



Where energy meets innovation.



The Evolution of the PI System at EQT in Support of our Digital Transformation

Presented by

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EQT Production



Where energy meets innovation.

Overview of Presentation

- EQT Corporation Overview
- EQT Midstream Objectives
- The Journey
- Example Case Studies and Benefits
- Next Steps
- EQT E&P's Journey





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EQT Corporation Overview



Where energy meets innovation.

Two Integrated Business Units

Natural Gas Exploration, Development, and Transportation

- Headquartered in Pittsburgh, PA
- 2018 marks our 130th Year in Business.
- Operations Across Appalachian Region & Texas
- Largest Natural Gas Producer in the United States
- More than 1,800 Employees
- Innovative Techniques & Strategies Employed Across Two Distinct Business Units
 - **EQT Production-Natural Gas Exploration, Drilling, & Development**
 - **EQT Midstream-Natural Gas Gathering, Transportation, & Storage**



Role in the Natural Gas Value Chain



EQT Midstream
PARTNERS, LP

• Approximately +2.0 BCFD Marcellus Gathering Capacity

• Gas Gathering

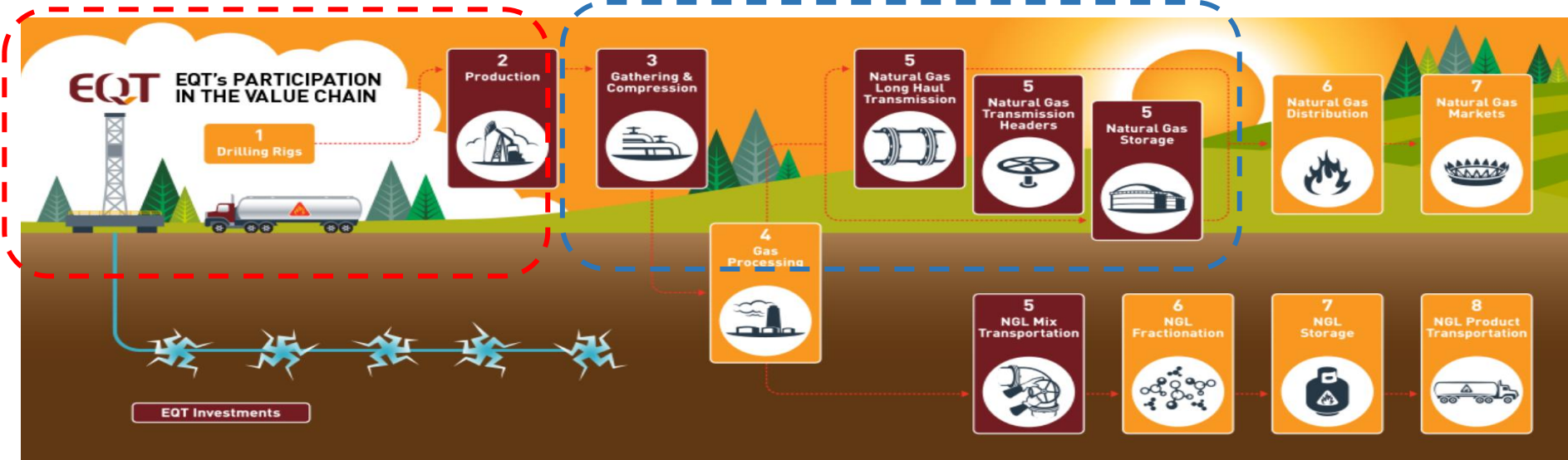
- Reciprocating Compressors/Engines
- Pipelines
- Measurement

• Transmission & Storage

- Reciprocating & Centrifugal Compressors
- Large Pipelines
- Storage Facilities

Brian

Oscar





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EQT Midstream Objectives

Midstream Goals & Focus

Objectives – Build Exceptional Operational and Business Intelligence

• Provide Natural Gas Gathering & Transportation Services

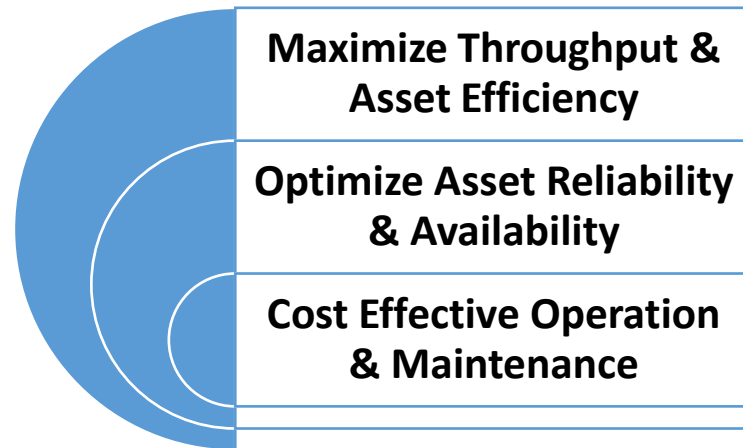
- Health & Safety #1 Priority
- Customer Service Focus
- High System Availability & Capacity
- Provide Value for Customers & Shareholders

• Strategy

- Operate & Maintain Assets Efficiently & Cost Effectively
- Apply Innovative Technologies to All Facets of the Business
- Maintain High Expectations of Quality & Integrity

• Plan & Implementation

- High Reliability – Compressors & Pipelines
- Data & Analysis for Operational Awareness & Excellence
- Transform the Business from Reactive to Proactive (Predictive) Model





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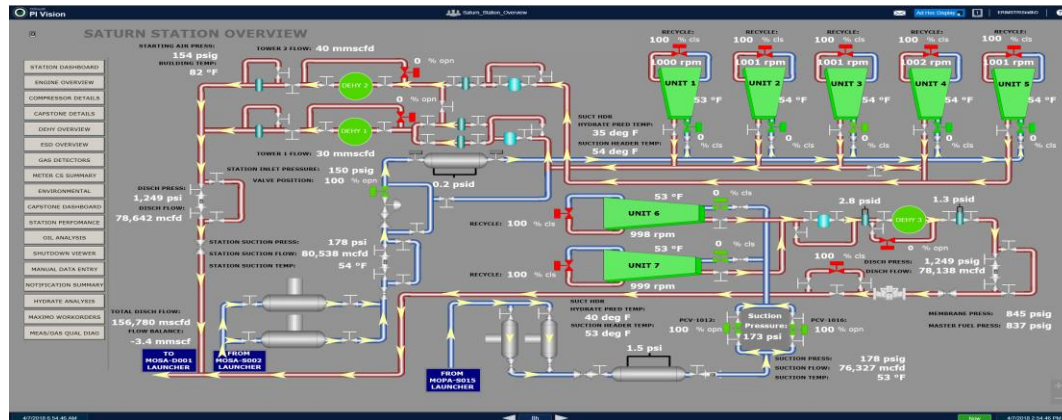
The Journey

EQT Midstream's PI Implementation Journey

Started in 2015 with Proof of Concept Project ONE Gathering Facility – Saturn Compressor Station



YEAR	STATION	ENGINE/COMP UNITS	TAGS
2015	Saturn	7	9287



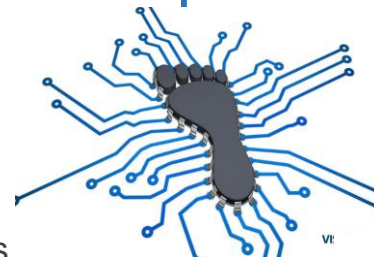
EQT Midstream's PI Implementation Journey

By End of 2018 Significantly Increased PI Digital Footprint



1. 40 Locations

- 16 Gathering Facilities
- 9 Transmission Facilities
- 1 Storage Facility
- 10 M&R Sites
- 4 Interconnect/Distribution Sites

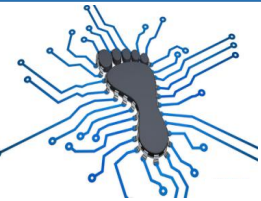


2. More than 100,000 Tags every Second

3. PI AF Metrics to Date:

- 1397 Analysis Templates
- 16751 Analysis
- 186 Element Templates
- 4173 Elements
- 828 Notification Rule Templates
- 9160 Notification Rules



