# Habits of a Highly Effective Problem Solver

Rick Smith

INTERNATIONAL PAPER



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# International Paper

- World's Largest Pulp and Paper Company
  - Founded 1898
  - 55,000 Employees
  - $21.7 Billion Net Sales (2017)
- OSIsoft Installed Base
  - 39 Facilities (61 PI Servers)
    - US, Brazil, Canada, France, India, Poland, Russia
  - 1.8+ Million Active PI Tags


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# Habits of a Highly Effective Problem Solver

- Be Proactive; **Begin with the End in Mind**; Put First Things First; **Think Win-Win**; **Seek First to Understand, Then to be Understood**; Synergize; **Sharpen the Saw**
- **Seek First to Understand** -> Insure, you understand the problem… Consider requirements not specifically spoken… Use examples from other projects to provoke ideas requester did not consider
- **Think Win-Win** -> Find the simplest solution to meet the objectives… Then consider possible extensions
- **Begin with the End in Mind** -> Mock-up a solution… Show data transformation steps and required inputs… Show required manual steps to keep solution working
- **Sharpen the Saw ->** Explore various techniques to solve problems… Even if you can't apply a particular technique right now


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# Complexity “Pyramid”

| | | | | |
|---|---|---|---|---|
| **Enterprise: PI & non-PI Data; “Really Business Critical”** | Excel / PI DataLink | AF + PI DataLink + Scripting | AF + SSRS/PowerBI (PI OLEDB) | AF + PIIBA -> BI Tools |
| **Facility: PI & non-PI Data; “Really Business Critical”** | | | | |
| **Multiple Areas/Facilities; Automated Reports; “Business Critical”** | | | | |
| **Complex Logic; Automation/Scheduled Reports; Timing Considerations** | | | | |
| **Periodic; Manual Report OK; Short-Term Life** | | | | |
| **Ad Hoc; Single Use; “Throw Away”** | | | | |


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# Examples to Demonstrate the Concepts

- **Tank Overflow**
  - Simple Example… PI DataLink is Probably Enough
- **Sheet Break Analysis**
  - Simple Example, But Might Justify Enterprise View
- **Enterprise Energy Monitoring**
  - Definitely Requires Enterprise Level Tools

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# Enterprise Architecture

- **Memphis, TN (Corporate Headquarters)**
  - **SAP + Business Warehouse(s) + Data Lakes**
- **Loveland, OH (Technology Center)**
  - **Production: PI DA + AF + PI Vision + MS SQL**
  - Development #1: Single Server (PI DA, AF, PI Vision)
  - Development #2: Single Server (PI DA, AF, PI Vision)
- **Mills**
  - **Production: DCS/PLC/QCS -> PI DA + AF + PI Vision**
  - Development (2018): Single Server (PI DA, AF, PI Vision)
  - SQL Cluster


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# Tank Overflow

Calculate Tank Overflow Time

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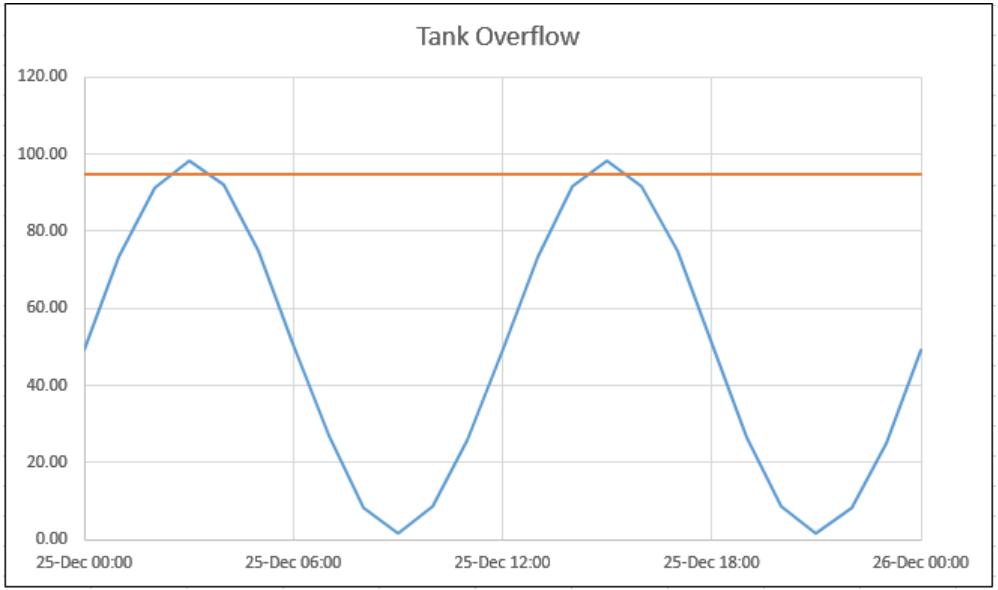
# Trend Data to Confirm Understanding

=PISampDat('DL-Filtered'!$B$2,'DL-Filtered'!$D$1,'DL-Filtered'!$D$2,'DL-Filtered'!$F$1,1,'DL-Filtered'!$B$1)

## Sinusoid Data

| | | |
|---|---|---|
| 25-Dec-18 00:00:00 | 49.15 | 95.00 |
| 25-Dec-18 01:00:00 | 73.23 | 95.00 |
| 25-Dec-18 02:00:00 | 91.37 | 95.00 |
| 25-Dec-18 03:00:00 | 98.30 | 95.00 |
| 25-Dec-18 04:00:00 | 91.98 | 95.00 |
| 25-Dec-18 05:00:00 | 74.95 | 95.00 |
| 25-Dec-18 06:00:00 | 50.88 | 95.00 |
| 25-Dec-18 07:00:00 | 26.81 | 95.00 |
| 25-Dec-18 08:00:00 | 8.18 | 95.00 |
| 25-Dec-18 09:00:00 | 1.70 | 95.00 |
| 25-Dec-18 10:00:00 | 8.57 | 95.00 |





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# Questions to Confirm Understanding

- Do **All** Tanks have **Level Transmitters**?
  - Are they **Working/Accurate**?
  - Do we know the overflow level?
- **Overflow Detection Switch** Instead of a Level?
- Look-Back Analysis or Long-Term?
  - How Long is Long-Term?
  - How often do we want to monitor?
    - Daily? Weekly? Monthly?


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# Assume Look-Back Only / Throw Away

- There Was an Incident Last Week…

- PI DataLink Example 1 -> Sampled Data
- PI DataLink Example 2 -> Calculated Data + Filtered Expression


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# PI DataLink Sampled Data Solution

| | | | | | |
|---|---|---|---|---|---|
| Server | s29epip1 | Start | 1/1/2019 | Interval | 1m |
| Tag | Sinusoid | Stop | 1/8/2019 | Overflow | 95 |

| Time Stamp | Level | Minut |
|---|---|---|
| 01-Jan-19 02:12:00 | 93.7487 | 0.00 |
| 01-Jan-19 02:13:00 | 93.94759 | 0.00 |
| 01-Jan-19 02:14:00 | 94.14647 | 0.00 |
| 01-Jan-19 02 | 94.34536 | |
| 01-Jan-19 02 | 94.54425 | |
| 01-Jan-19 02:17:00 | 94.74314 | 0.00 |
| 01-Jan-19 02:18:00 | 94.94203 | 0.00 |
| 01-Jan-19 02:19:00 | 95.14092 | 1.00 |
| 01-Jan-19 02:20:00 | 95.33981 | 1.00 |
| 01-Jan-19 02:21:00 | 95.5387 | 1.00 |
| 01-Jan-19 02:22:00 | 95.73759 | 1.00 |
| 01-Jan-19 02:23:00 | 95.93648 | 1.00 |
| 01-Jan-19 02:24:00 | 96.13537 | 1.00 |
| 01-Jan-19 02:25:00 | 96.33426 | 1.00 |
| 01-Jan-19 02:26:00 | 96.53314 | 1.00 |

1

2

=IF(C5>95,1,0)

| Row Labels | Sum of Minutes |
|---|---|
| 1-Jan | 180 |
| 2-Jan | 180 |
| 3-Jan | 180 |
| 4-Jan | 183 |
| 5-Jan | 183 |
| 6-Jan | 183 |
| 7-Jan | 183 |
| Grand Total | 1272 |

3

=PISampDat('DL-Sampled'!$B$2,'DL-Sampled'!$D$1,'DL-Sampled'!$D$2,'DL-Sampled'!$F$1,1,'DL-Sampled'!$B$1)


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# PI DataLink Calculated Data (Filtered)

| Server | s29epip1 | Start | 1/1/2019 | Interval | 1d | |
|---|---|---|---|---|---|---|
| Tag | Sinusoid | =B5/60 | /1/2019 | | | |
| | | | | | 'Sinusoid' > 95 | 'Sinusoidu' > 95 |
| **Time Stamp** | **Seconds** | **Minutes** | | **Time Stamp** | **Sinusoid** | **Sinusoidu** |
| 01-Jan-19 00:00:00 | 10800 | 180.000 | | 01-Jan-19 00:00:00 | 180.004 | 183.004 |
| 02-Jan-19 00:00:00 | 10800 | 180.000 | | 02-Jan-19 00:00:00 | 180.004 | 183.004 |
| 03-Jan-19 00:00:00 | 10800 | 180.000 | | 03-Jan-19 00:00:00 | 180.004 | 183.004 |
| 04-Jan-19 00:00:00 | 10980 | 183.000 | | 04-Jan-19 00:00:00 | 183.004 | 183.004 |
| 05-Jan-19 0 | 0 | 183.000 | | 05-Jan-19 00:0 | 183.004 | 1 |
| 06-Jan-19 0 | 0 | 183.000 | | 06-Jan-19 00:0 | 183.004 | 1 |
| 07-Jan-19 00:00:00 | 10980 | 183.000 | | 07-Jan-19 00:00:00 | 183.004 | 183.004 |
| 08-Jan-19 00:00:00 | 10800 | 180.000 | | 08-Jan-19 00:00:00 | 180.004 | 183.004 |
| 09-Jan-19 00:00:00 | 10800 | 180.000 | | 09-Jan-19 00:00:00 | 180.004 | 183.004 |
| 10-Jan-19 00:00:00 | 10800 | 180.000 | | 10-Jan-19 00:00:00 | 180.004 | 183.004 |
| 11-Jan-19 00:00:00 | 10980 | 183.000 | | 11-Jan-19 00:00:00 | 183.004 | 183.004 |
| 12-Jan-19 00:00:00 | 10980 | 183.000 | | 12-Jan-19 00:00:00 | 183.004 | 172.003 |
| 13-Jan-19 00:00:00 | 10860 | 181.000 | | 13-Jan-19 00:00:00 | 181.004 | 180.004 |
| 14-Jan-19 00:00:00 | 10800 | 180.000 | | 14-Jan-19 00:00:00 | 180.004 | 180.004 |
| 15-Jan-19 00:00:00 | 10860 | 181.000 | | 15-Jan-19 00:00:00 | 181.004 | 180.004 |
| 16-Jan-19 00:00:00 | 10860 | 181.000 | | 16-Jan-19 00:00:00 | 181.004 | 180.004 |
| 17-Jan-19 00:00:00 | 10800 | 180.000 | | 17-Jan-19 00:00:00 | 180.004 | 180.004 |
| 18-Jan-19 00:00:00 | 10920 | 182.000 | | 18-Jan-19 00:00:00 | 182.004 | 180.004 |
| 19-Jan-19 00:00:00 | 10800 | 180.000 | | 19-Jan-19 00:00:00 | 180.004 | 185.004 |
| 20-Jan-19 00:00:00 | 10860 | 181.000 | | 20-Jan-19 00:00:00 | 181.004 | 180.004 |
| 21-Jan-19 00:00:00 | 10680 | 178.000 | | 21-Jan-19 00:00:00 | 178.004 | 182.004 |

1

2

3

4

1

=PIAdvCalcFilDat('DL-Filtered'!$C$2,'DL-Filtered'!$E$1,'DL-Filtered'!$E$2,'DL-Filtered'!$G$1,"**'sinusoid' > 95**","**count**","**time-weighted**","**interpolated**","**1m**", 0, 1, 65, 'DL-Filtered'!$C$1)

3

=PIAdvCalcFilDat('DL-Filtered'!$G$4,'DL-Filtered'!$E$1,'DL-Filtered'!$E$2,'DL-Filtered'!$G$1,'DL-Filtered'!$G$3,"count","time-weighted","interpolated","1m",0, **0.016667**, 65,'DL-Filtered'!$C$1)

