')) / (bonm('*') - Bom('*'))	0.65923	0.65699	Map
actFore	if (BadVal(actcnt)) then NoOutput() // if exactly at midnight on the first, then continue previous value else if (monfrac = 0) then NoOutput() // forecast = (actual count) / (fraction of month to now) else actCnt / monfrac	10514	10550	Activations-ME-Forecast

Evaluation Time: 1/21/2020 10:28:04 AM Last Trigger Time: 1/21/2020 8:47:54 AM Elapsed Evaluation Time: 3.2ms

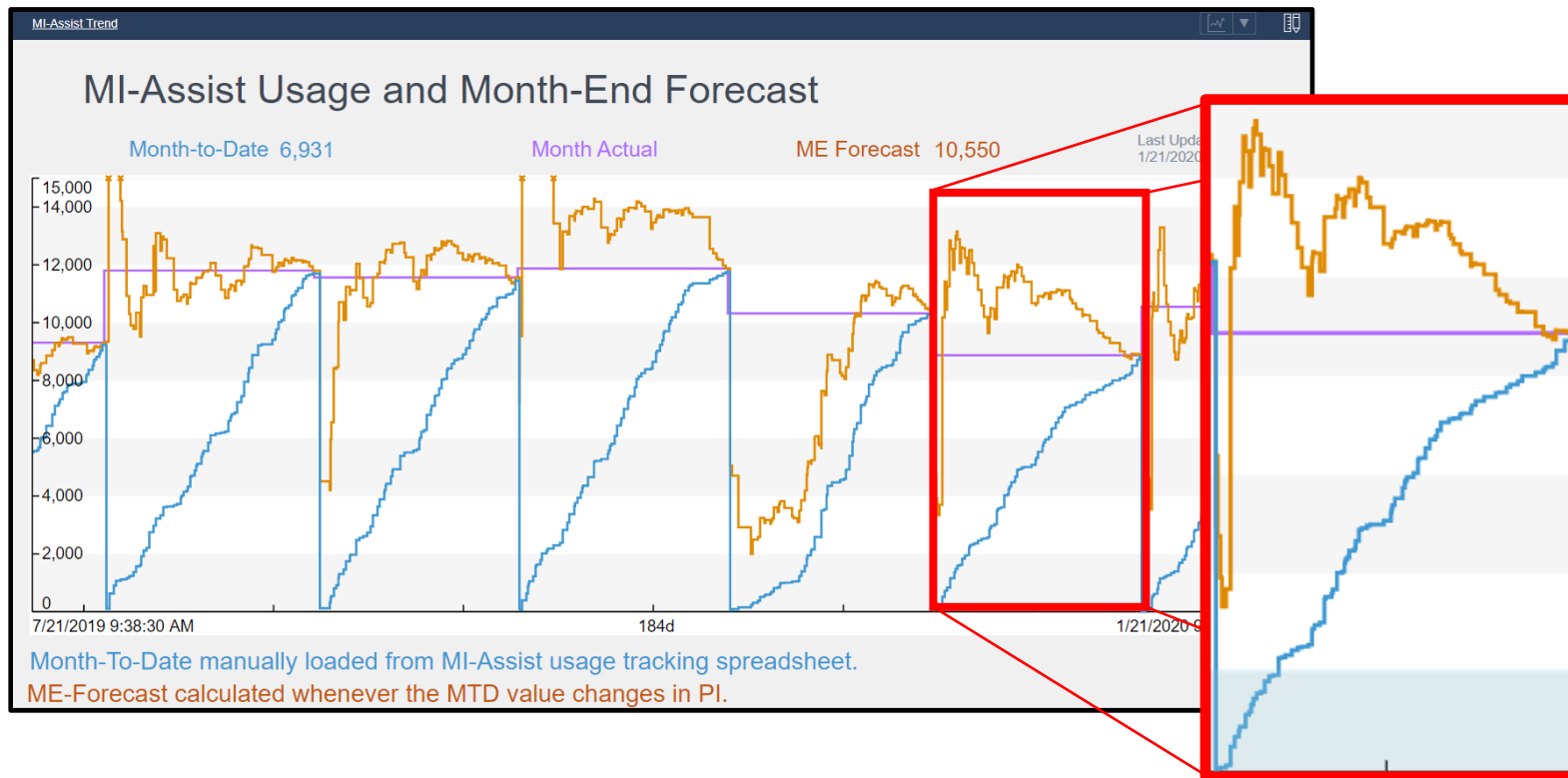
Scheduling: ☒ Event-Triggered ☐ Periodic

Trigger on: Any Input

Advanced...

Connected to the PI Analysis Service.

Simplify Finding Shift/Daily/Monthly Values



Summary

- **Step 0: Analyze the Spreadsheet**
- **Step 1: Migrate Calculations to AF**
 - Output Results to PI Tags or PI Event Frames
- **Step 2: Add Required Meta Data to AF**
 - Line, Unit, Shift, Grade, etc.
- **Step 3: (Optional) Link AF to External Data Sources**
- **Step 4: (Optional) Export Data Using PI Integrator for BA**
- **Step 5: Link Reporting Tool to New Data Source**
- **Just Start!**

Turning Static Spreadsheets Into Business Analytic Engines



- Rick Smith
- Process Information Manager
- International Paper
- Richard.SmithJr@ipaper.com

Questions?

Please wait for
the **microphone**

State your
name & company



Save the Date...



REGISTER YOUR INTEREST

AMSTERDAM

October 26-29, 2020





Links

- Conf. Portal -> <https://piworldcfp-us2020.hubb.me/Home/Dashboard>



CHALLENGES

SOLUTION

BENEFITS

“

”