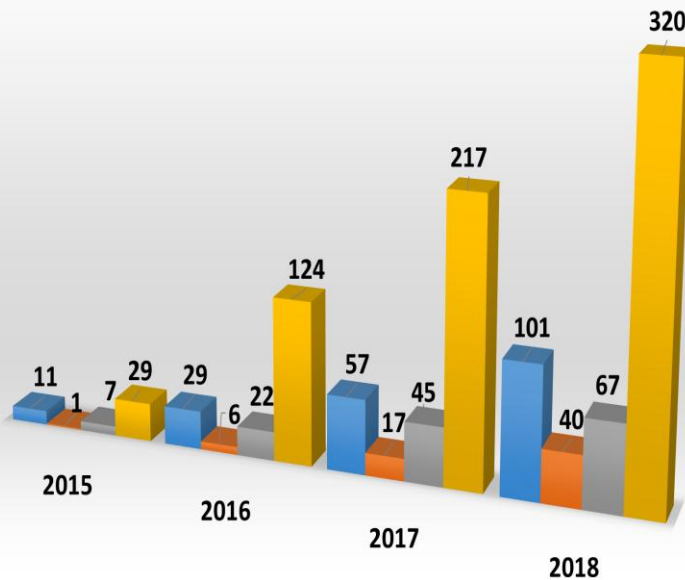


EQT Midstream's PI Implementation Journey

PI System Digital Footprint

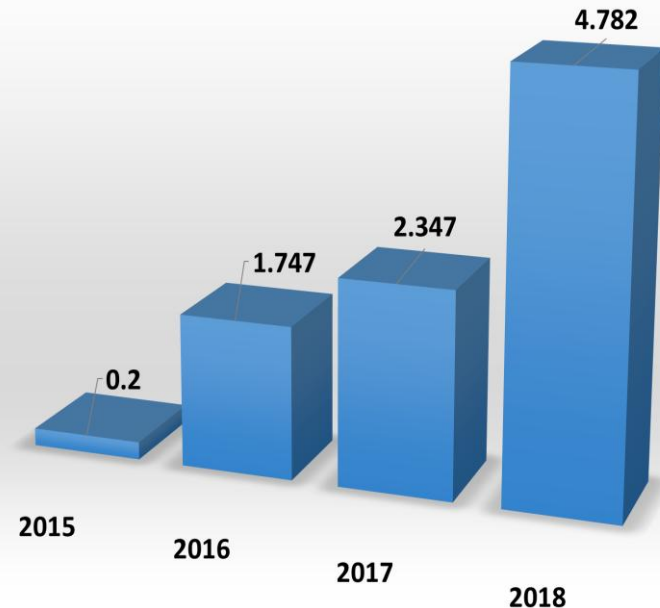
EQT PI System Metrics per Year

■ TAGS (X 1000) ■ Sites ■ Engine/Compressors ■ Total Assets



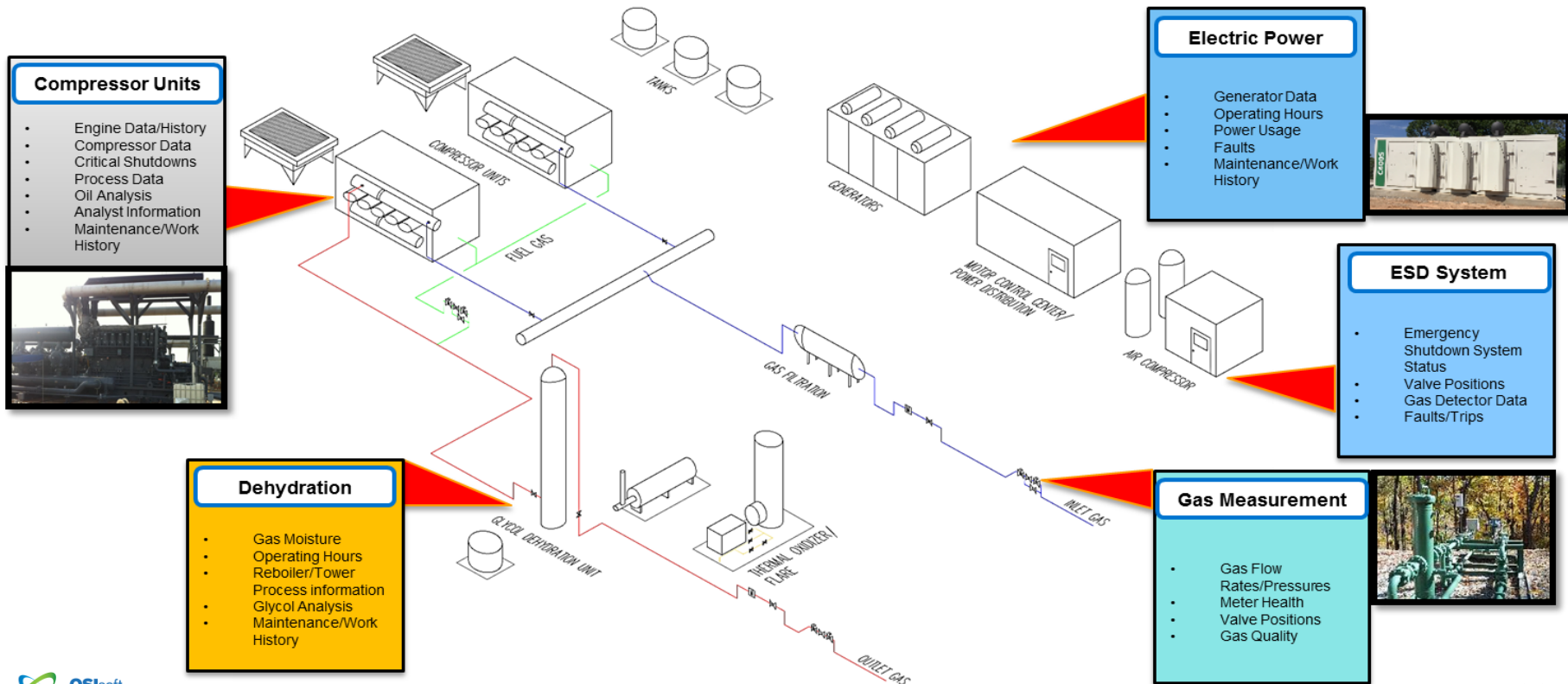
EQT PI System Metrics per Year

■ Volume of Gas (Billion Cubic Feet Per Day)

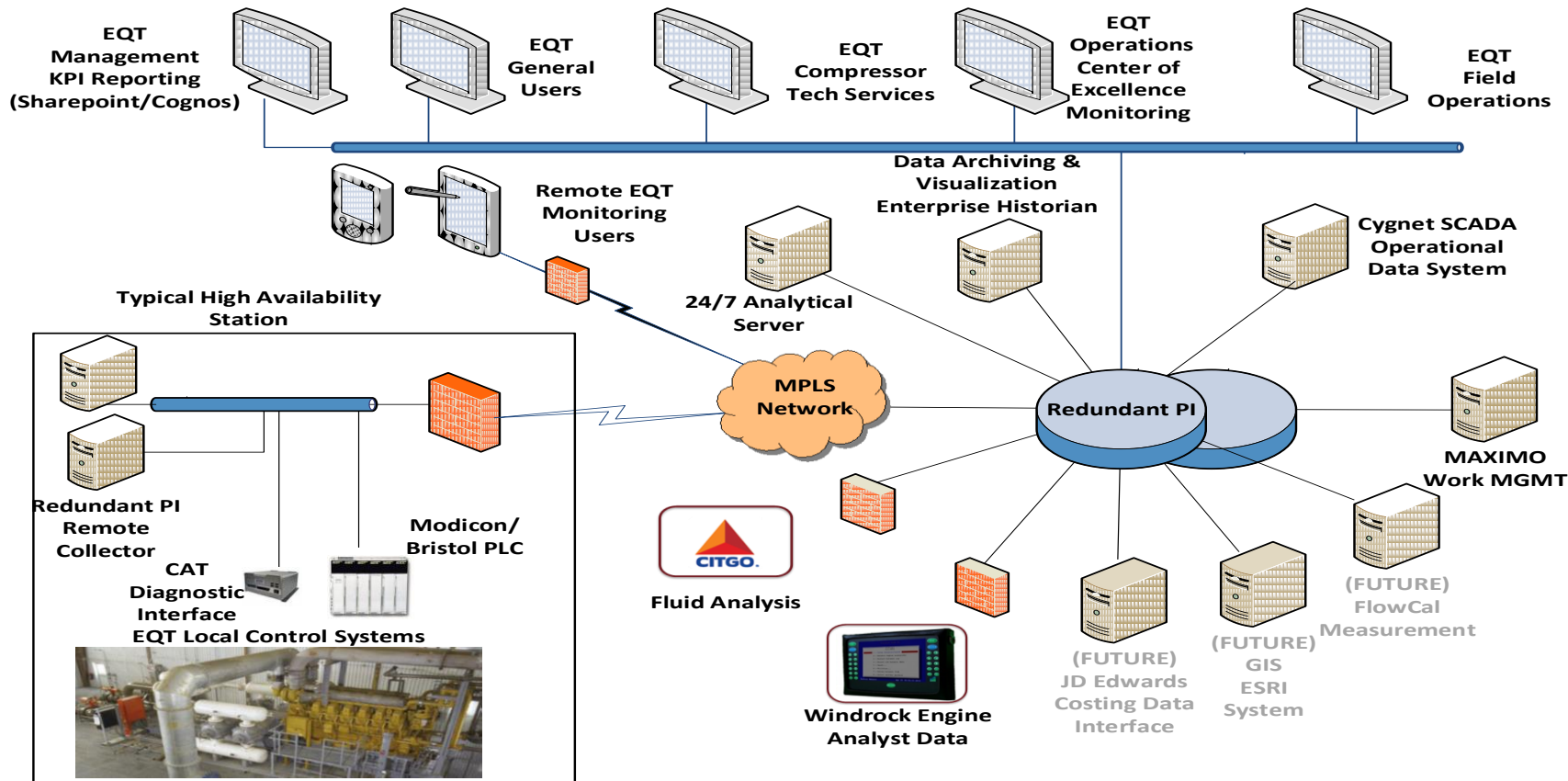


Typical Facility Overview

Multiple Data Sources – One Point of Access with PI



EQT Midstream's PI Network Architecture



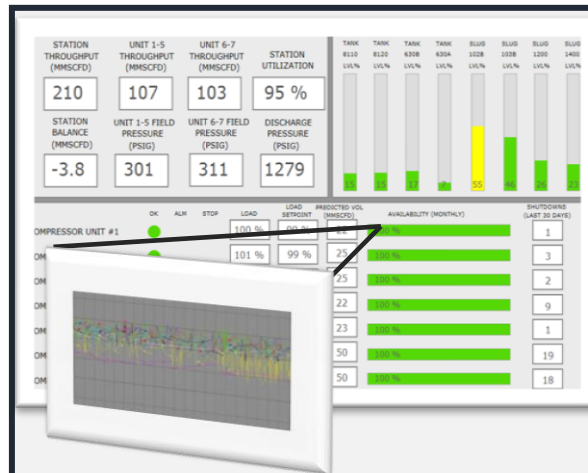
EQT Midstream PI System Development

Building the Tools for Reliability



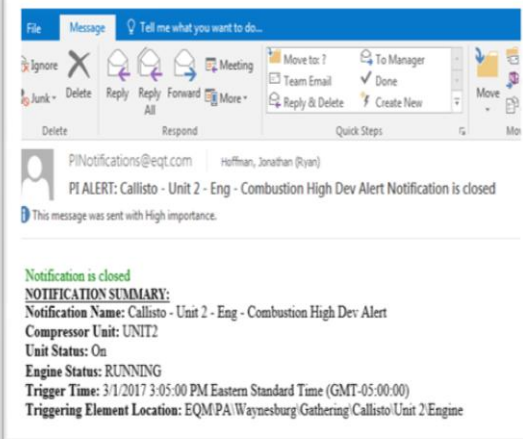
PI Asset Framework (PI AF)

- Develop Hierarchy of Compressor Station Assets
- Organization of Data Into Useful Sets
- Standardization Across Sites
- Templates for Scalability
- Translation/Integration With Other Business Systems



PI Vision

- Dashboards for Operational Monitoring
- Multiple Sources of Data Combined Into Single View
- Pair Analytics w/Real-Time Values
- Single Point Access Across Organization



PI Event Frames & Notifications

- 24/7 Monitoring & Communication of Anomalies
- Failure Detection, Efficiency Monitoring, Work Mgmt.
- Improve Operational Awareness
- Eliminate "Digging" for Issues

Original PI Business Justification was based on savings realized by event prevention primarily for Engine/Compression Assets

Sometimes it's the journey
that teaches you a lot about
your destination.



Gas Quality and Measurement

Environmental
Compliance Assurance



COMPLIANCE



PREVENTIVE MAINTENANCE



Gas Quality and Measurement



Measurement_Diagnostics_Tree_3 Asset: Applegate Odorizer

MEASUREMENT DIAGNOSTICS

System Overview

Odorizers

Asset	Global Alarm	Injection Rat
Applegate Odorizer	Off	0
Beagle Odorizer	Bad	0
Belle Vernon Odorizer	Off	0
Bradford Woods Odorizer	Off	0
Bunola Header Odorizer	Off	0
Bunola Storage Odorizer	Off	0
Bunola to H - 149 Odorizer	Off	0
Campbell Odorizer	Bad	0
Chub Odorizer	Off	0
Clinton Odorizer	Under Range	0

Ultrasonic Meters

Asset	Avg Velocity Gas	Avg Velocity Sound	Speed of...
Applegate USM	65.728	1,407.7	1,405.7
Applegate USM Run 2	64.026	1,406.5	1,405.7
Europa - USM	54.908	1,388.2	1,386
Janus Discharge USM	63.316	1,185.4	1,191.4
Pipers Ridge USM - Run 1	Bad	Bad	1,383.7
Pipers Ridge USM - Run 2	Bad	Bad	1,383.7
Saturn Discharge 1-5 USM	29.976	1,236.5	1,276.4
Saturn Discharge 6-7 USM	29.651	1,240.8	1,243.6
Saturn Suction 1-5 USM	107.8	1,238.6	1,276.4