4

=PIAdvCalcFilDat('DL-Filtered'!$H$4,'DL-Filtered'!$E$1,'DL-Filtered'!$E$2,'DL-Filtered'!$G$1,'DL-Filtered'!$H$3,"count","time-weighted","interpolated","1m", 0, 0.016667, 0, 'DL-Filtered'!$C$1)


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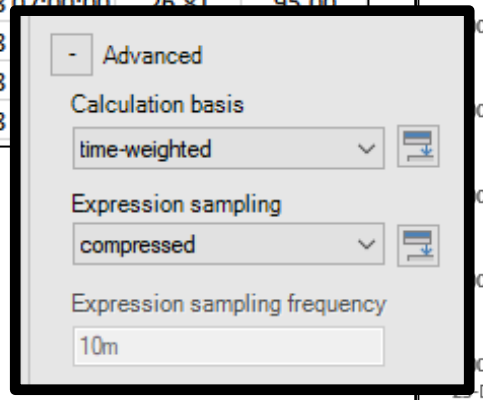
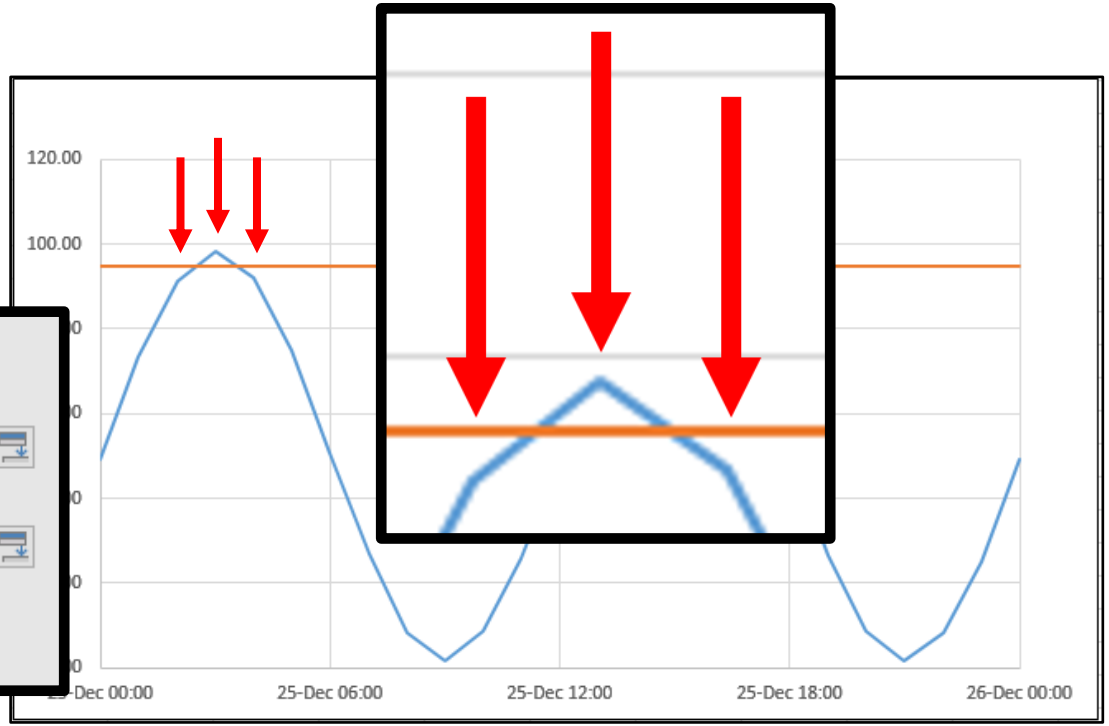
# Compressed/Interpolated Expression Sampling

| | | |
|---|---|---|
| 25-Dec-18 00:00:00 | 49.15 | 95.00 |
| 25-Dec-18 01:00:00 | 73.23 | 95.00 |
| 25-Dec-18 02:00:00 | 91.37 | 95.00 |
| 25-Dec-18 03:00:00 | 98.30 | 95.00 |
| 25-Dec-18 04:00:00 | 91.98 | 95.00 |
| 25-Dec-18 05:00:00 | 74.95 | 95.00 |
| 25-Dec-18 06:00:00 | 50.88 | 95.00 |
| 25-Dec-18 07:00:00 | 26.81 | 95.00 |
| 25-Dec-18 | | |
| 25-Dec-18 | | |
| 25-Dec-18 | | |





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# PI DataLink Calculated Data (Filtered)

| Server | s29epip1 | Start | 1/1/2019 | Interval | 1d | |
|---|---|---|---|---|---|---|
| Tag | Sinusoid | | /1/2019 | | | |
| | | | | | 'Sinusoid' > 95 | 'Sinusoidu' > 95 |
| Time Stamp | Seconds | Minutes | | Time Stamp | Sinusoid | Sinusoidu |
| 01-Jan-19 00:00:00 | 10800 | 180.000 | | 01-Jan-19 00:00:00 | 180.004 | 183.004 |
| 02-Jan-19 00:00:00 | 10800 | 180.000 | | 02-Jan-19 00:00:00 | 180.004 | 183.004 |
| 03-Jan-19 00:00:00 | 10800 | 180.000 | | 03-Jan-19 00:00:00 | 180.004 | 183.004 |
| 04-Jan-19 00:00:00 | 10980 | 183.000 | | 04-Jan-19 00:00:00 | 183.004 | 183.004 |
| 05-Jan-19 0 | 10980 | 183.000 | | 05-Jan-19 00:0 | 183.004 | 1 |
| 06-Jan-19 0 | 10980 | 183.000 | | 06-Jan-19 00:0 | 183.004 | 1 |
| 07-Jan-19 00:00:00 | 10980 | 183.000 | | 07-Jan-19 00:00:00 | 183.004 | 183.004 |
| | | | | 08-Jan-19 00:00:00 | 180.004 | 183.004 |
| | | | | 09-Jan-19 00:00:00 | 180.004 | 183.004 |
| | | | | 10-Jan-19 00:00:00 | 180.004 | 183.004 |
| | | | | 11-Jan-19 00:00:00 | 183.004 | 183.004 |
| | | | | 12-Jan-19 00:00:00 | 183.004 | 172.003 |
| | | | | 13-Jan-19 00:00:00 | 181.004 | 180.004 |
| | | | | 14-Jan-19 00:00:00 | 180.004 | 180.004 |
| | | | | 15-Jan-19 00:00:00 | 181.004 | 180.004 |
| | | | | 16-Jan-19 00:00:00 | 181.004 | 180.004 |
| | | | | 17-Jan-19 00:00:00 | 180.004 | 180.004 |
| | | | | 18-Jan-19 00:00:00 | 182.004 | 180.004 |
| | | | | 19-Jan-19 00:00:00 | 180.004 | 185.004 |
| | | | | 20-Jan-19 00:00:00 | 181.004 | 180.004 |
| | | | | 21-Jan-19 00:00:00 | 178.004 | 182.004 |

=B5/60

1 2 3 4

- Advanced

Calculation basis

time-weighted

Expression sampling

interpolated

Expression sampling frequency

1m

1

=PIAdvCalcFilDat('DL-Filtered'!$C$2,'DL-Filtered'!$E$1,'DL-Filtered'!$E$2,'DL-Filtered'!$G$1,"**'sinusoid' > 95**","**count**","**time-weighted**","**interpolated**","**1m**", 0, 1, 65, 'DL-Filtered'!$C$1)

3

=PIAdvCalcFilDat('DL-Filtered'!$G$4,'DL-Filtered'!$E$1,'DL-Filtered'!$E$2,'DL-Filtered'!$G$1,'DL-Filtered'!$G$3,"count","time-weighted","interpolated","1m",0, **0.016667**, 65,'DL-Filtered'!$C$1)

4

=PIAdvCalcFilDat('DL-Filtered'!$H$4,'DL-Filtered'!$E$1,'DL-Filtered'!$E$2,'DL-Filtered'!$G$1,'DL-Filtered'!$H$3,"count","time-weighted","interpolated","1m", 0, 0.016667, 0, 'DL-Filtered'!$C$1)


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# Move Up Complexity Pyramid -> PI OLEDB

| | | | |
|---|---|---|---|
| Server-PI | s29epip1 | | |
| Start Date | 1/1/2019 | | |
| End Date | 2/1/2019 | | |
| Frequency | 1D | | |
| Tag | | sinusoid | sinusoidu |
| Source Type | | PI | PI |
| Value Type | | TIMEGT | TIMEGT |
| High Limit | | 95 | 95 |
| Eng Units | | Minutes | Minutes |
| Descriptic | Timestamp | 12 Hour Sine Wave | UTC 12 Hour Sine W |
| | 01-Jan-2019 00:00:00 | 180.00 | 183.00 |
| | 02-Jan-2019 00:00:00 | 180.00 | 183.00 |
| | 03-Jan-2019 00:00:00 | 180.00 | 183.00 |
| | 04-Jan-2019 00:00:00 | 183.00 | 183.00 |
| | 05-Jan-2019 00:00:00 | 183.00 | 183.00 |
| | 06-Jan-2019 00:00:00 | 183.00 | 183.00 |
| | 07-Jan-2019 00:00:00 | 183.00 | 183.00 |
| | 08-Jan-2019 00:00:00 | 180.00 | 183.00 |
| | 09-Jan-2019 00:00:00 | 180.00 | 183.00 |
| | 10-Jan-2019 00:00:00 | 180.00 | 183.00 |
| | 11-Jan-2019 00:00:00 | 183.00 | 183.00 |
| | 12-Jan-2019 00:00:00 | 183.00 | 183.00 |
| | 13-Jan-2019 00:00:00 | 181.00 | 180.00 |

```
SELECT TAG, TIME, CAST(TIMESTEP AS STRING)  as timestep, VALUE
FROM PIARCHIVE..PICOUN
WHERE TAG = 'SINUSOID'
AND FILTEREXPR = '"SINUSOID" > 95.000 '
AND TIME BETWEEN '01-Jan-2019 00:00:00'
AND '31-Jan-2019 23:59:59'
AND timestep = '1D'
AND filtersampletype = 'Interval' and filtersampleInterval='1m'
AND CALCBASIS = 'TimeWeighted'
```


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# What Might the AF Element Look Like?

- Tank Name, ID, SAP Functional Location
- Tank Dimensions: Height, Radius or Length & Width
- Contents Material
- Level: Actual, Usable Zero, Overflow Height
- Level UOM
- Volume: Design, Usable, Current


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# Ad Hoc AF Solution via PI System Explorer

## Analysis Expression

| Name | Expression | Value at Evaluatio | Value at Last Trigg | Output Attribute |
|---|---|---|---|---|
| vMin | `TimeGT('Level-Prod','*-1d','*', 'Overflow Height')/60` | 183.12 | 178.46 | Map |
| vProd | `Convert(TimeGT('Level-Prod','*-1d','*', 'Overflow Height'),"min")` | 183.12 min | 178.46 min | Overflow Minutes (Daily) |

## Element

Category: <None>

| | | | | | |
|---|---|---|---|---|---|
| | Level | 13.821 % | 2/26/2019 10:27:18 AM | percent | \\S29EPIDEV01\SINUSOID |
| | Overflow Height | 95 % | 1/1/1970 12:00:00 AM | percent | |

Daily Summary (AF)

Preview results for SPL-Tank-Overflow-Daily

Start Time: 1/1/19 End Time: 1/8/19

| Trigger Time | vMin | Level (%) | Overflow Height (%) |
|---|---|---|---|
| 1/1/2019 12:00:00 AM | 181.63 | 49.441 | 95 |
| 1/2/2019 12:00:00 AM | 181.01 | 49.144 | 95 |
| 1/3/2019 12:00:00 AM | 182.1 | 49.116 | 95 |
| 1/4/2019 12:00:00 AM | 180.53 | 49.441 | 95 |
| 1/5/2019 12:00:00 AM | 181.01 | 49.144 | 95 |
| 1/6/2019 12:00:00 AM | 182.1 | 49.114 | 95 |
| 1/7/2019 12:00:00 AM | 180.53 | 49.441 | 95 |
| 1/8/2019 12:00:00 AM | 181.01 | 49.144 | 95 |


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# Summarize Example #1

- Seek First to Understand - Asked Questions
- Sharpened the Saw -Went Beyond Minimum
- AF is Great Ad Hoc Analysis Tool


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# Simple Problem… Stop Here?

… We Will Stop Here… There are More Opportunities Down the Road…


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# Sheet Break Analysis

Did the Improvement Team Actually Improve?


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# New Engineer Data Access Exercises

1. Water Consumption (PI, MI-Assist)
2. Sheet Break Analysis (PI, MI-Assist)
3. Pine Percentage Production Shift? (PA, MI-Assist)
4. Kamyr Production (PA, MI-Assist)
5. Customer Complaints (PA, MI-Assist)
6. 30-Day Rolling Average for 10-Years (CEMR+TraceMI+MI-Assist)
7. Reel Average PI Data (MI-Assist) **–> New (Feb. 2018)**
8. PI TimeXX Functions (MI-Assist) **–> New (Feb. 2018)**
9. More Value Types (MI-Assist) **–> New (Aug. 2018)**

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# What Does Sheet Break Data Look Like?

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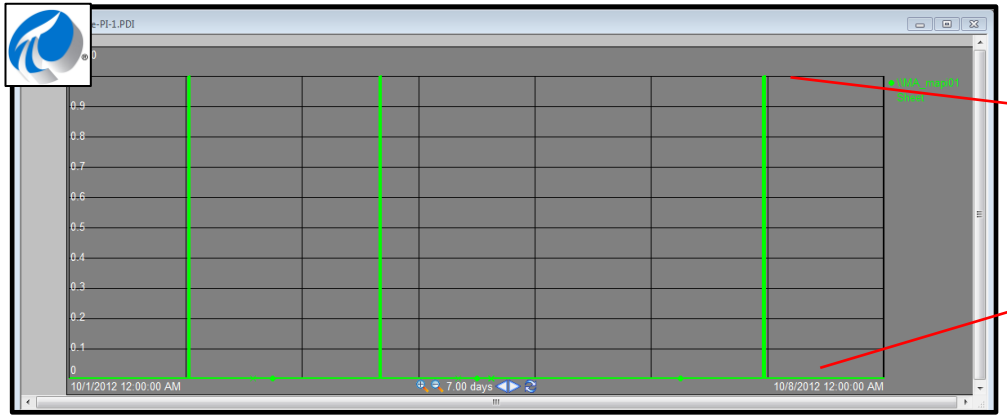
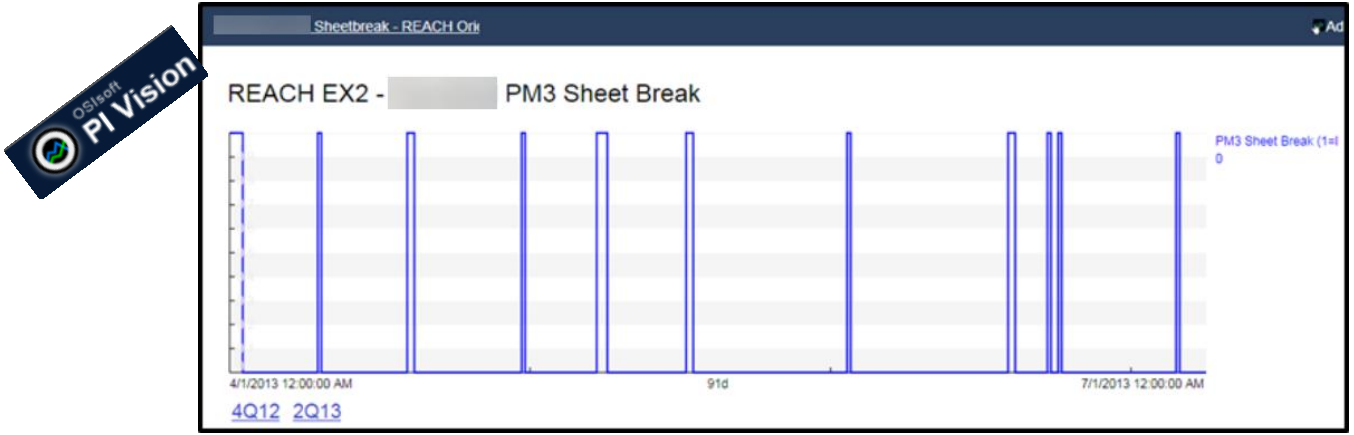
# What Does Sheet Break Data Look Like?




**1 = Break**

**0 = Sheet**





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# What Does Sheet Break Data Look Like?

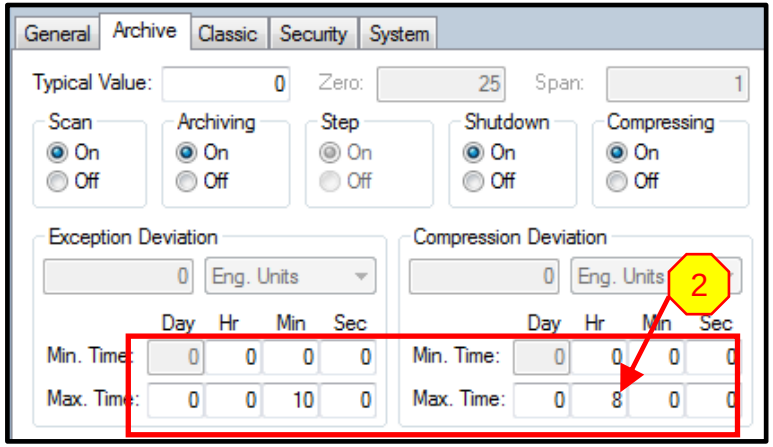
| Number of Values: | 475 |
|---|---|
| 01-Oct-12 10:51:30 | Sheet |
| 01-Oct-12 18:41:37 | Sheet |
| 02-Oct-12 00:38:24 | Break |
| 02-Oct-12 00:53:36 | Sheet |
| 02-Oct-12 08:43:41 | Sheet |
| 02-Oct-12 13:52:08 | I/O Timeout |
| 02-Oct-12 13:52:22 | Sheet |
| 02-Oct-12 21:42:30 | Sheet |
| 03-Oct-12 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

2

3

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





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# Scenario Description

- Today is July 5, 2013.
- The Paper Machine Project Team Finished Implementing their Final Recommendations to Improve Wet-End Sheet Break Frequency.
- You are to Verify the Team's Effectiveness.
- Chart the Number of Wet End Breaks Comparing 4Q12 to 2Q13
- **Decide if the team made an improvement?**
- **CLASS -> Suggest the Data Collection Strategy**


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# Data Collection Strategies

- Count Records from Paper Log Sheets
- Count Transitions “Sheet” to “Break”
  - PI ProcessBook / PI Vision Trend
  - PI DataLink Sampled Data (1-Minute)
  - PI DataLink Compressed Data
  - ~~PI DataLink TimeEQ~~
- Event Frames (Trigger = “Break”)
  - PI System Explorer
  - PI DataLink
  - PI Integrator for Business Analytics


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# Potential Result Presentations

PI DL Compressed

| 4 | 5 | 6 | 10 | 11 | 12 | Month |
|---|---|---|---|---|---|---|
| 20 | 29 | 22 | 39 | 36 | 32 | Total |

PI DL Sampled

| 4 | 5 | 6 | 10 | 11 | 12 | Month |
|---|---|---|---|---|---|---|
| 20 | 29 | 21 | 35 | 34 | 29 | Total |

MIA-PI Key

| Sum of newBreak | Column Labels | |
|---|---|---|
| Row Labels | BASE | EVAL |
| 2012 | | |
| Oct | 39 | |
| Nov | 36 | |
| Dec | 32 | |
| 2013 | | |
| Apr | | 20 |
| May | | 29 |
| Jun | | 22 |

MIA-Event Frame

| Row Labels | numBreaks | Avg Duration |
|---|---|---|
| 2012 | | |
| Oct | 39 | 00:26:37 |
| Nov | 36 | 04:43:32 |
| Dec | 32 | 01:02:34 |
| 2013 | | |
| Apr | 20 | 01:24:18 |
| May | 29 | 01:43:51 |
| Jun | 22 | 01:37:33 |
| Grand Total | 178 | 01:52:52 |

PI DL Event Frame

| Row Labels | numBreaks | Duration (Avg) |
|---|---|---|
| 2012 | | |
| Oct | 39 | 0 00:26:37 |
| Nov | 36 | 0 04:43:32 |
| Dec | 32 | 0 01:02:34 |
| 2013 | | |
| Jan | 38 | 0 00:59:07 |
| Feb | 23 | 0 02:14:00 |
| Mar | 21 | 0 03:09:14 |
| Apr | 20 | 0 01:24:18 |
| May | 29 | 0 01:43:51 |
| Jun | 22 | 0 01:37:33 |
| Grand Total | 260 | 0 01:53:03 |


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# Strategy and Helpful Information

- Helpful Information
  - PI Tag: \\MyMachine\PM#-HS-1234A.F.wet
  - Compressed Data (888 Values)
  - Sampled Data (1-Min -> 131,040 Values)
- Select One Method From
  - PI DataLink Sampled Data (1-Minute)
  - PI DataLink Compressed Data
  - MI-Assist Sampled Data
  - MI-Assist Compressed Data
- Instructor Will Demonstrate Event Frames Technique

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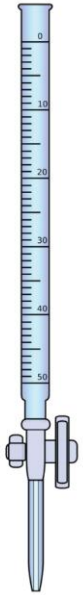
# PI DataLink Sampled Data



{=PISampDat('PI-Sampled'!$B$2,'PI-Sampled'!$B$3,'PI-Sampled'!$B$4,"1m",1,'PI-Sampled'!$B$1)}

1

| | | | |
|---|---|---|---|
| Server | | | |
| TAG: | | | |
| Start Time: | 4/1/2013 7:00 | | /1/2012 7:00 |
| End Time: | 7/1/2013 7:00 | 131040.00 | 1/1/2013 7:00 |

2 3 4

| Evaluation Period | | Baseline Period | | Base Month | Base Breaks | Eval Month | Eval Breaks |
|---|---|---|---|---|---|---|---|
| 01-Apr-13 07:00:00 | Break | 01-Oct-12 07:00:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:01:00 | Break | 01-Oct-12 07:01:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:02:00 | Break | 01-Oct-12 07:02:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:03:00 | Break | ct-12 07:03:00 | Sheet | | 0 | 10 | 0 |
| 01-Apr-13 07:04:00 | Break | Oct-12 07:04:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:05:00 | Break | 01-Oct-12 07:05:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:06:00 | Break | 01-Oct-12 07:06:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:07:00 | Break | 01-Oct-12 07:07:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:08:00 | Break | 01-Oct-12 07:08:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:09:00 | Break | 01-Oct-12 07:09:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:10:00 | Break | 01-Oct-12 07:10:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:11:00 | Break | 01-Oct-12 07:11:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:12:00 | Break | 01-Oct-12 07:12:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:13:00 | Break | 01-Oct-12 07:13:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:14:00 | Break | 01-Oct-12 07:14:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:15:00 | Break | 01-Oct-12 07:15:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:16:00 | Break | 01-Oct-12 07:16:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:17:00 | Break | 01-Oct-12 07:17:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:18:00 | Break | 01-Oct-12 07:18:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:19:00 | Break | 01-Oct-12 07:19:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:20:00 | Break | 01-Oct-12 07:20:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:21:00 | Break | 01-Oct-12 07:21:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:22:00 | Break | 01-Oct-12 07:22:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:23:00 | Break | 01-Oct-12 07:23:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:24:00 | Break | 01-Oct-12 07:24:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:25:00 | Break | 01-Oct-12 07:25:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:26:00 | Break | 01-Oct-12 07:26:00 | Sheet | 4 | 0 | | |
| 01-Apr-13 07:27:00 | Break | 01-Oct-12 07:27:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:28:00 | Break | 01-Oct-12 07:28:00 | Sheet | 4 | 0 | 10 | 0 |
| 01-Apr-13 07:29:00 | Break | 01-Oct-12 07:29:00 | Sheet | 4 | 0 | 10 | 0 |

=SUMIF(I$7:I$140000,"=10",J$7:J$140000)

5

| | Base (4Q12) | Eval (1Q13) |
|---|---|---|
| M1 | 35 | 20 |
| M2 | 34 | 29 |
| M3 | 29 | 21 |
| Total | 117 | 71 |

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

1. Configuration
2. Sampled Data (Evaluation Period)
3. Sampled Data (Baseline Period)
4. Date -> Month and Determine Break Counts
5. Summarize Breaks By Month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# PI DataLink 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 |