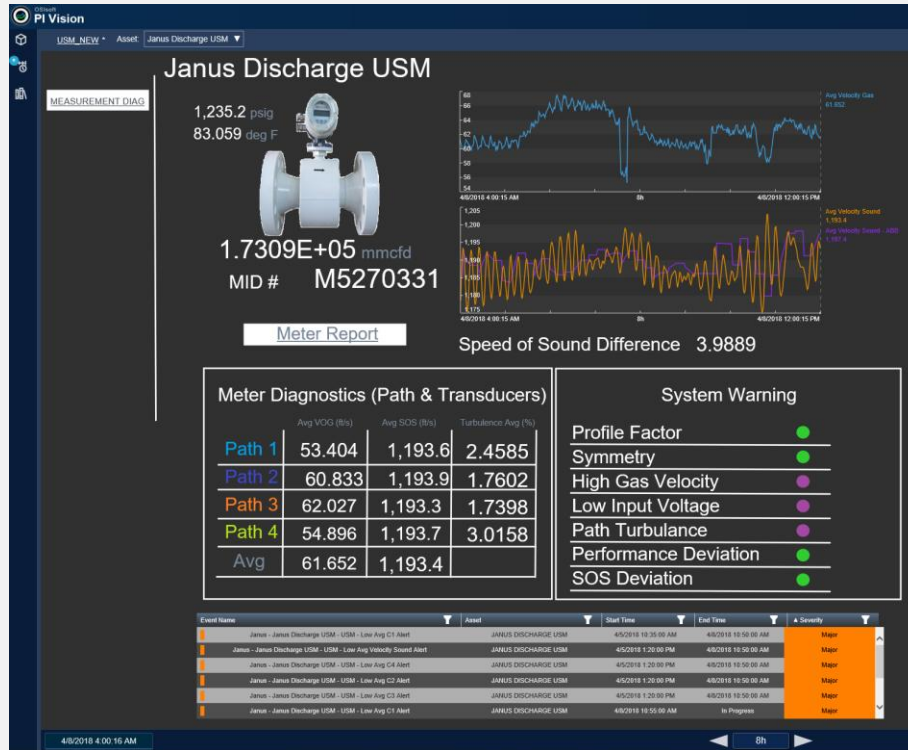
Gas Chromatograph - ABB

Site Name	Speed of Sound - Calc	BTU Dry	BTU Saturated	CO2	N2	Specific Gravity	Total Gallons Per MCF	Compressibility
Applegate GC - ABB	1,405.7	1,030.4	1,012.5	0.27893	0.21409	0.57179	17.229	0.99791
Pipers Ridge GC - ABB	1,383.7	1,039.9	1,021.9	0.22695	0.22045	0.57706	17.332	0.99786
Europa - ABB	1,386	1,046.9	1,028.7	0.25133	0.2343	0.58205	17.42	0.99782
Saturn 6-7 ABB	1,276.4	1,193.7	1,173	0.18846	0.41572	0.67683	18.814	0.9969
Saturn 1-5 ABB	1,245.2	1,213.9	1,192.8	0.1781	0.41068	0.68969	18.976	0.99677
Janus - ABB	1,191.4	1,229.3	1,207.9	0.4431	0.4431	0.69991	19.097	0.99666

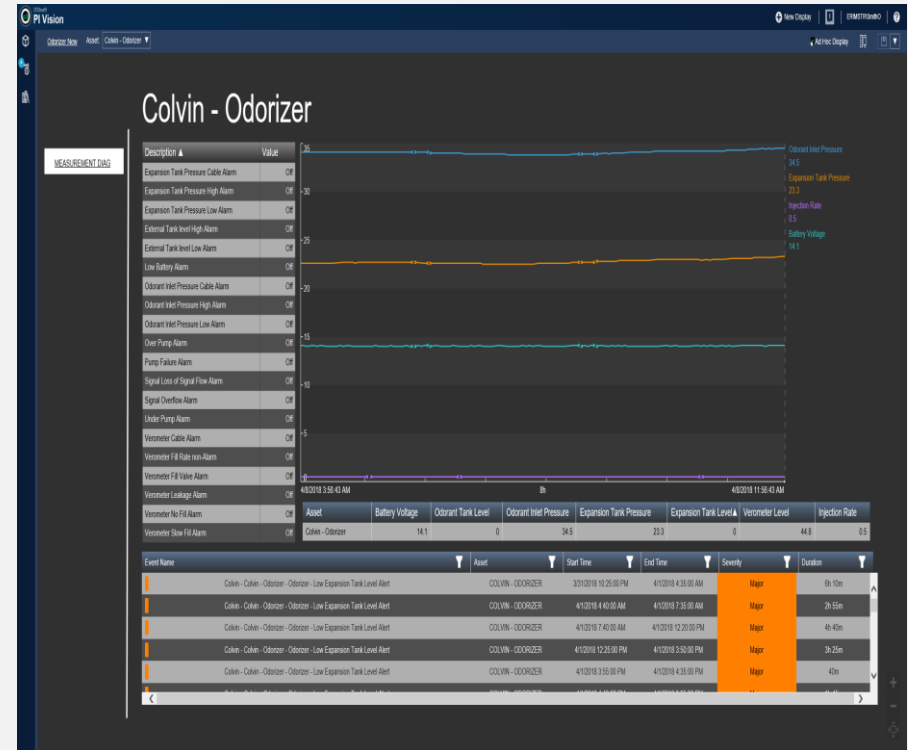
Moisture Analyzer

Asset	Moisture Concentration
Applegate - Moisture Analyzer	3.41
Europa - Moisture Analyzer	1.80
Janus - Delhy 1 Outlet - Moisture Analyzer	5.19
Janus - Delhy 2 Outlet - Moisture Analyzer	1.9
Janus - Total Station Discharge - Moisture Analyzer	3.18
Janus - Total Station Suction - Moisture Analyzer	14.3
Pipers Ridge - Moisture Analyzer	1.80

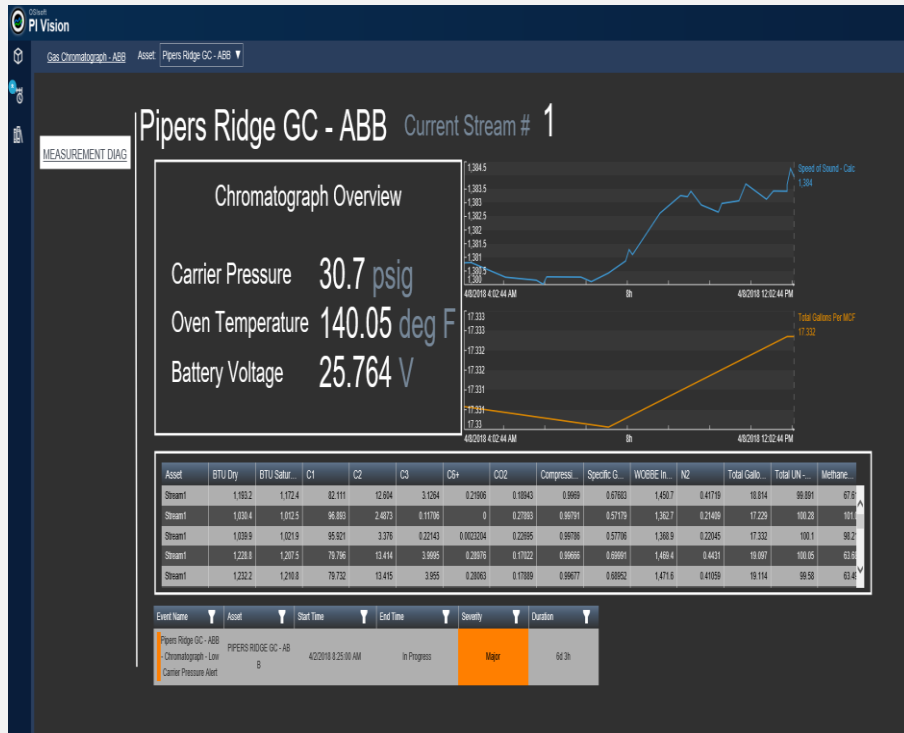
Ultra Sonic Meters



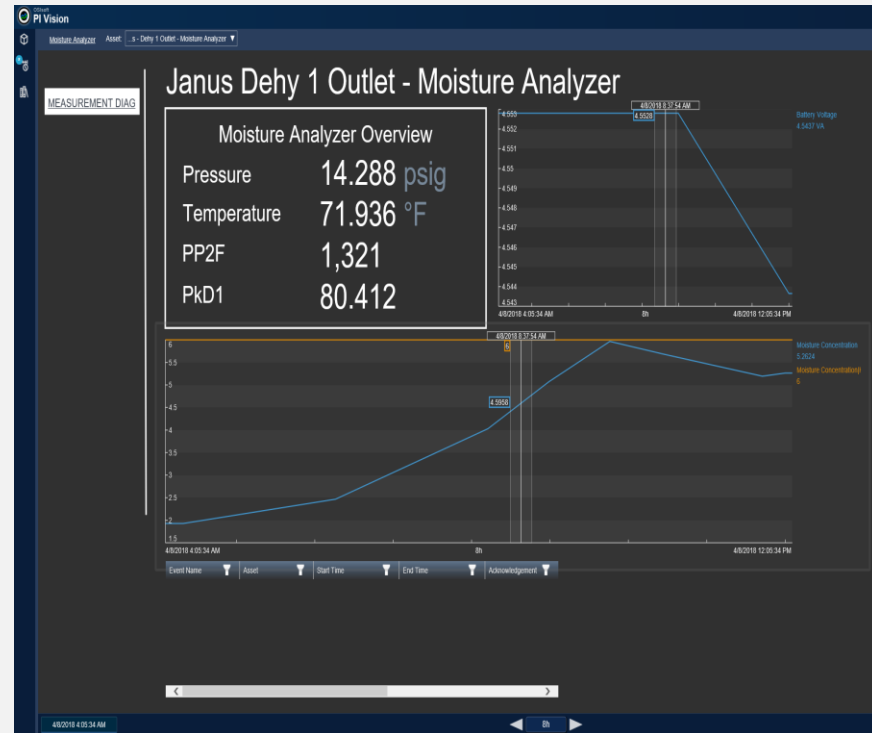
Odorizers



Chromatographs



Moisture Analyzers





Greenhouse Gases

Table 1: Greenhouse Gas Emissions (in million tonnes of CO₂ equivalent)

Year	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆
1990	15.0	0.5	0.1	0.0	0.0	0.0
1991	15.5	0.5	0.1	0.0	0.0	0.0
1992	16.0	0.5	0.1	0.0	0.0	0.0
1993	16.5	0.5	0.1	0.0	0.0	0.0
1994	17.0	0.5	0.1	0.0	0.0	0.0
1995	17.5	0.5	0.1	0.0	0.0	0.0
1996	18.0	0.5	0.1	0.0	0.0	0.0
1997	18.5	0.5	0.1	0.0	0.0	0.0
1998	19.0	0.5	0.1	0.0	0.0	0.0
1999	19.5	0.5	0.1	0.0	0.0	0.0
2000	20.0	0.5	0.1	0.0	0.0	0.0
2001	20.5	0.5	0.1	0.0	0.0	0.0
2002	21.0	0.5	0.1	0.0	0.0	0.0
2003	21.5	0.5	0.1	0.0	0.0	0.0
2004	22.0	0.5	0.1	0.0	0.0	0.0
2005	22.5	0.5	0.1	0.0	0.0	0.0
2006	23.0	0.5	0.1	0.0	0.0	0.0
2007	23.5	0.5	0.1	0.0	0.0	0.0
2008	24.0	0.5	0.1	0.0	0.0	0.0
2009	24.5	0.5	0.1	0.0	0.0	0.0
2010	25.0	0.5	0.1	0.0	0.0	0.0

Molecular Models:

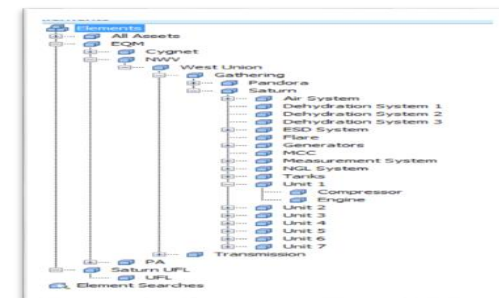
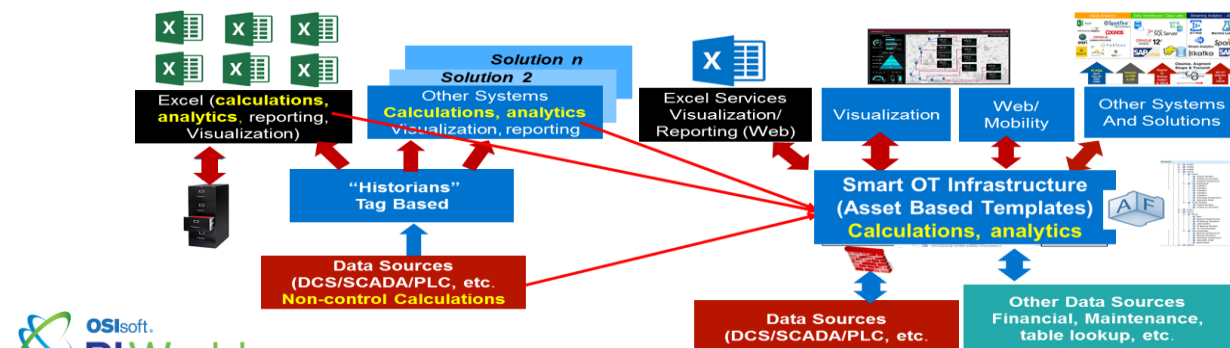
- Methane (CH₄):** A central carbon atom (black) bonded to four hydrogen atoms (white) in a tetrahedral arrangement.
- Carbon Dioxide (CO₂):** A central carbon atom (black) bonded to two oxygen atoms (red) in a linear arrangement.
- Nitrous Oxide (N₂O):** A central nitrogen atom (blue) bonded to two oxygen atoms (red) in a bent arrangement.

Newborn Development Tracker - 2024														
	Age	Weight	Length	Head Circ.	Feet Length	Diaper Size	Diaper Change	Feeding	Sleeping	Diaper	Diaper	Diaper	Diaper	Diaper
	Weeks	kg	cm	cm	cm	Size	Count	ml	Hours	Size	Size	Size	Size	Size
1	0	3.5	50	33	10	S	10	60	12	S	S	S	S	S
2	1	4.5	55	35	11	M	12	70	14	M	M	M	M	M
3	2	5.5	60	37	12	M	14	80	16	M	M	M	M	M
4	3	6.5	65	39	13	L	16	90	18	L	L	L	L	L
5	4	7.5	70	41	14	L	18	100	20	L	L	L	L	L
6	5	8.5	75	43	15	L	20	110	22	L	L	L	L	L
7	6	9.5	80	45	16	L	22	120	24	L	L	L	L	L
8	7	10.5	85	47	17	L	24	130	26	L	L	L	L	L
9	8	11.5	90	49	18	L	26	140	28	L	L	L	L	L
10	9	12.5	95	51	19	L	28	150	30	L	L	L	L	L
11	10	13.5	100	53	20	L	30	160	32	L	L	L	L	L
12	11	14.5	105	55	21	L	32	170	34	L	L	L	L	L
13	12	15.5	110	57	22	L	34	180	36	L	L	L	L	L
14	13	16.5	115	59	23	L	36	190	38	L	L	L	L	L
15	14	17.5	120	61	24	L	38	200	40	L	L	L	L	L
16	15	18.5	125	63	25	L	40	210	42	L	L	L	L	L
17	16	19.5	130	65	26	L	42	220	44	L	L	L	L	L
18	17	20.5	135	67	27	L	44	230	46	L	L	L	L	L
19	18	21.5	140	69	28	L	46	240	48	L	L	L	L	L
20	19	22.5	145	71	29	L	48	250	50	L	L	L	L	L
21	20	23.5	150	73	30	L	50	260	52	L	L	L	L	L
22	21	24.5	155	75	31	L	52	270	54	L	L	L	L	L
23	22	25.5	160	77	32	L	54	280	56	L	L	L	L	L
24	23	26.5	165	79	33	L	56	290	58	L	L	L	L	L
25	24	27.5	170	81	34	L	58	300	60	L	L	L	L	L
26	25	28.5	175	83	35	L	60	310	62	L	L	L	L	L
27	26	29.5	180	85	36	L	62	320	64	L	L	L	L	L
28	27	30.5	185	87	37	L	64	330	66	L	L	L	L	L
29	28	31.5	190	89	38	L	66	340	68	L	L	L	L	L
30	29	32.5	195	91	39	L	68	350	70	L	L	L	L	L
31	30	33.5	200	93	40	L	70	360	72	L	L	L	L	L
32	31	34.5	205	95	41	L	72	370	74	L	L	L	L	L
33	32	35.5	210	97	42	L	74	380	76	L	L	L	L	L
34	33	36.5	215	99	43	L	76	390	78	L	L	L	L	L
35	34	37.5	220	101	44	L	78	400	80	L	L	L	L	L
36	35	38.5	225	103	45	L	80	410	82	L	L	L	L	L
37	36	39.5	230	105	46	L	82	420	84	L	L	L	L	L
38	37	40.5	235	107	47	L	84	430	86	L	L	L	L	L
39	38	41.5	240	109	48	L	86	440	88	L	L	L	L	L
40	39	42.5	245	111	49	L	88	450	90	L	L	L	L	L
41	40	43.5	250	113	50	L	90	460	92	L	L	L	L	L
42	41	44.5	255	115	51	L	92	470	94	L	L	L	L	L
43	42	45.5	260	117	52	L	94	480	96	L	L	L	L	L
44	43	46.5	265	119	53	L	96	490	98	L	L	L	L	L
45	44	47.5	270	121	54	L	98	500	100	L	L	L	L	L
46	45	48.5	275	123	55	L	100	510	102	L	L	L	L	L
47	46	49.5	280	125	56	L	102	520	104	L	L	L	L	L
48	47	50.5	285	127	57	L	104	530	106	L	L	L	L	L
49	48	51.5	290	129	58	L	106	540	108	L	L	L	L	L
50	49	52.5	295	131	59	L	108	550	110	L	L	L	L	L
51	50	53.5	300	133	60	L	110	560	112	L	L	L	L	L
52	51	54.5	305	135	61	L	112	570	114	L	L	L	L	L
53	52	55.5	310	137	62	L	114	580	116	L	L	L	L	L
54	53	56.5	315	139	63	L	116	590	118	L	L	L	L	L
55	54	57.5	320	141	64	L	118	600	120	L	L	L	L	L
56	55	58.5	325	143	65	L	120	610	122	L	L	L	L	L
57	56	59.5	330	145	66	L	122	620	124	L	L	L	L	L
58	57	60.5	335	147	67	L	124	630	126	L	L	L	L	L
59	58	61.5	340	149	68	L	126	640	128	L	L	L	L	L
60	59	62.5	345	151	69	L	128	650	130	L	L	L	L	L
61	60	63.5	350	153	70	L	130	660	132	L	L	L	L	L
62	61	64.5	355	155	71	L	132	670	134	L	L	L	L	L
63	62	65.5	360	157	72	L	134	680	136	L	L	L	L	L
64	63	66.5	365	159	73	L	136	690	138	L	L	L	L	L
65	64	67.5	370	161	74	L	138	700	140	L	L	L	L	L
66	65	68.5	375	163	75	L	140	710	142	L	L	L	L	L
67	66	69.5	380	165	76	L	142	720	144	L	L	L	L	L
68	67	70.5	385	167	77	L	144	730	146	L	L	L	L	L
69	68	71.5	390	169	78	L	146	740	148	L	L	L	L	L
70	69	72.5	395	171	79	L	148	750	150	L	L	L	L	L
71	70	73.5	400	173	80	L	150	760	152	L	L	L	L	L
72	71	74.5	405	175	81	L	152	770	154	L	L	L	L	L
73	72	75.5	410	177	82	L	154	780	156	L	L	L	L	L
74	73	76.5	415	179	83	L	156	790	158	L	L	L	L	L
75	74	77.5	420	181	84	L	158	800	160	L	L	L	L	L
76	75	78.5	425	183	85	L	160	810	162	L	L	L	L	L
77	76	79.5	430	185	86	L	162	820	164	L	L	L	L	L
78	77	80.5	435	187	87	L	164	830	166	L	L	L	L	L
79	78	81.5	440	189	88	L	166	840	168	L	L	L	L	L
80	79	82.5	445	191	89	L	168	850	170	L	L	L	L	L
81	80	83.5	450	193	90	L	170	860	172	L	L	L	L	L
82	81	84.5	455	195	91	L	172	870	174	L	L	L	L	L
83	82	85.5	460	197	92	L	174	880	176	L	L	L	L	L
84	83	86.5	465	199	93	L	176	890	178	L	L	L	L	L
85	84	87.5	470	201	94	L	178	900	180	L	L	L	L	L
86	85	88.5	475	203	95	L	180	910	182	L	L	L	L	L
87	86	89.5	480	205	96	L	182	920	184	L	L	L	L	L
88	87	90.5	485	207	97	L	184	930	186	L	L	L	L	L
89	88	91.5	490	209	98	L	186	940	188	L	L	L	L	L
90	89	92.5	495	211	99	L	188	950	190	L	L	L	L	L
91	90	93.5	500	213	100	L	190	960	192	L	L	L	L	L
92	91	94.5	505	215	101	L	192	970	194	L	L	L	L	L
93	92	95.5	510	217	102	L	194	980	196	L	L	L	L	L
94	93	96.5	515	219	103	L	196	990	198	L	L	L	L	L
95	94	97.5	520	221	104	L	198	1000	200	L	L	L	L	L
96	95	98.5	525	223	105	L	200	1010	202	L	L	L	L	L
97	96	99.5	530	225	106	L	202	1020	204	L	L	L	L	L
98	97	100.5	535	227	107	L	204	1030	206	L	L	L	L	L
99	98	101.5	540	229	108	L	206	1040	208	L	L	L	L	L
100	99	102.5	545	231	109	L	208	1050	210	L	L	L	L	L
101	100	103.5	550	233	110	L	210	1060	212	L	L	L	L	L
102	101	104.5	555	235	111	L	212	1070	214	L	L	L	L	L
103	102	105.5	560	237	112	L	214	1080	216	L	L	L	L	L
104	103	106.5	565	239	113	L	216	1090	218	L	L	L	L	L
105	104	107.5	570	241	114	L	218	1100	220	L	L	L	L	L
106	105	108.5	575	243	115	L	220	1110	222	L	L	L	L	L
107	106	109.5	580	245	116	L	222	1120	224	L	L	L	L	L
108	107	110.5	585	247	117	L	224	1130	226	L	L	L	L	L
109	108	111.5	590	249	118	L	226	1140	228	L	L	L	L	L
110	109	112.5	595	251	119	L	228	1150	230	L	L	L	L	L
111	110	113.5	600	253	120	L	230	1160	232	L	L	L	L	L
112	111	114.5	605	255	121	L	232	1170	234	L	L	L	L	L
113	112	115.5	610	257	122	L	234	1180	236	L	L	L	L	L
114	113	116.5	615	259	123	L	236	1190	238	L	L	L	L	L
115	114	117.5	620	261	124	L	238	1200	240	L	L	L	L	L
116	115	118.5	625	263	125	L	240	1210	242	L	L	L	L	L
117	116	119.5	630	265	126	L	242	1220	244	L	L	L	L	L
118	117	120.5	635	267	127</									

The screenshot displays an Excel spreadsheet titled "SATURN Environmental Report". The spreadsheet is organized into several sections:

- Timeline:** The top row shows years from 2010 to 2024, with a "Total" column on the far right.
- Revenue Section:** This section includes columns for "Revenue", "Costs", and "Profit". It is further divided into "Revenue 1" and "Revenue 2".
- Costs Section:** This section includes columns for "Costs", "Profit", and "Loss". It is further divided into "Costs 1" and "Costs 2".
- Profit/Loss Section:** This section includes columns for "Profit", "Loss", and "Total".
- Summary Section:** The bottom row, labeled "Total", provides a summary of the data for each year and category.