1

| Number of Values: | 417 |
|---|---|
| 01-Apr-13 13:36:07 | Break |
| 01-Apr-13 21:26:11 | Break |
| 01-[illegible]2:56:00 | Sheet |
| 02[illegible]5:46:07 | Sheet |
| 02-Apr-13 11:32:01 | Break |
| 02-Apr-13 11:40:25 | Sheet |
| 02-Apr-13 19:30:34 | Sheet |
| 03-Apr-13 03:20:38 | Sheet |
| 03-Apr-13 11:10:43 | Sheet |
| 03-Apr-13 15:44:56 | Break |
| 03-Apr-13 16:02:52 | Sheet |
| 03-Apr-13 23:52:59 | Sheet |
| 04-Apr-13 07:43:07 | Sheet |
| 04-Apr-13 15:33:14 | Sheet |
| 04-Apr-13 23:23:21 | Sheet |
| 05-Apr-13 07:13:26 | Sheet |
| 05-Apr-13 15:03:31 | Sheet |
| 05-Apr-13 22:53:38 | Sheet |
| 06-Apr-13 06:43:43 | Sheet |
| 06-Apr-13 14:33:49 | Sheet |
| 06-Apr-13 22:23:56 | Sheet |
| 07-Apr-13 06:14:00 | Sheet |
| 07-Apr-13 14:04:10 | Sheet |
| 07-Apr-13 21:54:14 | Sheet |
| 08-Apr-13 05:44:19 | Sheet |
| 08-Apr-13 08:08:18 | Break |
| 08-Apr-13 08:21:24 | Sheet |
| 08-Apr-13 16:11:31 | Sheet |
| 09-Apr-13 00:01:38 | Sheet |
| 09-Apr-13 03:27:03 | Break |

2

| Number of Values: | 474 |
|---|---|
| 01-Oct-12 11:51:30 | Sheet |
| 01-Oct-12 19:41:37 | Sheet |
| 02-O[illegible]38:24 | Break |
| 02-O[illegible]53:36 | Sheet |
| 02-Oct-12 09:43:41 | Sheet |
| 02-Oct-12 14:52:08 | I/O Timeout |
| 02-Oct-12 14:52:22 | Sheet |
| 02-Oct-12 22:42:30 | Sheet |
| 03-Oct-12 06:32:41 | Sheet |
| 03-Oct-12 14:22:48 | Sheet |
| 03-Oct-12 16:59:31 | Break |
| 03-Oct-12 17:15:41 | Sheet |
| 04-Oct-12 01:05:44 | Sheet |
| 04-Oct-12 08:55:49 | Sheet |
| 04-Oct-12 09:06:53 | I/O Timeout |
| 04-Oct-12 09:09:36 | Sheet |
| 04-Oct-12 15:55:53 | I/O Timeout |
| 04-Oct-12 15:55:55 | Sheet |
| 04-Oct-12 16:06:58 | I/O Timeout |
| 04-Oct-12 16:07:08 | Sheet |
| 04-Oct-12 23:57:19 | Sheet |
| 05-Oct-12 07:47:27 | Sheet |
| 05-Oct-12 15:37:36 | Sheet |
| 05-Oct-12 23:27:42 | Sheet |
| 06-Oct-12 07:17:50 | Sheet |
| 06-Oct-12 15:07:55 | Sheet |
| 06-Oct-12 22:58:05 | Sheet |
| 07-Oct-12 00:02:49 | Break |
| 07-Oct-12 00:17:29 | Sheet |
| 07-Oct-12 00:20:03 | Break |

3

| Base Month | Base Breaks | Eval Month | Eval Breaks |
|---|---|---|---|
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | | 10 | 1 |
| 4 | | 10 | 0 |
| 4 | 1 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 1 | 10 | 0 |
| 4 | 0 | 10 | 1 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 0 | 10 | 0 |
| 4 | 1 | 10 | 1 |

4

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

| | Base (4Q12) | Eval (1Q13) |
|---|---|---|
| M1 | 39 | 20 |
| M2 | 36 | 29 |
| M3 | 32 | 22 |
| Total | 117 | 71 |

5

=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 Breaks by Month


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# Rick's MI-Assist Solution

| | | | | | | |
|---|---|---|---|---|---|---|
| Server-PI | | | | | | |
| Start Date | 9/1/2012 7:00 | | | | | |
| End Date | 7/1/2013 7:00 | | | | | |
| Frequency (min) | | | | | | |
| Tag | | | CALC | CALC | CALC | CALC |
| Source Type | | PI | CALC | CALC | CALC | CALC |
| Calc Formula | | | 0 | | | NoBreak |
| Eng Units | | | | | | |
| | Period Start | | | 10/1/2012 7:00 | 4/1/2013 7:00 | |
| | Period End | | | 1/1/2013 7:00 | 7/1/2013 7:00 | |
| Description | Timestamp | Sheet Break Wet End | newBreak | Base Period | Eval Period | Period |
| | 9/1/2012 7:46 | Sheet | 0 | | | NoBreak |
| | 9/1/2012 8:30 | Sheet | 0 | | | NoBreak |
| | 9/1/2012 16:21 | Sheet | 0 | | | NoBreak |
| | 9/2/2012 0:11 | Sheet | 0 | | | NoBreak |
| | 9/2/2012 8:01 | Sheet | 0 | | | NoBreak |
| | | | | | | NoBreak |
| | 9/4/2012 16:17 | Sheet | 0 | | | |
| | 9/5/2012 0:07 | Sheet | 0 | | | |
| | 9/5/2012 7:58 | Sheet | 0 | | | NoBreak |
| | 9/5/2012 15:48 | Sheet | 0 | | | NoBreak |
| | 9/5/2012 23:39 | Sheet | 0 | | | NoBreak |
| | 9/6/2012 7:29 | Sheet | 0 | | | NoBreak |
| | 9/6/2012 15:20 | Sheet | 0 | | | NoBreak |

| Sum of newBreak | Column Labels | |
|---|---|---|
| Row Labels | BASE | EVAL |
| 2012 | | |
| Oct | 39 | |
| Nov | 36 | |
| Dec | 32 | |
| 2013 | | |
| Apr | | 20 |
| May | | 29 |
| Jun | | 22 |

1. Configuration
2. MI-Assist (PI Sampled Data PI Key)
3. MI-Assist (Auto-Calculated Data)
4. Summarize Break Count by Month

- newBreak: If "Break" Now and Prev "Sheet" THEN 1 ELSE 0
- Base: IF TS in Base Period Then "BASE"
- Eval: IF TS in Evaluation Period THEN "EVAL"
- Period: IF newBreak = 1 THEN [Base]&[Eval] ELSE "NoBreak"


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# Simple Problem… Stop Here?

…Naaaahhhh… What if We Wanted to Compare Across Company?


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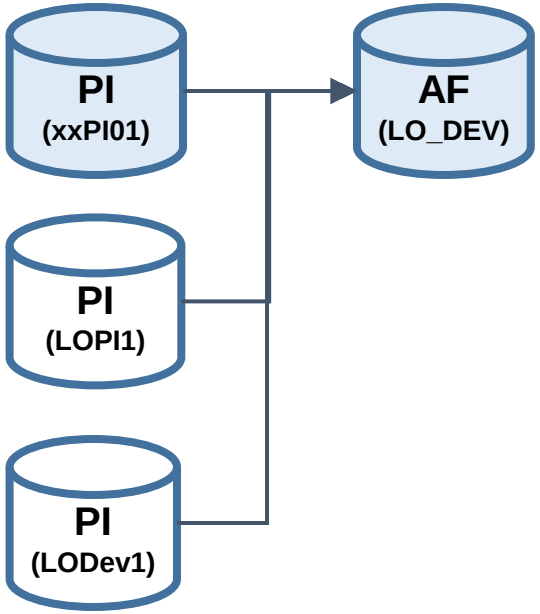
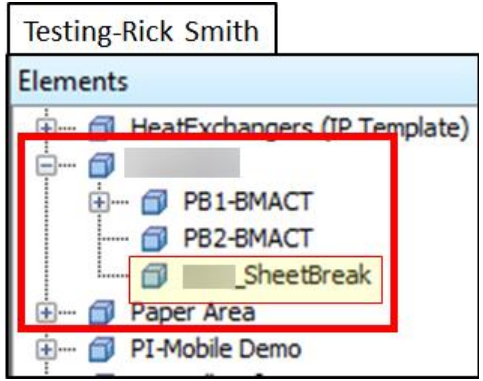
# PM Sheet Break (LO-Dev)




| 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 |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# Event Frame Configuration

File Search View Go Tools Help

Database | Query Date | Back | Check In | Refresh | New Element | Search Elements

Elements

- HeatExchangers (IP Temp
- PB1-BMACT
- PB2-BMACT
- _SheetBreak
- Paper Area
- PI-Mobile Demo
- Pine Hill Refiners
- PM_Energy
- Red River
- Riverdale
- Rome
- ViewByFacility
- ViewByTemplate
  - Batch Digesters
  - Kamyr Digesters
  - Winders/Rewinders
    - Cedar River-W1
    - Cedar River-W2
    - Franklin-W4
    - Franklin-W4 (2016)
    - Prattville-PM2
    - Savannah-W8 (2016
- Element Searches

Elements | Event Frames | Library | Unit of Measure | Contacts | Management

PM3_SheetBreak

General | Child Elements | Attributes | Ports | Analyses | Notification Rules | Version

| Name | Backfilling |
|---|---|
| SheetBreak | ✓ |

Name: SheetBreak

Description:

Categories:

Analysis Type: Expression | Rollup | Event Frame Generation | SQC

Create a new notification rule for SheetBreak

Event Frame Template: EF:PMSheetBreak

| Name | Expression | True for |
|---|---|---|
| **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 | Periodic

Trigger on: Any Input

Connected to the PI Analysis Service.

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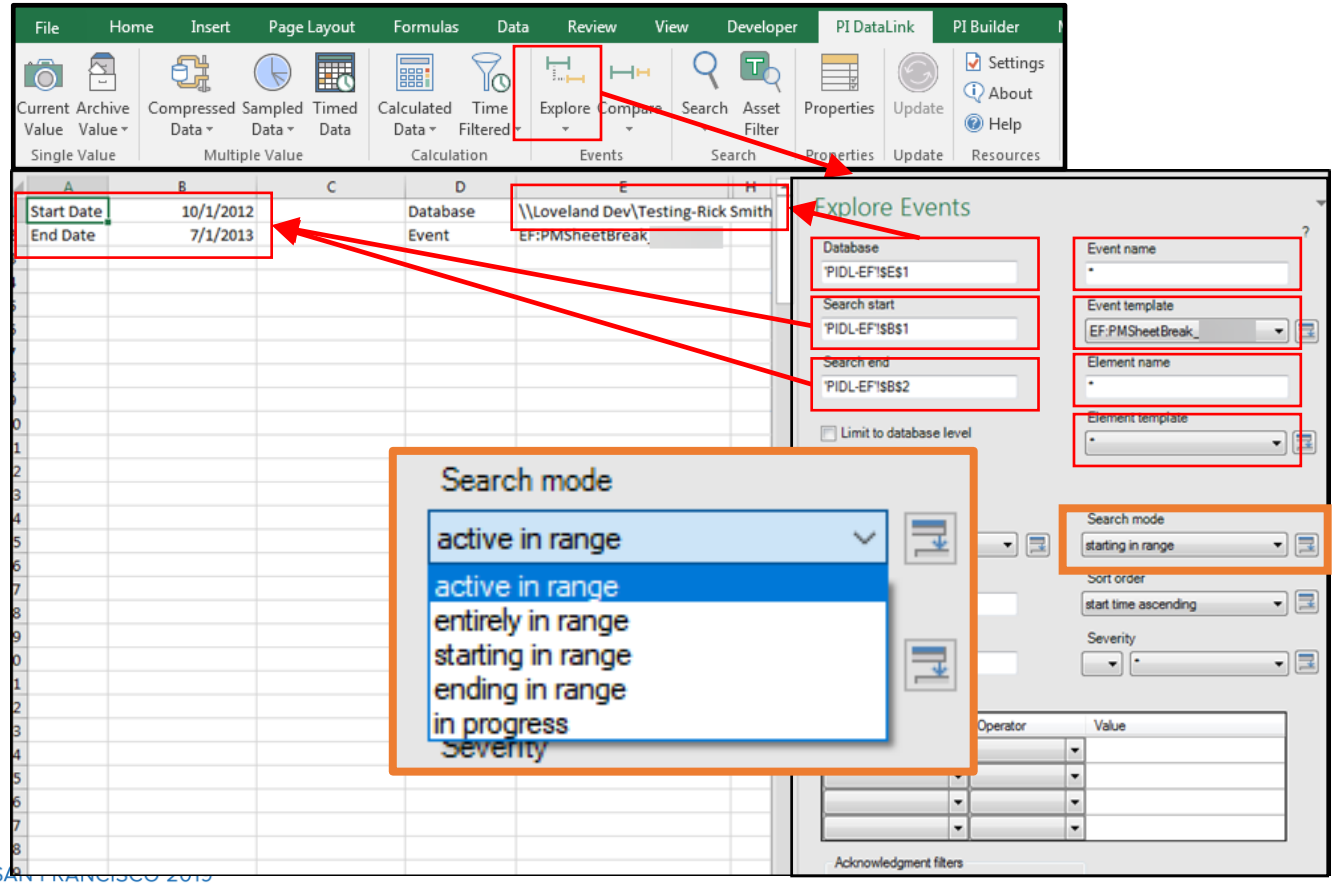
# Retrieve Event Frames Using PI DataLink