The data is presented in a structured manner, with each year's data occupying a specific column. The "Total" row at the bottom provides a comprehensive overview of the financial performance across all years and categories.





Scheduled / Condition Based Maintenance



\\PRC\MAPPW03\SAF\EQT (Midstream) - PI System Explorer

File Search View Go Tools Help

Database Query Date Back Check In Refresh New Element New Attribute

Elements

- Elements
 - All Assets
 - Aggregate
 - Blackville
 - Callisto
 - Air System
 - Dehydration System 1
 - Dehydration System 2
 - Dehydration System 3
 - ESD System
 - Generators
 - MCC
 - Measurement System
 - Misc
 - Tanks
 - Unit 1
 - Compressor
 - Engine
 - Unit 2
 - Unit 3
 - Unit 4
 - Unit 5
 - Corona
 - Europa
 - Halo
 - Hopewell
 - Jo
 - Jesus
 - Jefferson
 - Jupiter
 - Mako
 - Pandora
 - Pipers
 - Plasma
 - Pluto
 - Rager
 - Saturn

Compressor

Filter

Filter	Name
Category: RunTime	Pressure Ratio - Stage 2
	Station Discharge Pressure
	Compressor - In Service Date
	Compressor - Next Service Date
	Virtual Run Time - Compressor - Job Plan
	Virtual Run Time - Compressor - Maintenance Interval
	Virtual Run Time - Compressor - Next Maintenance Interval
	Virtual Run Time Meter - Compressor
Category: Constants	_Constants
	_Coresight
	_Manual Data
	HE Piston Dam - Throw 1
	HE Piston Dam - Throw 2
	HE Piston Dam - Throw 3
	HE Piston Dam - Throw 4
	HE Piston Dam - Throw 5
	HE Piston Dam - Throw 6
Category: Fuel Gas	Fuel Flow
Category: Gas Pressures	1st Stage Disch Press
	2nd Stage Disch Press
	3rd Stage Disch Press
	Discharge Press - Final
	Stage 1 - Load Step 8 - Compression Ratio Calc
	Stage 1 - Load Step 9 - Compression Ratio Calc

Elements

Event Frames

Library

Unit of Measure

https://prcmappw03cs.eqt.com/PIVision/#/Displays/781/Ci

hour meter - Google Search

PI Vision - Capstone - Virtua...

Search Share More

PI Vision

Capstone - Virtual Run Time Asset: Bay A

Capstone - Virtual Run Time - Callisto - Bay A

Unit Run Hours: 31,501 hr

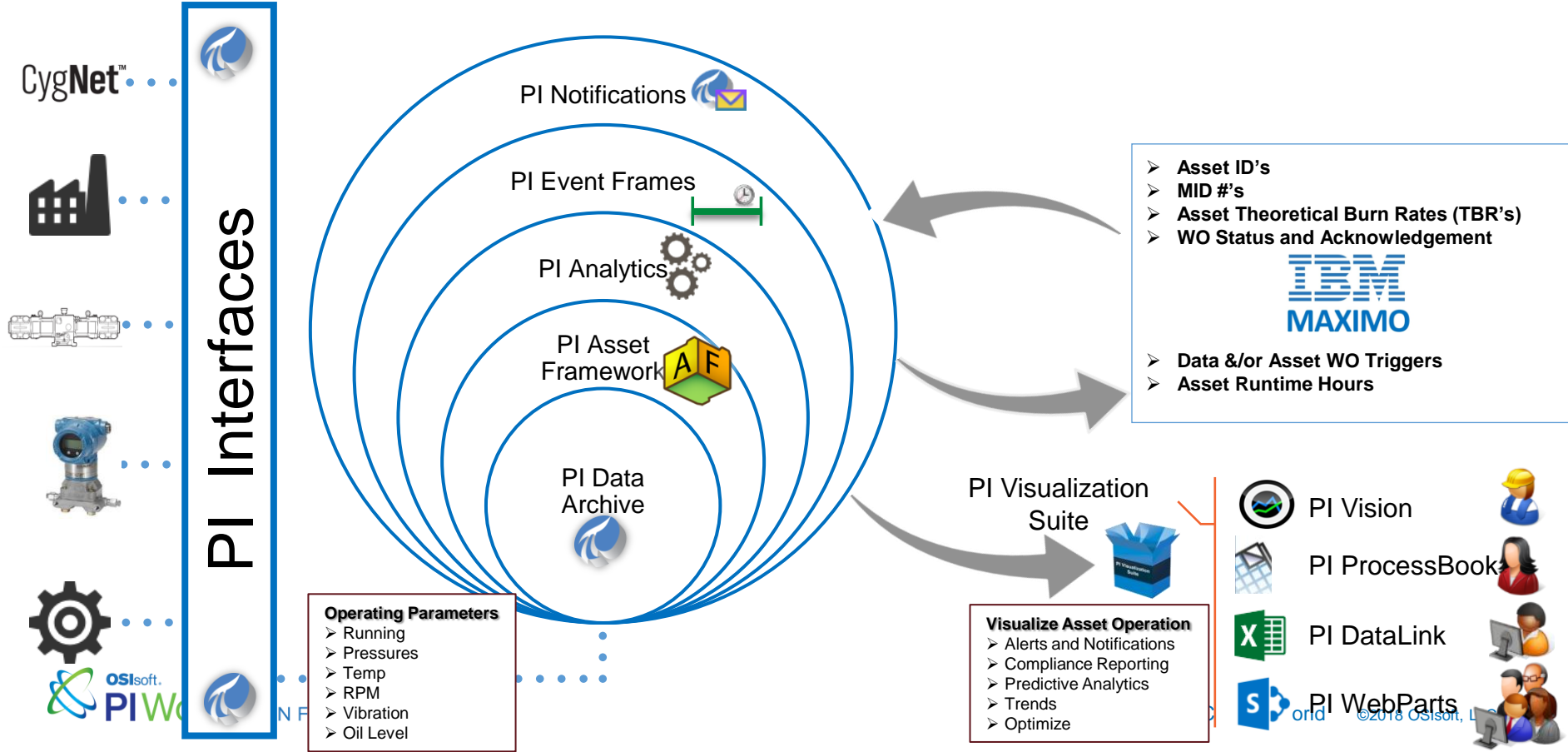
Next Maintenance: 498.7 hr

Next Job Plan: JP1446

In Service Date: 9/5/2014 4:15:30 AM

Estimated Next Service Date: 4/30/2018 12:16:00 PM

EQT PI Preventive Maintenance / Work Management Data Flow and Infrastructure Diagram





Where energy meets innovation.

Case Studies and Benefits

Identification & Diagnosis of “Bad Actors”

Using PI Analytics & Notifications to Identify & Diagnose Recurring Issues

Case Study: **Engine Load/Speed Control** - Improve Equipment Availability & Reliability

Notification Name	Occurrences in Last 24 Hours	Occurrences in Last Week	Occurrences in Last Month	Occurrences YTD	Date of Last Occurrence	Level
Saturn - Unit 3 - Eng - Speed High Delta Alert	7	64	169	410	10/3/2016 7:26	Level 1
Saturn - Unit 3 - Eng - High Fuel Position % Alert	0	8	11	11	10/1/2016 14:03	Level 1
Saturn - Unit 3 - Comp - Throw High Disch Temp Theo v Actual Alert	0	6	14	275	10/1/2016 21:15	Level 2
Saturn - Unit 3 - Comp - Shutdown Alert	0	4	10	51	9/29/2016 20:15	Level 1
Saturn - Unit 3 - Comp - Low Speed Alert	0	2	4	17	10/1/2016 11:25	Level 3
Saturn - Unit 3 - Eng - Load % Alert	0	1	1	6	9/29/2016 19:08	Level 2

Background

- Frequent Deviations Indicate Underlying Issues
- Identifying & Detecting Correlation of Deviations Improves Effectiveness of Diagnostics
- Prior to PI – Limited Visibility into Assets

Solution

- Leverage PI Analytics to Monitor Critical Parameters
- Develop PI Notifications to Alert & Track Deviations
- Reliability Review of “Bad Actors”

Results

- Reduced Identification & Troubleshooting Time
- Reduce Repeat Shutdowns
- Eliminate Parts Consumption – Replace to Troubleshoot

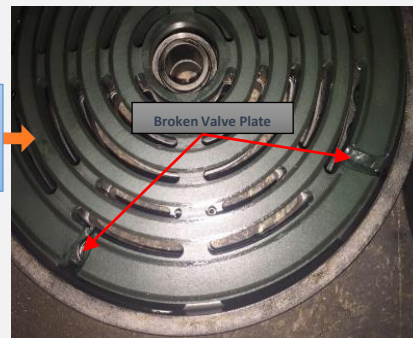
Engineering & Analysis to Maximize Resources

PI Analytics & Notifications to Reduce Field Data Collection Time

Case Study: **Compressor Valve Condition** – Targeted Use of Resources

EQT JUPITER COMPRESSOR DETAILS																			
STATION OVERVIEW		THROW DISCHARGE TEMPERATURE (°F)																	
STATION DASHBOARD		1	1	1	2	2	2	3	3	3	4	4	4	4	4	4	4	4	4
ENGINE OVERVIEW		ACT	PRD	DEV	ACT	PRD	DEV	ACT	PRD	DEV	ACT	PRD	DEV	ACT	PRD	DEV	ACT	PRD	DEV
UNIT #1		155	153		178	185		163	154		172	169		177	182		177	182	
UNIT #2		158	157		190	187		155	157		177	182		177	182		177	182	
UNIT #3		173	147		155	154		155	157		177	182		177	182		177	182	
UNIT #4		163	158		123	122		158	156		190	190		190	190		190	190	
UNIT #5		160	158		124	124		162	158		188	190		188	190		188	190	
DISCHARGE PRESSURE (PSIG)		FIELD UNIT FINAL SUC AMP ERM REC																	
1ST STG		2ND STG	3RD STG	DISCH PRESS (PSIG)	UNIT TEMP (°F)	LOAD STEP	VLV POS (%)	LOAD (%)	AMP (%)	ERM (%)	REC (%)	VLV POS (%)	SPEED (RPM)	PRD (%)	DEV (%)	ACT (%)	PRD (%)	DEV (%)	ACT (%)
UNIT #1		386	631	1053	264	212	106	5	62	100	99	100	1000	100	998	100	998	100	998
UNIT #2		350	594	1053	264	196	101	5	62	100	87	100	998	100	998	100	998	100	998
UNIT #3		378	619	1052	264	217	106	5	59	100	90	100	998	100	998	100	998	100	998
UNIT #4		498	923	1082	338	287	86	12	55	100	79	100	1002	100	1002	100	1002	100	1002
UNIT #5		498	911	1082	338	284	87	12	53	101	79	100	999	100	999	100	999	100	999

High ΔT
(Predicted
vs. Actual)



STATION OVERVIEW		THROW DISCHARGE TEMPERATURE (°F)																	
STATION DASHBOARD		1	1	1	2	2	2	3	3	3	4	4	4	4	4	4	4	4	4
ENGINE OVERVIEW		ACT	PRD	DEV	ACT	PRD	DEV	ACT	PRD	DEV	ACT	PRD	DEV	ACT	PRD	DEV	ACT	PRD	DEV
UNIT #1		155	153		178	185		163	154		172	169		177	182		177	182	
UNIT #2		158	157		190	187		155	157		177	182		177	182		177	182	
UNIT #3		173	147		155	154		155	157		177	182		177	182		177	182	
UNIT #4		163	158		123	122		158	156		190	190		190	190		190	190	
UNIT #5		160	158		124	124		162	158		188	190		188	190		188	190	

Background

- Compressor Valves – High Frequency Failure
- Affect Compressor Performance & Efficiency
- Typically Identified by Equipment Analysts on Weekly/Semi-Weekly Field Analysis
- Equipment Analyst Time Valuable & Limited

Solution

- Leverage PI Analytics to Predict Theoretical Gas Discharge Temperature
- High Deviation in Actual Temp. w/Predicted Indicates Potential Valve Issue
- Condition Based Analysis Vs. Time Based

Results

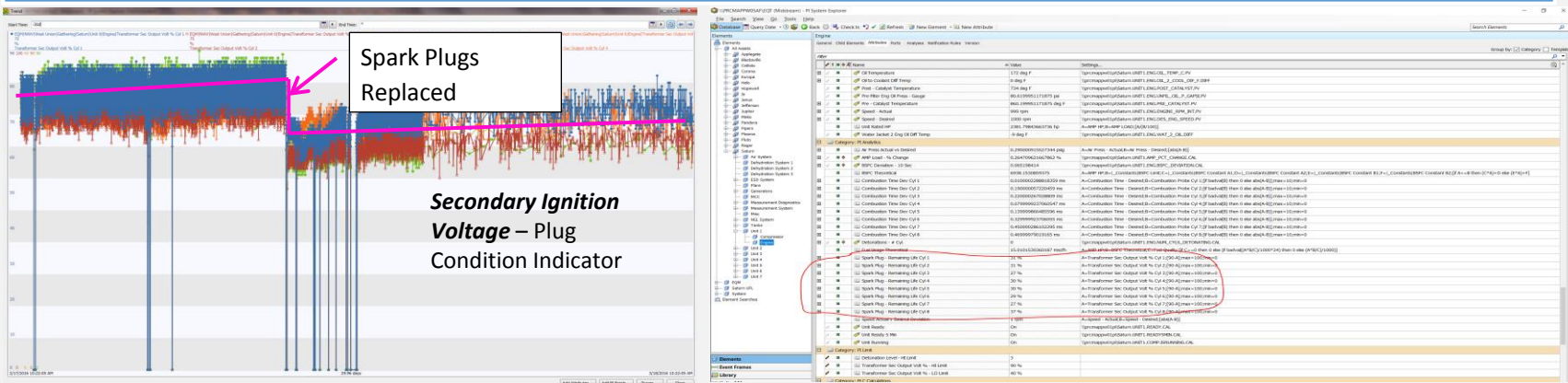
- Reduce Data Collection Time - Equipment Analyst
- Use PI as 1st Tier Approach to Focus Resources
- Repurpose Analyst Time to Other Areas of Condition Monitoring
- Provide Operations With Tools to Detect Issues Prior to Analyst Visit

Data & Trends for Condition Based Maintenance

PI Trends & PI Analytics to Maximize Component Life & Value



Case Study: **Spark Plugs** – Insight into Equipment Condition



Background

- Spark Plug Life Varies by Application/Site
- Secondary Ignition Voltage – Leading Indicator of Plug Condition
- Voltage Increases Slowly as Plug Decays Over Time
- Plugs Represent Challenge with Utilizing Condition Monitoring & Maintenance

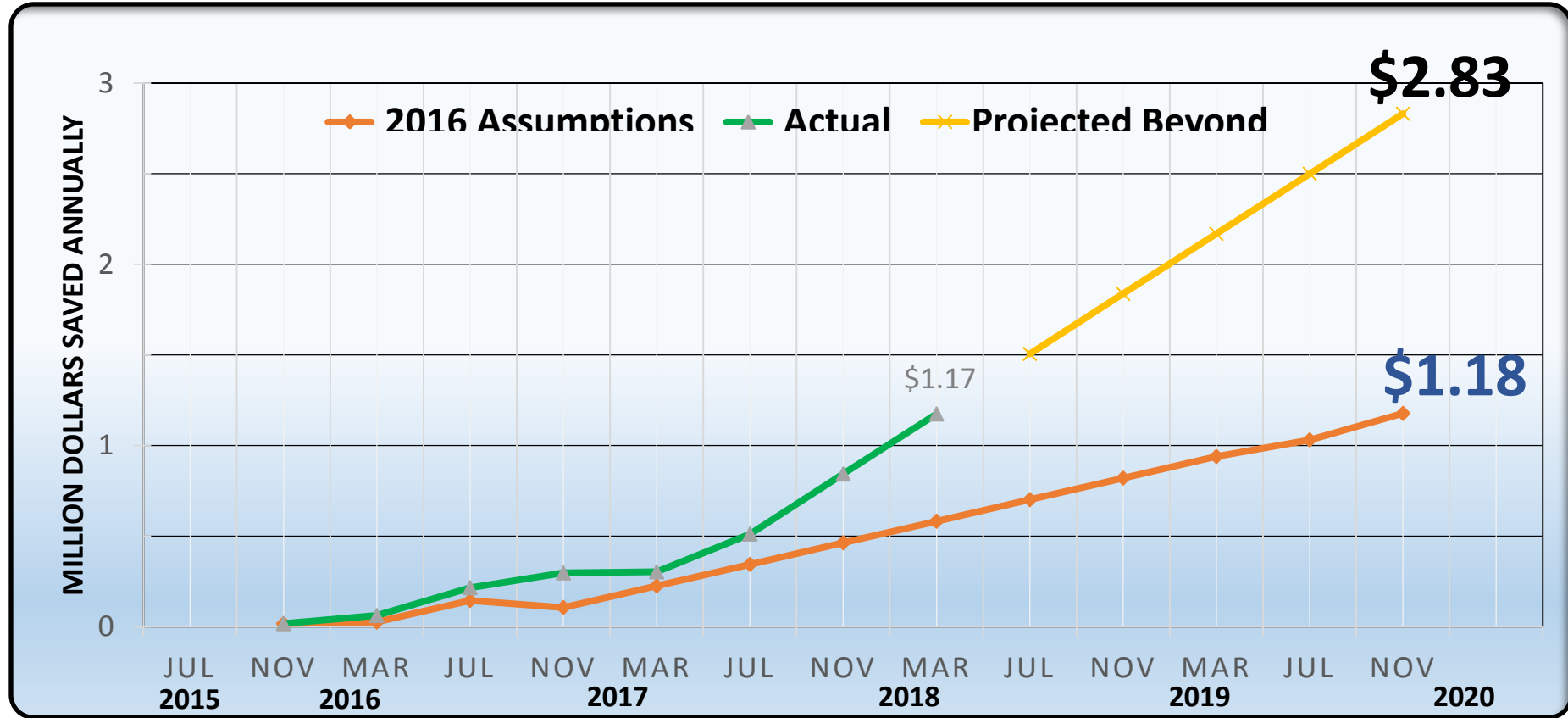
Solution

- Use PI Vision & Notifications to Trend Increase in Leading Indicator Value
- Integrate PI AF & Maximo to Generate WO at Defined Conditions
- Apply Spark Plug Philosophy to Other, Higher Impact Systems

Results

- Reduce Frequency of Spark Plug Changes
- Eliminate Downtime & Cost of Unnecessary Plug Changes
- PI/Maximo Integration – Develop Tracking System for Reliability Analysis
- Foundation to Begin Assessment of Condition Indicators & Application to Overarching Systems

EQT PI ANNUAL TANGIBLE SAVINGS FROM EVENT PREVENTION



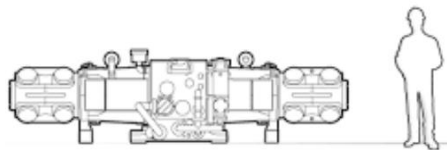


Where energy meets innovation.

Next Steps

JUST DO IT.

Where are We Headed?



Digital
Products

Product
Innovation

Revenue
Improvement



Data
Driven
Services

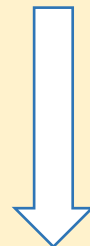
New
Services



Digitally
Enabled
Operations

Operational
Excellence

Cost
Reduction



Digital Transformation

YOU *CAN'T* JUST DO IT.