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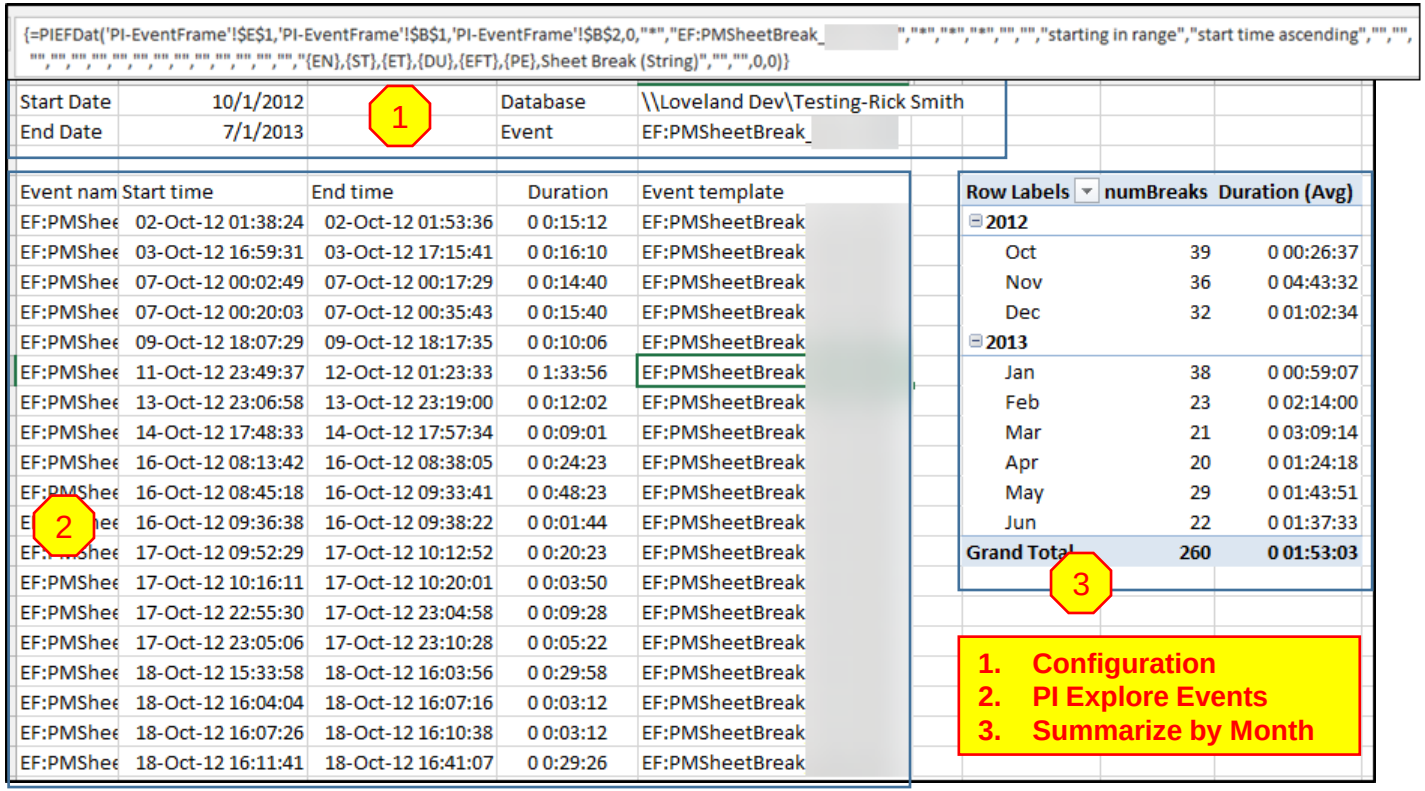
# Retrieve Event Frame Using PI DataLink



{=PIEFDat('PI-EventFrame'!$E$1,'PI-EventFrame'!$B$1,'PI-EventFrame'!$B$2,0,"*","EF:PMSheetBreak_[redacted]","*","*","*","","","starting in range","start time ascending","","",
"","","","","","","","","","","","","","","","{EN},{ST},{ET},{DU},{EFT},{PE},Sheet Break (String)","","",0,0)}

| | | | | |
|---|---|---|---|---|
| Start Date | 10/1/2012 | 1 | Database | \\Loveland Dev\Testing-Rick Smith |
| End Date | 7/1/2013 | | Event | EF:PMSheetBreak_[redacted] |

| Event nam | Start time | End time | Duration | Event template |
|---|---|---|---|---|
| EF:PMShee | 02-Oct-12 01:38:24 | 02-Oct-12 01:53:36 | 0 0:15:12 | EF:PMSheetBreak |
| EF:PMShee | 03-Oct-12 16:59:31 | 03-Oct-12 17:15:41 | 0 0:16:10 | EF:PMSheetBreak |
| EF:PMShee | 07-Oct-12 00:02:49 | 07-Oct-12 00:17:29 | 0 0:14:40 | EF:PMSheetBreak |
| EF:PMShee | 07-Oct-12 00:20:03 | 07-Oct-12 00:35:43 | 0 0:15:40 | EF:PMSheetBreak |
| EF:PMShee | 09-Oct-12 18:07:29 | 09-Oct-12 18:17:35 | 0 0:10:06 | EF:PMSheetBreak |
| EF:PMShee | 11-Oct-12 23:49:37 | 12-Oct-12 01:23:33 | 0 1:33:56 | EF:PMSheetBreak |
| EF:PMShee | 13-Oct-12 23:06:58 | 13-Oct-12 23:19:00 | 0 0:12:02 | EF:PMSheetBreak |
| EF:PMShee | 14-Oct-12 17:48:33 | 14-Oct-12 17:57:34 | 0 0:09:01 | EF:PMSheetBreak |
| EF:PMShee | 16-Oct-12 08:13:42 | 16-Oct-12 08:38:05 | 0 0:24:23 | EF:PMSheetBreak |
| EF:PMShee | 16-Oct-12 08:45:18 | 16-Oct-12 09:33:41 | 0 0:48:23 | EF:PMSheetBreak |
| 2 | 16-Oct-12 09:36:38 | 16-Oct-12 09:38:22 | 0 0:01:44 | EF:PMSheetBreak |
| EF:PMShee | 17-Oct-12 09:52:29 | 17-Oct-12 10:12:52 | 0 0:20:23 | EF:PMSheetBreak |
| EF:PMShee | 17-Oct-12 10:16:11 | 17-Oct-12 10:20:01 | 0 0:03:50 | EF:PMSheetBreak |
| EF:PMShee | 17-Oct-12 22:55:30 | 17-Oct-12 23:04:58 | 0 0:09:28 | EF:PMSheetBreak |
| EF:PMShee | 17-Oct-12 23:05:06 | 17-Oct-12 23:10:28 | 0 0:05:22 | EF:PMSheetBreak |
| EF:PMShee | 18-Oct-12 15:33:58 | 18-Oct-12 16:03:56 | 0 0:29:58 | EF:PMSheetBreak |
| EF:PMShee | 18-Oct-12 16:04:04 | 18-Oct-12 16:07:16 | 0 0:03:12 | EF:PMSheetBreak |
| EF:PMShee | 18-Oct-12 16:07:26 | 18-Oct-12 16:10:38 | 0 0:03:12 | EF:PMSheetBreak |
| EF:PMShee | 18-Oct-12 16:11:41 | 18-Oct-12 16:41:07 | 0 0:29:26 | EF:PMSheetBreak |

| Row Labels | numBreaks | Duration (Avg) |
|---|---|---|
| 2012 | | |
| Oct | 39 | 0 00:26:37 |
| Nov | 36 | 0 04:43:32 |
| Dec | 32 | 0 01:02:34 |
| 2013 | | |
| Jan | 38 | 0 00:59:07 |
| Feb | 23 | 0 02:14:00 |
| Mar | 21 | 0 03:09:14 |
| Apr | 20 | 0 01:24:18 |
| May | 29 | 0 01:43:51 |
| Jun | 22 | 0 01:37:33 |
| Grand Total | 260 | 0 01:53:03 |

3

1. Configuration
2. PI Explore Events
3. Summarize by Month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# Retrieve Event Frames Using MI-Assist

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | EFConfig | S:Loveland_Dev;DB:Testing-Rick Smith;T:EF:PMSheetBreak_ | | | | | |
| 2 | Start Date | 10/1/2012 | | | | | |
| 3 | End Date | 7/1/2013 | | | | | |
| 4 | EFEventN: | % | | | | | |
| 5 | EFMaxEve | 1000 | | | | | |
| 6 | Eng Units | | | | | | |
| 7 | Descriptic | StartTime | EndTime | Duration | Severity | EFName | Sheet Break (String) |
| 8 | | 10/2/2012 01:38:24 | 10/2/2012 01:53:36 | 0:15:12 | None | _SheetBreak | Break |
| 9 | | | 12 17:15:41 | 0:16:10 | ne | _SheetBreak | Break |
| 10 | | | 12 00:17:29 | 0:14:40 | ne | _SheetBreak | Break |
| 11 | | | 12 00:35:43 | 0:15:40 | None | _SheetBreak | Break |
| 12 | | | 12 18:17:35 | 0:10:06 | None | _SheetBreak | Break |
| 13 | | | 12 01:23:33 | 1:33:56 | None | _SheetBreak | Break |
| 14 | | | 12 23:19:00 | 0:12:02 | None | _SheetBreak | Break |
| 15 | | | 12 17:57:34 | 0:09:01 | None | _SheetBreak | Break |
| 16 | | | 12 08:38:05 | 0:24:23 | None | _SheetBreak | |
| 17 | | | 12 09:33:41 | 0:48:23 | None | _SheetBreak | |
| 18 | | 10/16/2012 09:36:38 | 10/16/2012 09:38:22 | 0:01:44 | None | _SheetBreak | |
| 19 | | 10/17/2012 09:52:29 | 10/17/2012 10:12:52 | 0:20:23 | None | _SheetBreak | Break |

| Row Labels | mBreaks | Avg Duration |
|---|---|---|
| 2012 | | |
| Oct | 39 | 00:26:37 |
| Nov | 36 | 04:43:32 |
| Dec | 32 | 01:02:34 |
| 2013 | | |
| Apr | 20 | 01:24:18 |
| May | 29 | 01:43:51 |
| Jun | 22 | 01:37:33 |
| Grand Total | 178 | 01:52:52 |

1. Configuration
2. MI-Assist Events
3. Summarize Break by Month

PI SQL on MessageLog Tab


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# PowerBI (PI OLEDB Query)

```
SELECT efa.name Attribute, UOMAbbreviation(efa.DefaultUOMID) as DefaultUOM
FROM [Testing-Rick Smith].EventFrame.EventFrameTemplate eft
INNER JOIN [Testing-Rick Smith].EventFrame.EventFrameTemplateAttribute efa ON
efa.EventFrameTemplateID = eft.ID
WHERE eft.NAME LIKE 'EF:PMSHEETBREAK_XX_PM3
```

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# PI Integrator for Business Analytics

https://s29epidev01:5443

My Views

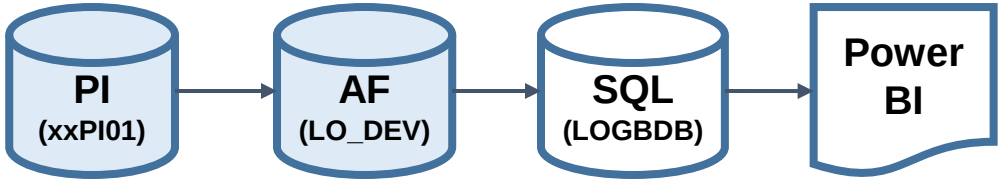
+ Create Asset View
Build a data view starting with your asset hierarchy

+ 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 |
| Riverdale Reels | Scheduled | Event | Continuous | 12/1/17 12:00:00 AM | * | Aug 5, 2018 10:37:54 AM |
| Riverdale Sheet Break Rethread | Scheduled | Event | Continuous | 1/1/17 12:00 AM | * | Aug 5, 2018 10:30:04 AM |
| RM-PM1-Poorly-Compressed | Published | Asset | Once | 1/1/2018 | 2/1/2018 | Feb 16, 2018 10:13:18 PM |
| TI-Digester Blow Dips | Scheduled | Asset | Continuous | 7/31/18 12:00:00 AM | * | Aug 5, 2018 10:56:29 AM |
| TI-Digester Blow Dips-EF | 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 |