A Cultural Change: People, Processes, & Technology

A Sustainable PI System Begins With Details

Long Term Vision & Management Support

Support Business Case w/Value

Communicate Strategy

Identify Resources

Utilize PI System as Tool for a Culture Shift

Identify Critical Data & Build Foundation

Data to Support Business Case

Focus on Data Quality & Integrity from Beginning

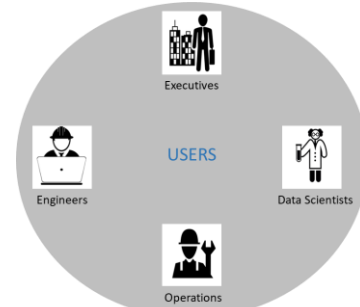
Develop Manageable Scope and Scale Up

Develop AF to Support Long Term Strategy & Sustainability

Communication & Feedback

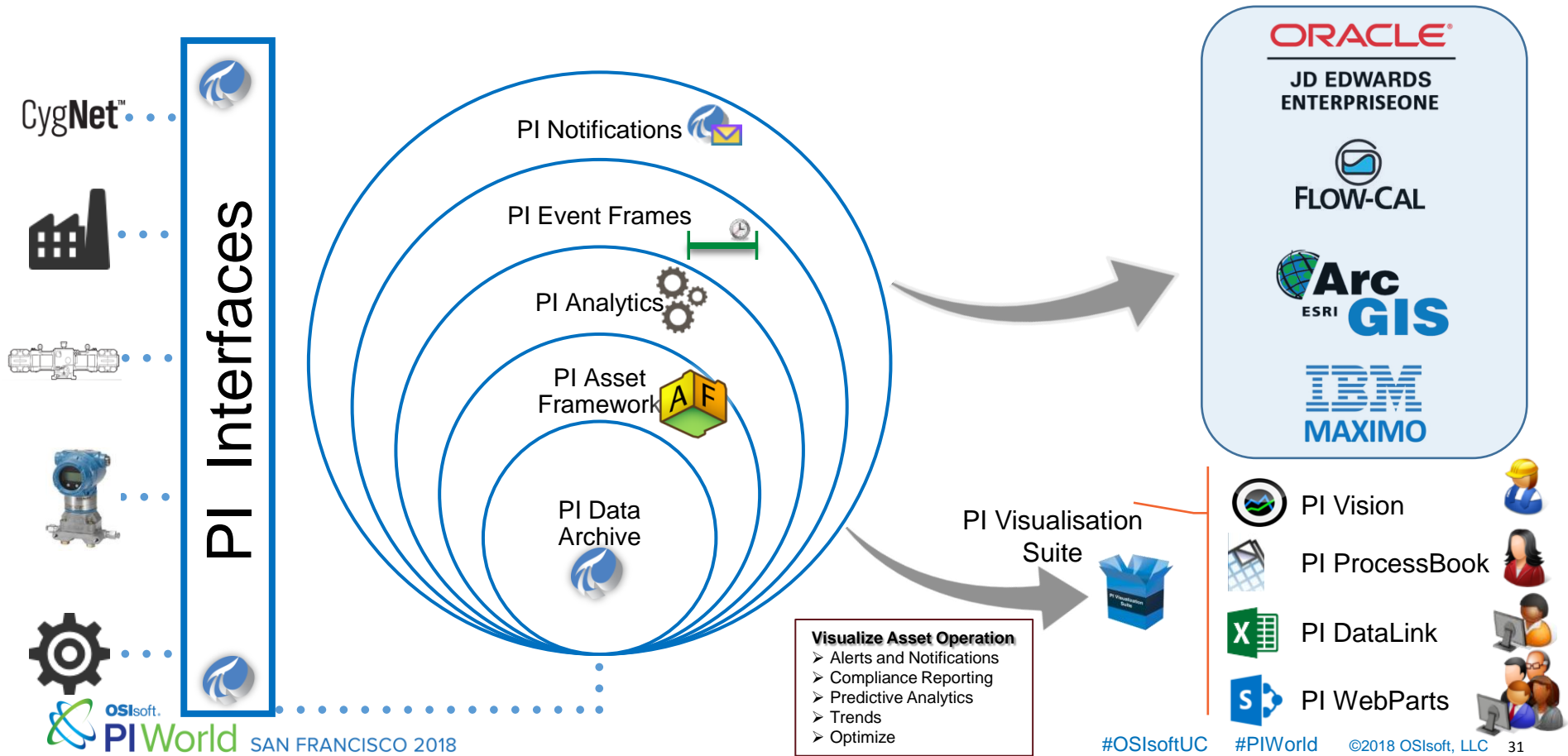
Engage Users in Development

Build Tools & Process with Users in Mind



Feedback Loop for System Improvement & Value

Looking Ahead: EQT Midstream & The PI System



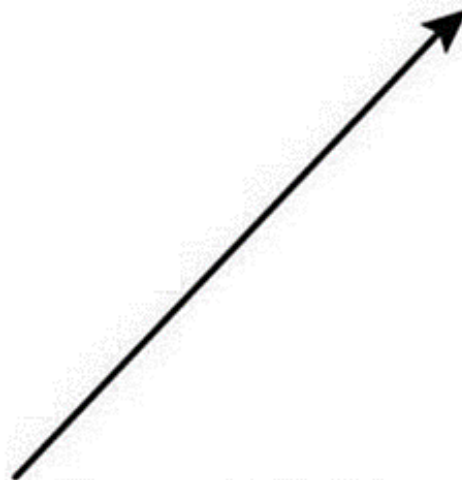
Looking Ahead: EQT Midstream & The PI System

The Next Steps in the Journey Towards Digital Business Transformation

I am learning to trust the journey
even if I don't understand it.

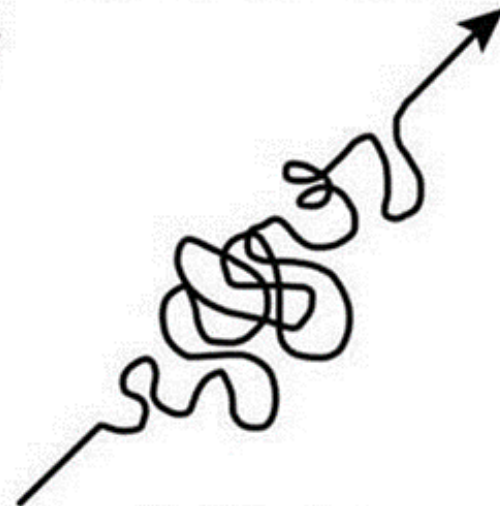


SUCCESS



what people think
it looks like

SUCCESS



what it really
looks like

Enabling Business Transformation with the PI System



Leverage normalized & contextualized OT data to enable a culture of operational excellence and continuous improvement

COMPANY AND GOAL

EQT Midstream provides NG gathering & transmission services. **Desired to transform their business to reduce costs & improve revenue** by supporting a culture of digital enablement and empowerment coupled with work process redesign

CHALLENGE

Desire to leverage digital technology to enable operational excellence to deliver transformative business value

- Maximize Throughput
- Optimize Asset Reliability & Availability
- Lower O&M Costs thru cost effective operations & maintenance
- Improve asset integrity and overall safety and environmental performance

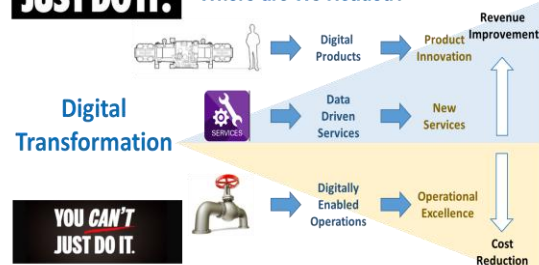
SOLUTION

Selected the PI System as a strategic enterprise OT infrastructure to provide the foundation for our business transformation journey

- Initial POC on a compressor station
- Grow capabilities and awareness of the power of the PI System
- SME enablement and empowerment
- Work process redesign leveraging normalized, contextualized data

JUST DO IT.

Where are We Headed?



RESULTS

An estimated Annual Cumulative Tangible Savings from event prevention was estimated at **\$1M** is now projected to be an annual savings of **\$3M** by 2020.

- Rollout to 40 locations
- Reduced O&M cost, safety and environmental incidents
- PI AF templates enable rapid scale and SME enablement
- Changing culture and work processed – a true transformation



Where energy meets innovation.

EPC Real Time Data

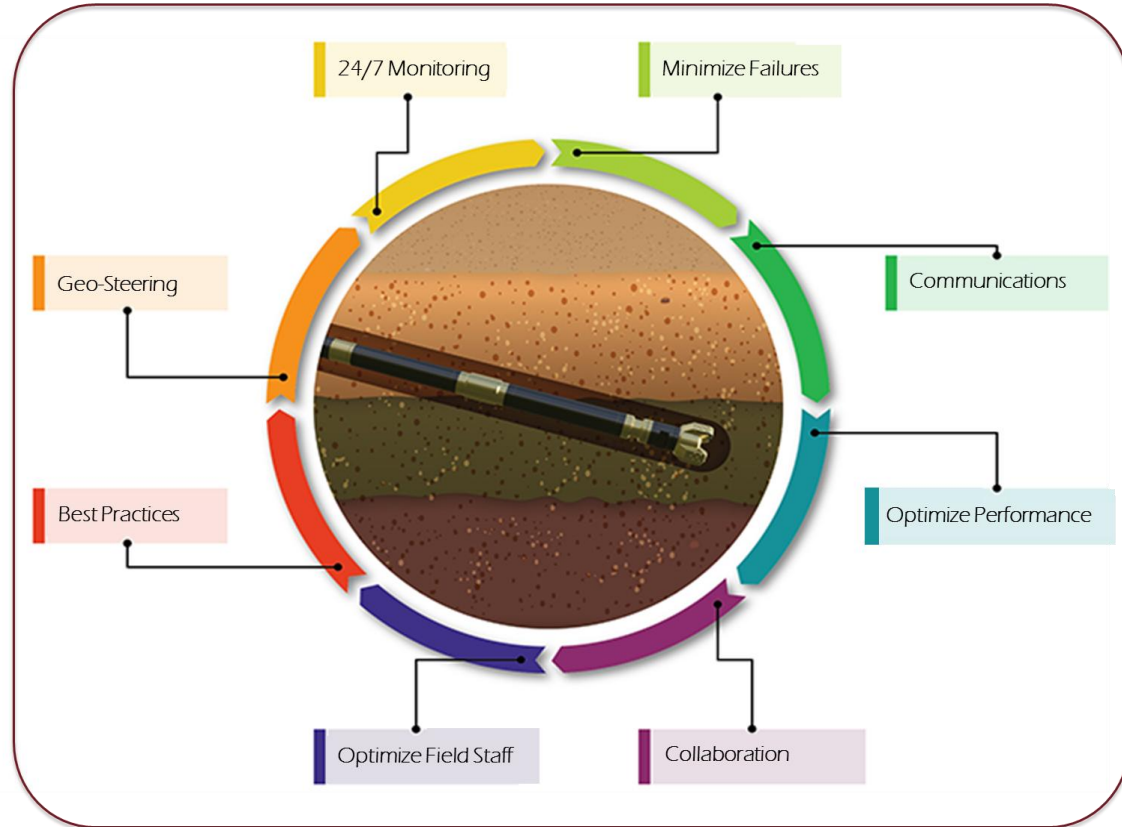
EQT Real Time Operations Center

• RTOC Goals

- Minimize People on Locations
- Optimize Field Resources
- Enhance Collaboration
- Reduce Inefficiencies & Failures
- Improve Consistency
- Maintain Low Costs

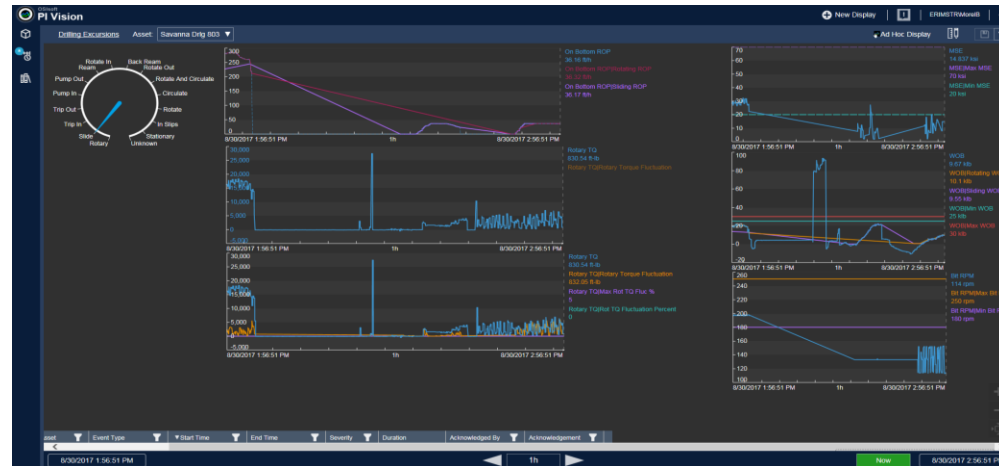
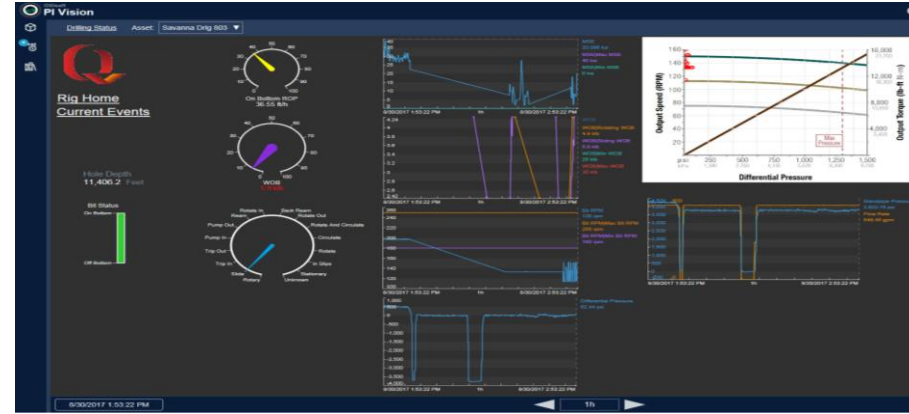
• Upstream Direction