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# PI View - Data Looks Similar

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 | it Frame Dur | TimeStamp | et Break (Sti |
|---|---|---|---|---|---|---|
| EF:PMSheetBreak_MA_PM3_EX2 | 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_MA_PM3_EX2 | 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_MA_PM3_EX2 | 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_MA_PM3_EX2 | 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_MA_PM3_EX2 | Sheet | 1/7/2012 6:47:10 PM | 1/7/2012 6:52:59 PM | 6 | 1/7/2012 6:52:59 PM | Break |
| EF:PMSheetBreak_MA_PM3_EX2 | 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_MA_PM3_EX2 | 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_MA_PM3_EX2 | 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_MA_PM3_EX2 | 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_MA_PM3_EX2 | 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_MA_PM3_EX2 | Sheet | 1/15/2012 2:56:05 AM | 1/15/2012 3 | | | |
| EF:PMSheetBreak_MA_PM3_EX2 | Sheet | 1/15/2012 7:36:05 AM | 1/15/2012 8 | | | |
| EF:PMSheetBreak_MA_PM3_EX2 | Sheet | 1/15/2012 8:18:51 AM | 1/15/2012 8 | | | |
| EF:PMSheetBreak_MA_PM3_EX2 | Sheet | 1/15/2012 3:01:59 PM | 1/15/2012 3 | | | |
| EF:PMSheetBreak_MA_PM3_EX2 | Sheet | 1/20/2012 12:25:11 AM | 1/20/2012 1 | | | |
| EF:PMSheetBreak_MA_PM3_EX2 | Sheet | 1/20/2012 1:02:59 AM | 1/20/2012 2 | | | |
| EF:PMSheetBreak_MA_PM3_EX2 | Sheet | 1/20/2012 2:58:34 AM | 1/20/2012 3 | | | |
| EF:PMSheetBreak_MA_PM3_EX2 | Sheet | 1/20/2012 4:51:54 PM | 1/20/2012 5 | | | |
| EF:PMSheetBreak_MA_PM3_EX2 | 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_MA_PM3_EX2 | Sheet | 1/26/2012 2:41:23 PM | 1/27/2012 10:17:05 PM | 1896 | 1/27/2012 10:17:05 P | Break |
| EF:PMSheetBreak_MA_PM3_EX2 | 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_MA_PM3_EX2 | 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_MA_PM3_EX2 | Sheet | 2/7/2012 8:29:00 AM | 2/7/2012 8:32:29 AM | 3 | 2/7/2012 8:32:29 AM | Break |

- User Not Writing PI SQL Queries
- User Not Exposed to Complex Queries
- User Selects Just the Columns They Want
- User Selects Statistics on Column-by-Column Basis
- Hides Future Template Changes from End Users


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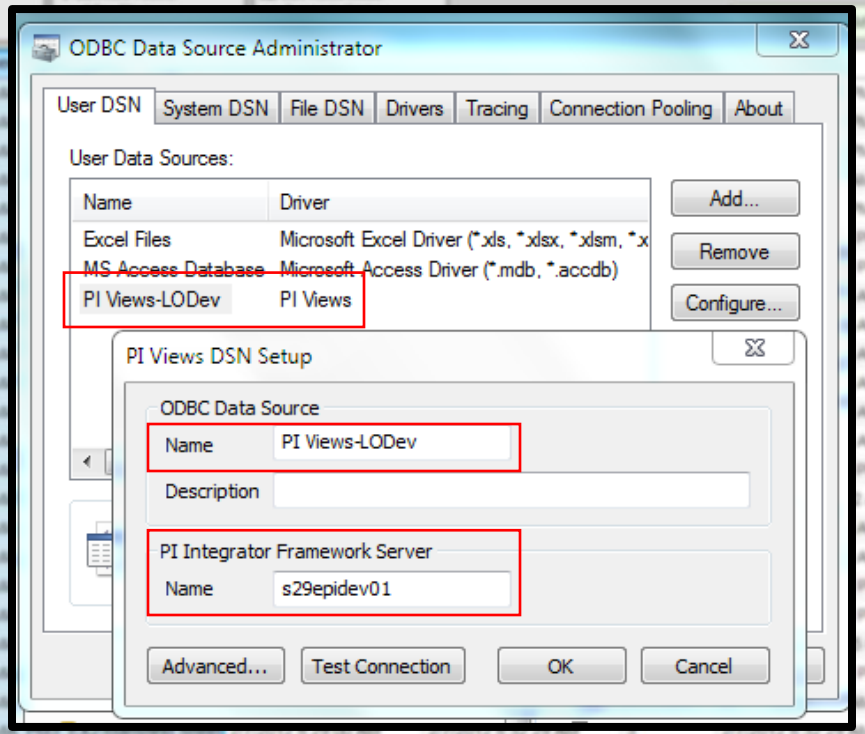
# Create ODBC Connection to PI View

Control Panel > Administrator Tools > Data Sources (ODBC)



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# PowerBI (PI Integrator for Business Analytics)

| Month | Count of Sheet Break (String) |
|---|---|
| January | 21 |
| February | 8 |
| March | 13 |
| April | 26 |
| May | 14 |
| June | 36 |
| July | 35 |
| August | 37 |
| September | 15 |
| October | 39 |
| November | [illegible] |
| December | 32 |

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# Your Results May Vary

PI Datalink Compressed

| 4 | 5 | 6 | 10 | 11 | 12 | Month |
|---|---|---|---|---|---|---|
| 20 | 29 | 22 | 39 | 36 | 32 | Total |

PI Datalink Sampled

| 4 | 5 | 6 | 10 | 11 | 12 | Month |
|---|---|---|---|---|---|---|
| 20 | 29 | 21 | 35 | 34 | 29 | Total |

PowerBI

| Month | Count of Sheet Break (String) |
|---|---|
| January | 21 |
| February | 8 |
| March | 13 |
| April | 26 |
| May | 14 |
| June | 36 |
| July | 35 |
| August | 37 |
| September | 15 |
| October | 39 |
| November | [illegible] |
| December | 32 |

MIA-PI Key

| Sum of newBreak | Column Labels | |
|---|---|---|
| Row Labels | BASE | EVAL |
| 2012 | | |
| Oct | 39 | |
| Nov | 36 | |
| Dec | 32 | |
| 2013 | | |
| Apr | | 20 |
| May | | 29 |
| Jun | | 22 |

MIA-Event Frame

| Row Labels | numBreaks | Avg Duration |
|---|---|---|
| 2012 | | |
| Oct | 39 | 00:26:37 |
| Nov | 36 | 04:43:32 |
| Dec | 32 | 01:02:34 |
| 2013 | | |
| Apr | 20 | 01:24:18 |
| May | 29 | 01:43:51 |
| Jun | 22 | 01:37:33 |
| Grand Total | 178 | 01:52:52 |

PI DL Event Frame

| Row Labels | numBreaks | Duration (Avg) |
|---|---|---|
| 2012 | | |
| Oct | 39 | 0 00:26:37 |
| Nov | 36 | 0 04:43:32 |
| Dec | 32 | 0 01:02:34 |
| 2013 | | |
| Jan | 38 | 0 00:59:07 |
| Feb | 23 | 0 02:14:00 |
| Mar | 21 | 0 03:09:14 |
| Apr | 20 | 0 01:24:18 |
| May | 29 | 0 01:43:51 |
| Jun | 22 | 0 01:37:33 |
| Grand Total | 260 | 0 01:53:03 |


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# Summarize Example #2

- **Standardized Method**
- Took Logic Decisions Away from End-User
- Demonstrated **Multiple Data Access Methods**
  - PI DataLink, PI OLEDB, PIIBA
- Retrieve across **Enterprise** and/or Roll-up to Common Database


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# Enterprise Energy Monitoring


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# Corporate Purchasing Needs Natural Gas Usage

- **Initial Request**
  - Natural Gas Consumption from All Facilities -> Corporate Purchasing
  - Compare to Contracts.
- **Initial Questions**
  - Are the Contract **Flows Measured**? A few.
  - Are the Measurements **Working/Accurate**? Maybe.
  - Are the Measurements in the **Proper Units of Measure**? Maybe.
  - How do we **Correlate** Facility Measurements to Supplier Measurements?
- **Deep-Dive Questions**
  - 1-to-Many Natural Gas Suppliers per Facility
  - Long-Term Contracts to Base-Load Facility
  - Short-Term Contracts to Meet Short-Term Needs
  - 1-to-Many Facilities Can Share Consumption Pool

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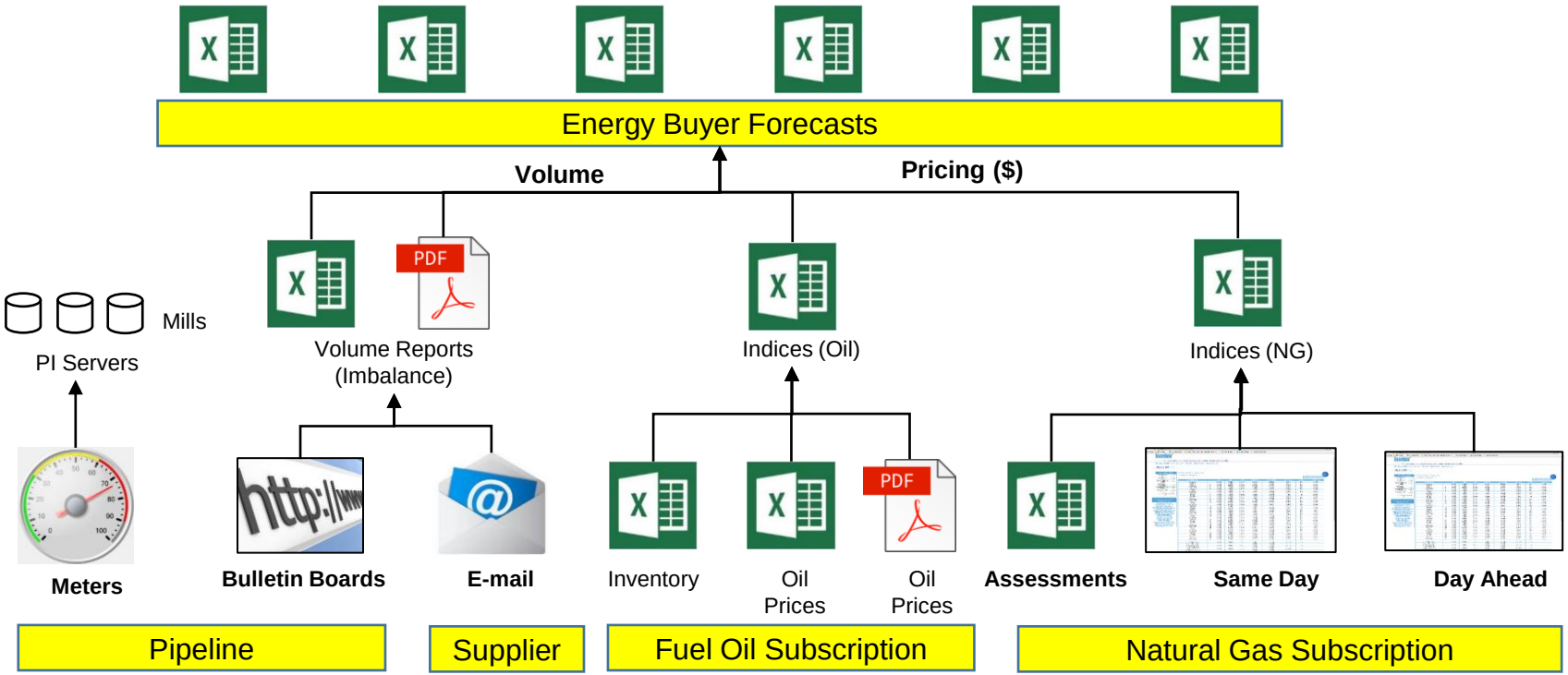
# Natural Gas Monitoring – Current State





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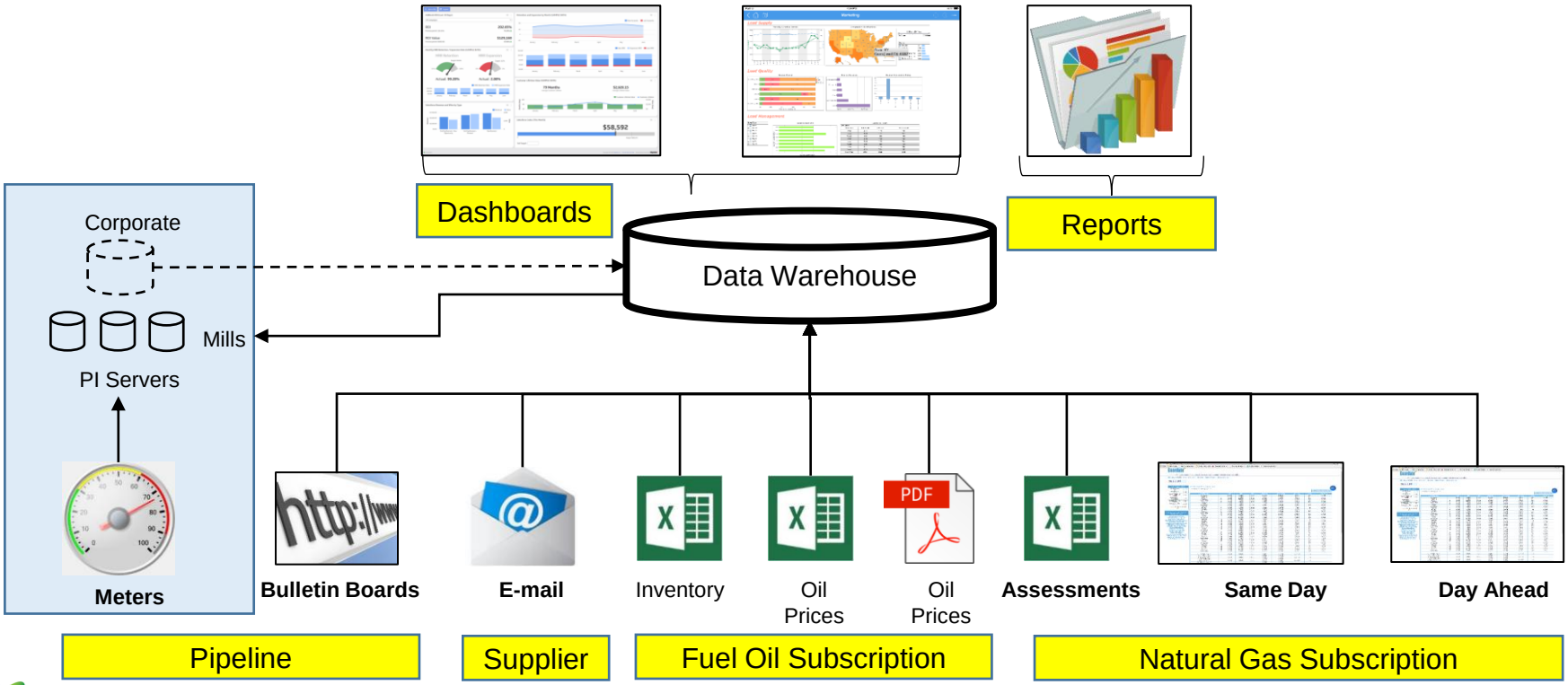
# Natural Gas Monitoring – Future State





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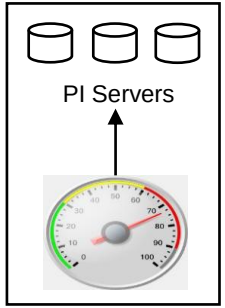
# Initial Effort (1H18)

- Pick a Multi-Supplier Facility
- Get Missing Supplier Meters into PI
- Validate Units of Measure
  - KSCF/Hour; SCF/Min; MMBTU/Hour; etc…
- Compare Supplier Meters to Facility Meters (or Sum of Meters)
- Extract Data into Excel; Add Contracted Amounts; Test Calculations
  - **PI DataLink to Validate PI Tags**
- Build AF Around Natural Gas Suppliers
- Facility PI Vision Displays





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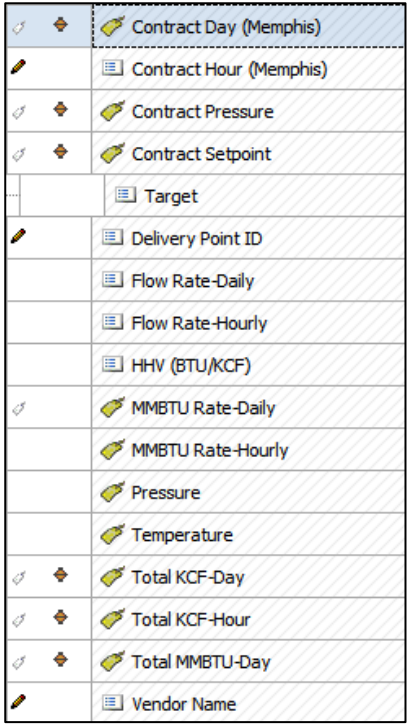
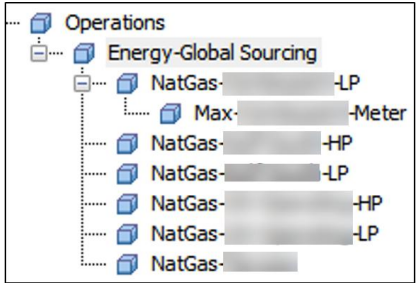
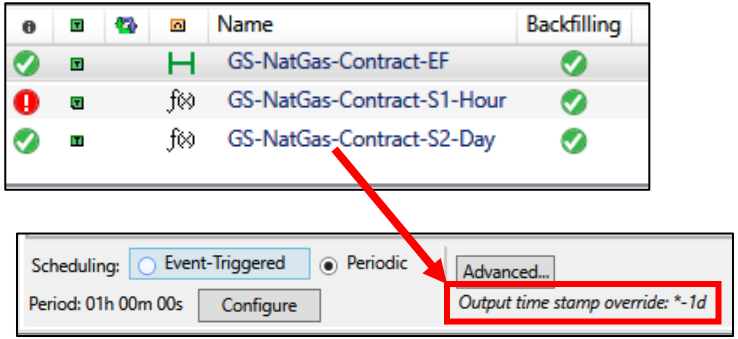
# Build Out the AF Structure




- Summarize Data by Hour
- Summarize Data by Day
- Generate Event Frame for the Day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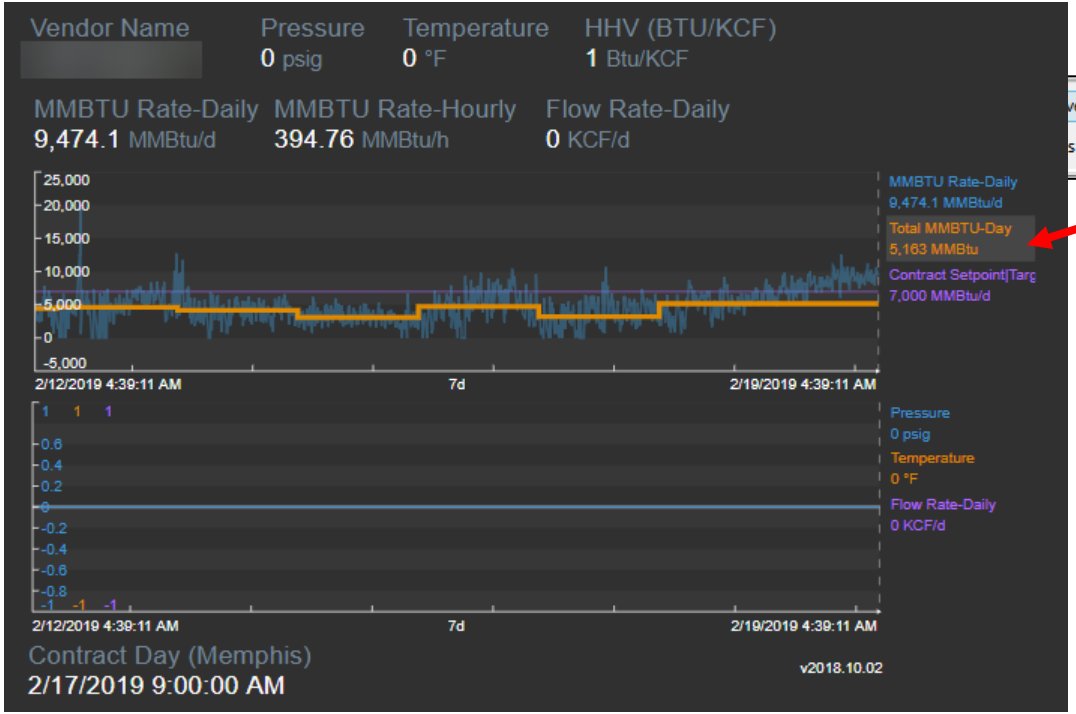
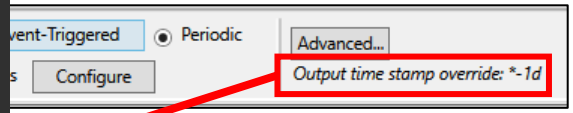
# Use PI Vision to Replace PI ProcessBook




- Visualize “Yesterday’s” Value
- Visualize via PI Vision (Thin Client)
- Templates -> Single Display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# Daily Summary via PSE Event Frame View

| Name | 1 [29.00:00:00] . | Duration | Start Time | End Time |
|---|---|---|---|---|
| GS-NatGas_NatGas HP_2019-01-20 09:00 | | 1:0:00:00 | 1/20/2019 9:00:00 AM | 1/21/2019 9:00:00 AM |
| GS-NatGas_NatGas :-LP_2019-01-20 09:00 | | 1:0:00:00 | 1/20/2019 9:00:00 AM | 1/21/2019 9:00:00 AM |
| GS-NatGas_NatGas LP_2019-01-20 09:00 | | 1:0:00:00 | 1/20/2019 9:00:00 AM | 1/21/2019 9:00:00 AM |
| GS-NatGas_NatGas ng-HP_2019-01-20 09:00 | | | | |
| GS-NatGas_NatGas ng-LP_2019-01-20 09:00 | | | | |
| GS-NatGas_NatGas HP_2019-01-21 09:00 | | | | |
| GS-NatGas_NatGas :-LP_2019-01-21 09:00 | | | | |
| GS-NatGas_NatGas LP_2019-01-21 09:00 | | | | |
| GS-NatGas_NatGas ng-HP_2019-01-21 09:00 | | | | |
| GS-NatGas_NatGas ng-LP_2019-01-21 09:00 | | | | |
| GS-NatGas_NatGas HP_2019-01-22 09:00 | | | | |
| GS-NatGas_NatGas :-LP_2019-01-22 09:00 | | | | |
| GS-NatGas_NatGas LP_2019-01-22 09:00 | | | | |
| GS-NatGas_NatGas ng-HP_2019-01-22 09:00 | | | | |
| GS-NatGas_NatGas ng-LP_2019-01-22 09:00 | | | | |
| GS-NatGas_NatGas HP_2019-01-23 09:00 | | | | |

| | |
|---|---|
| BTU (BTU/KCF) | 0 |
| Contract Day (Memphis) | 1/19/2019 9:00:00 AM |
| Contract Pressure | 0 psi |
| Contract Setpoint | 1000 MMBtu/d |
| Delivery Point ID | 801547 |
| Pressure | 129.15 psi |
| Temperature | 45.453 °F |
| Total KCF-Day | The referenced Attribute '.\El... |
| Total MMBTU-Day | 499.5 MMBtu/d |
| Vendor Name | |


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# PI OLEDB - Event Frame Dump

| Frequency | 1D | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Eng Units | | | MMBtu/d | | KCF/d | MMBtu/d | psi | °F | |
| Description | StartTime | Contract Day (Memphis) | Contract Setpoint | Delivery Point ID | Total KCF-Day | Total MMBTU-Day | Pressure | Temp | Vendor Name |
| | 11-Feb-2019 10:00:00 | 2/10/2019 | 6789.00 | 11745 | | 6528.63 | | | V2-HP |
| | 11-Feb-2019 10:00:00 | 2/10/2019 | 1000.00 | 801547 | | 500.22 | 128.95 | 50.44 | V1-LP |
| | 11-Feb-2019 10:00:00 | 2/10/2019 | 7000.00 | 11745 | | 4464.05 | | | V2-LP |
| | 11-Feb-2019 10:00:00 | 2/10/2019 | 6789.00 | PG5-0537 | 988.39 | | 282.31 | | V3-HP |
| | 11-Feb-2019 10:00:00 | 2/10/2019 | 6789.00 | PG5-0538 | 11.12 | | 83.07 | | V3-LP |
| | 12-Feb-2019 10:00:00 | 2/11/2019 | 6789.00 | 11745 | | 6941.15 | | | V2-HP |
| | 12-Feb-2019 10:00:00 | 2/11/2019 | 1000.00 | 801547 | | 499.99 | 129.20 | 48.42 | V1-LP |
| | 12-Feb-2019 10:00:00 | 2/11/2019 | | | | | | | |
| | 12-Feb-2019 10:00:00 | 2/12/2019 | | | | | | | |
| | 12-Feb-2019 10:00:00 | 2/12/2019 | | | | | | | |
| | 13-Feb-2019 10:00:00 | 2/12/2019 | | | | | | | |
| | 13-Feb-2019 10:00:00 | 2/12/2019 | | | | | | | |
| | 13-Feb-2019 10:00:00 | 2/13/2019 | | | | | | | |
| | 13-Feb-2019 10:00:00 | 2/13/2019 | | | | | | | |
| | 13-Feb-2019 10:00:00 | 2/13/2019 | | | | | | | |

```
SELECT ef.StartTime, ef.Name EFName, efa.*, ef.modified
FROM (SELECT * FROM [PIAF].[EventFrame].[EventFrame]
        WHERE EventFrameTemplateID IN (SELECT ID
                FROM [PIAF].[EventFrame].[EventFrameTemplate]
                WHERE Name LIKE 'EF-GLOBALSOURCING-NATGAS-DAILY' )) ef
INNER JOIN [PIAF].[EventFrame].[EventFrameHierarchy] efh  ON efh.ID = ef.ID
INNER JOIN [PIAF].[DataT].[TransposeEventFrameSnapshot_EF-GLOBALSOURCING-NATGAS-
DAILY](ef.ID) efa
                ON efa.EventFrameID = ef.id
WHERE ef.StartTime >= '11-Feb-2019 00:00:00' and ef.StartTime < '18-Feb-2019 00:00:00'
ORDER BY ef.StartTime
OPTION (FORCE ORDER, IGNORE ERRORS, EMBED ERRORS)
```


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# PI OLEDB – Interpolate Asset Range

| Vendor Name | Contract Day | StartTime | Delivery Point ID | Total MMBTU-Day | Total KCF-Day | Temperature | Pressure | Contract Pressure | Contract Setpoint |
|---|---|---|---|---|---|---|---|---|---|
| V1-LP | 10/8/2018 | 10/8/2018 10:00 | 801547 | 940.24 | 0.00 | 71.27 | 127.09 | 0 | 1000 |
| V2-HP | 10/8/2018 | 10/8/2018 10:00 | 11745 | 6221.83 | 0.00 | 0.00 | 0.00 | 0 | 6789 |
| V2-LP | 10/8/2018 | 10/8/2018 10:00 | 11745 | 6959.81 | 0.00 | 0.00 | 0.00 | 0 | 7000 |
| V3-HP | 10/8/2018 | 10/8/2018 10:00 | PG5-0537 | 986.92 | 986.92 | 0.00 | 282.36 | 0 | 6789 |
| V3-LP | 10/8/2018 | 10/8/2018 10:00 | PG5-0538 | 146.39 | 146.39 | 0.00 | 83.04 | 0 | 6789 |
| V1-LP | 10/9/2018 | 10/9/2018 10:00 | 801547 | 939.61 | 0.00 | 71.36 | 127.86 | 0 | 1000 |
| V2-HP | 10/9/2018 | 10/9/2018 10:00 | 11745 | 6353.21 | 0.00 | 0.00 | 0.00 | 0 | 6789 |
| V2-LP | 10/9/2018 | 10/9/2018 10:00 | 11745 | 6935.29 | 0.00 | 0.00 | 0.00 | 0 | 7000 |
| V3-HP | 10/9/2018 | 10/9/2018 10:00 | PG5-0537 | 986.74 | 986.74 | 0.00 | 282.47 | 0 | 6789 |
| V3-LP | 10/9/2018 | 10/9/2018 10:00 | PG5-0538 | 216.35 | 216.35 | 0.00 | 83.44 | 0 | 6789 |
| V1-LP | 10/10/2018 | 10/10/2018 10 | | | | | | | |
| V2-HP | 10/10/2018 | 10/10/2018 10 | | | | | | | |
| V2-LP | 10/10/2018 | 10/10/2018 10 | | | | | | | |
| V3-HP | 10/10/2018 | 10/10/2018 10 | | | | | | | |
| V3-LP | 10/10/2018 | 10/10/2018 10 | | | | | | | |
| V1-LP | 10/11/2018 | 10/11/2018 10 | | | | | | | |
| V2-HP | 10/11/2018 | 10/11/2018 10 | | | | | | | |
| V2-LP | 10/11/2018 | 10/11/2018 10 | | | | | | | |
| V3-HP | 10/11/2018 | 10/11/2018 10 | | | | | | | |
| V3-LP | 10/11/2018 | 10/11/2018 10 | | | | | | | |
| V1-LP | 10/12/2018 | 10/12/2018 10 | | | | | | | |

```
SELECT tir.[Vendor Name], tir.time as [StartTime] , tir.[Delivery Point ID], tir.[Total MMBTU-Day],
tir.[Total KCF-Day], tir.Temperature, tir.Pressure , tir.[Contract Pressure], tir.[Contract Setpoint],
format(tir.[Contract Day (Memphis)],'yyyy-MM-dd') as [Contract Day], eh.Path + eh.Name Element
FROM [PIAF].[Asset].[ElementTemplate] et
INNER JOIN [PIAF].[Asset].[Element] e  ON et.ID = e.ElementTemplateID
INNER JOIN [PIAF].[Asset].[ElementHierarchy] eh  ON e.ID = eh.ElementID
INNER JOIN [PIAF].[DataT].[ft_TransposeInterpolateRange_EL-GlobalSourcing-NatGas] tir
 ON eh.ElementID = tir.ElementID
WHERE et.Name = N'EL-GlobalSourcing-NatGas'
AND tir.StartTime = DATE(N't-30d+9h')  AND tir.EndTime = DATE(N't')  AND tir.TimeStep = N'1D'
OPTION (FORCE ORDER, IGNORE ERRORS, EMBED ERRORS)
```


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# Looks Good So Far… Continue…

- 2H18: Central SQL Database
  - Business Rules (Contracts and Costs)
  - Retrieve Past 30 Days Consumption by Day (PI OLEDB Query)
- 2019:
  - **Send Cost Information to Mills**
    - Send Consumption Targets and Unit Pricing to Facility via PI UFL
  - **Stand up PI Integrator for Business Analytics**
    - Change Data Retrieval from PI OLEDB Query to PI BIIBA
    - Hide AF changes w/ PI View for Sustainability
  - **Expand Facilities / Add Electricity**


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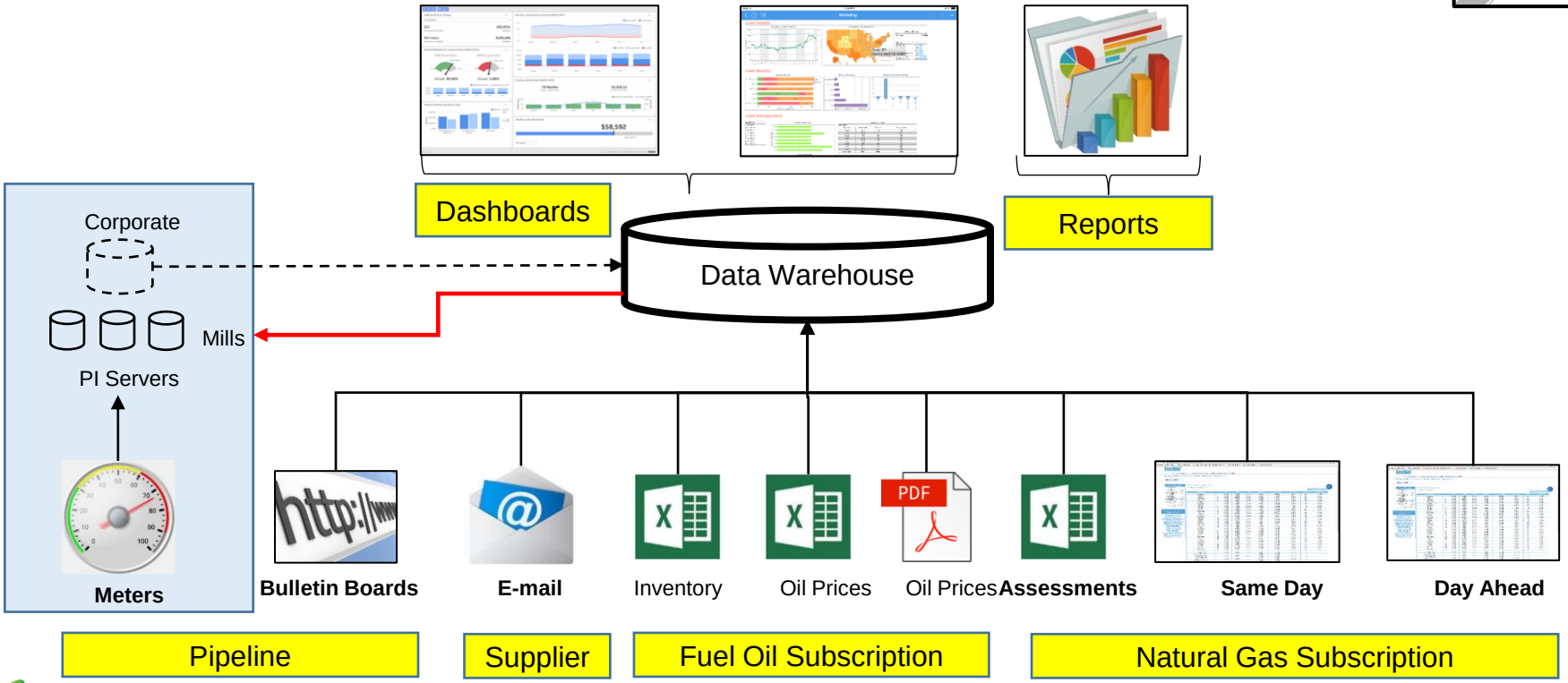
# Natural Gas Monitoring – Future State





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# Summarize Example #3

- **Started with End in Mind**
- Asked Questions Early to Identify Issues
- Sharpened Saw on Earlier (Easier) Projects
- Provided Early Win-Win for Users


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# Rick's Take-Aways

- **PI DataLink** is Good for…
  - **Simple/Throw-Away** Problems
  - **Early Phases** of More **Complex** Problems
- **AF** is Good for…
  - **Hiding PI Tag Changes**
  - **More Complex Problems and Timing Events**
- **AF and PIIBA** are Good for…
  - **Hiding PI AF Structure Changes**
- **Confirm Understanding, Begin with the End in Mind, Think Win-Win** and **Sharpen the Saw**


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# Habits of a Highly Effective Problem Solver

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



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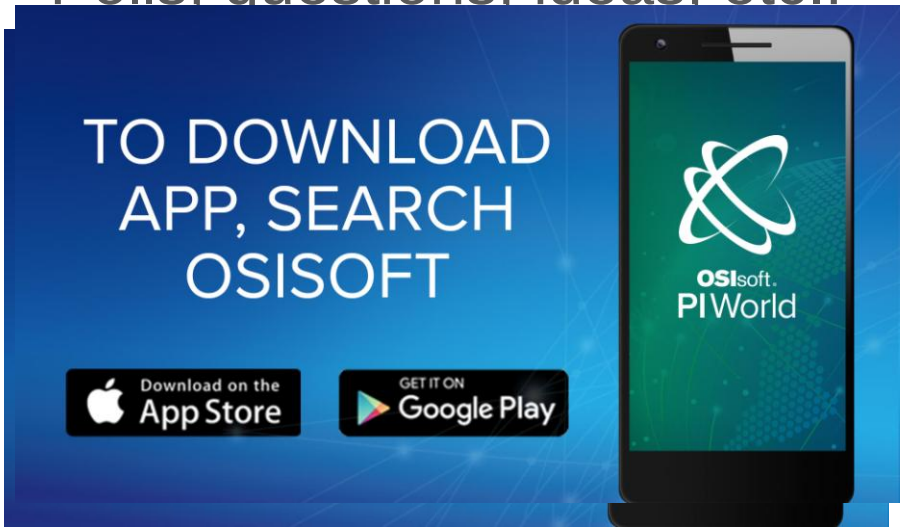
# Questions?

Please wait for
the **microphone**

State your
**name & company**

# Please remember to…

Slido.com or sli.do
#paper
Polls, questions, ideas, etc.!





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