- Drilling
- Completions
- Production
- Logistics
 - Water
 - Construction



Drilling – OSIsoft PI System Trial

- **2016 – Strategy Developed**
 - Focused on resource allocation & data driven decisions
- **2017 – Completed 3 Month Trial**
 - Resources allocated by OSI and Midstream
 - Completed all trial targets
 - Single EQT resource to develop
- **Event Frames - Alerts**
 - Performance Roadmaps
 - Best Practices
 - Trend changes
 - Failure Analysis Feedback Loop
 - Drilling State Analytics
- **Automated Performance Metrics**
 - Footage / ROP details
 - On/Off bottom time



Failure Prediction

- **Torque Fluctuation**

- Bit Failure Occurred
- Surface Measurement
- Target Value Exceeded

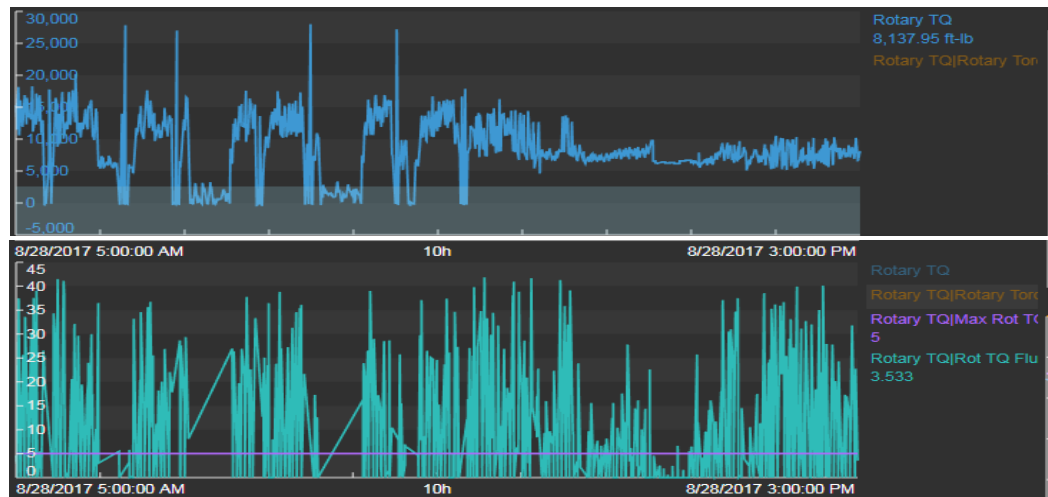
Example 1



- **Alerts**

- RTOC Staff
- Elevated Alerts
- Acknowledge

Example 2



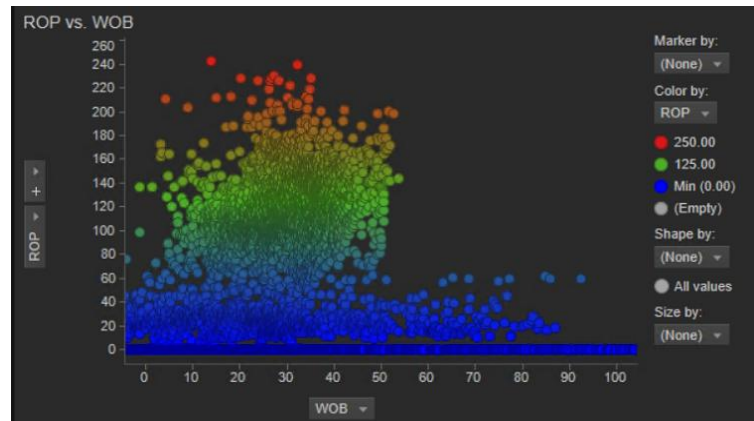
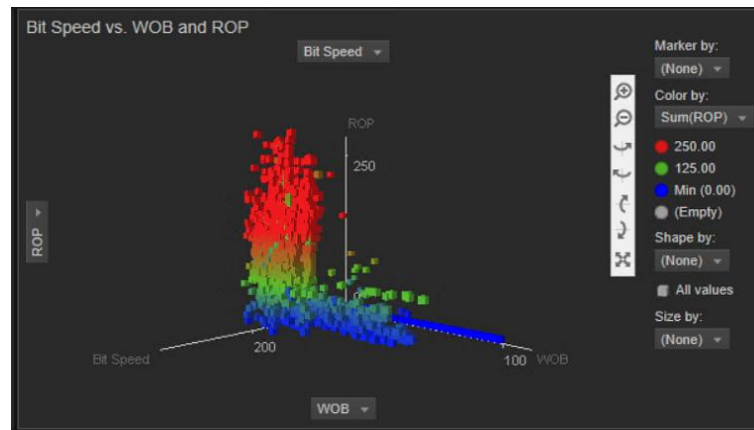
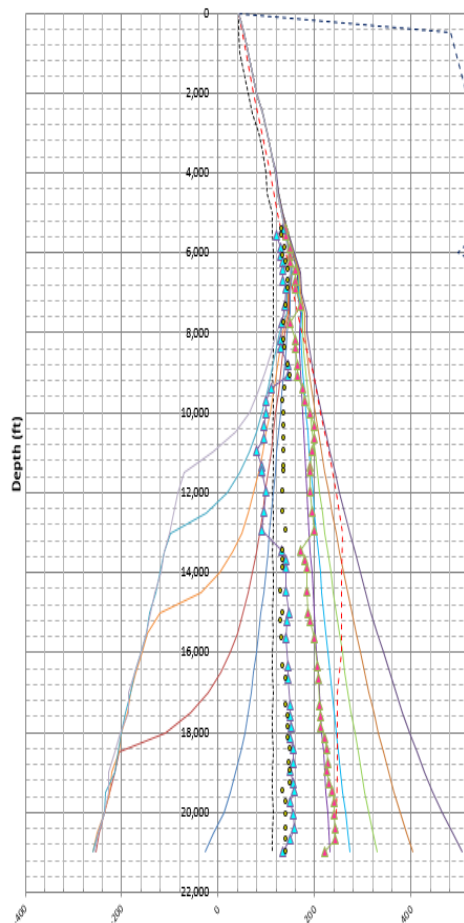
Failure Prevention

Event Name	Asset	Event Type	Start Time	End Time	Severity	Duration	Acknowledged By	Acknowledgement
Torque Excursion Savanna Drlg 803 2017-08-31 04:56:26	SAVANNA DRL G 803	Torque Excursion	8/31/2017 4:56:26 AM	8/31/2017 5:17:59 AM	Warning	21m 33s		Acknowledge
Rotary RPM Excursion Savanna Drlg 803 2017-08-31 04:52:00	SAVANNA DRL G 803	Rotary RPM Excursion	8/31/2017 4:52:00 AM	8/31/2017 5:18:41 AM	None	26m 40s		Acknowledge
UCS Decrease Savanna Drlg 803 2017-08-31 04:50:59	SAVANNA DRL G 803	UCS Decrease	8/31/2017 4:50:59 AM	8/31/2017 4:56:56 AM	None	5m 56s		Acknowledge



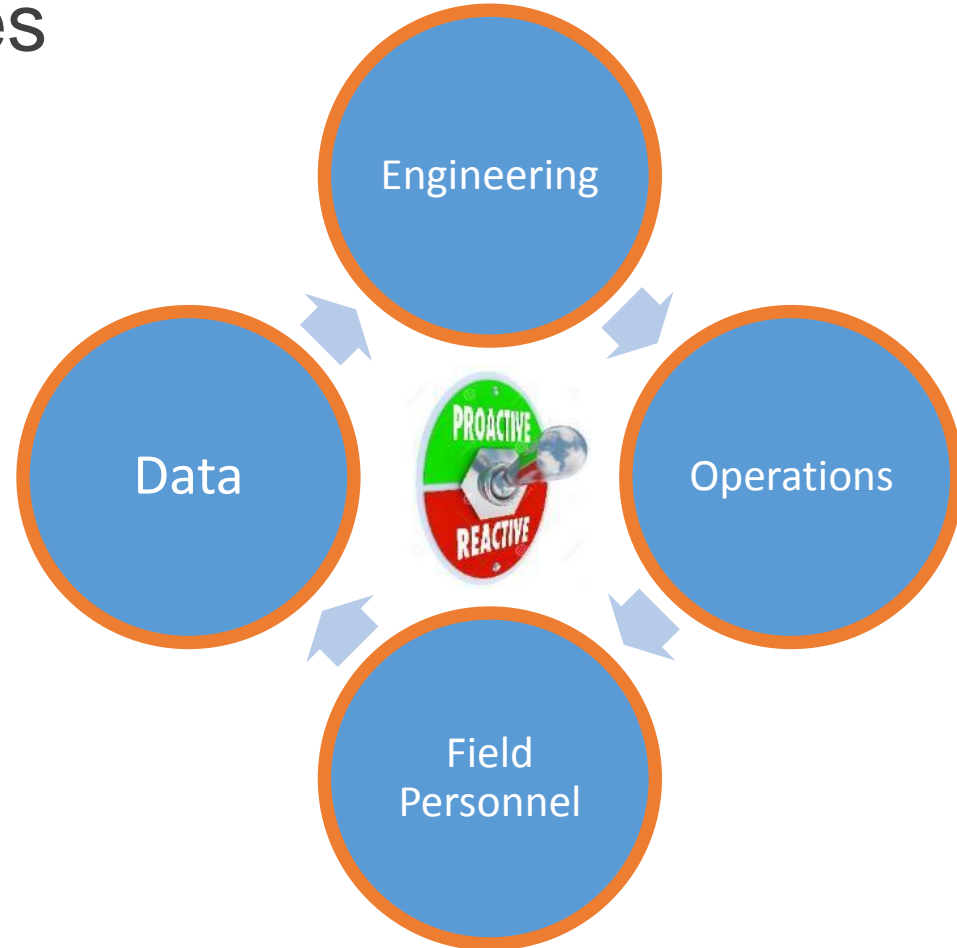
Future Additions

- Optimization Design Tool
 - Roadmaps
 - Inefficiencies
 - RT Parameter Guidance
 - Machine Learning
- Failure Analysis
 - Event Alerts
- Robust Data Connections
- Collision Avoidance
- Automated Drilling Tools
 - Live Performance Metrics
 - Drilling Parameters
 - Real Time Engineering Tool



Organizational Challenges

- **Culture Change**
 - Vendor Buy In
 - Field Personnel
 - Effective Communication Plan
- **Managing Issues**
 - Power / Facility Interruptions
 - Office Distraction
 - Failures / Hole Problems / NPT
- **Data / IT Requirements**
 - 24/7 Office & Field Support
 - New Technology / Architecture Solutions
 - Data Speed / Volume Requirements
 - Data Sources
- **Field Communications**
 - Standardization
 - Reliability
 - Consistency
 - Push / Pull Capabilities
 - Transcripts



Production Engineering & Operations



Historian

- Real time data for existing facilities in Cygnet



Analytics

- Development of alarms that require trending or additional computation out of the traditional high/low bounds
- WMO – Asset tracking and automated work order creation with real time data
- Condition based maintenance

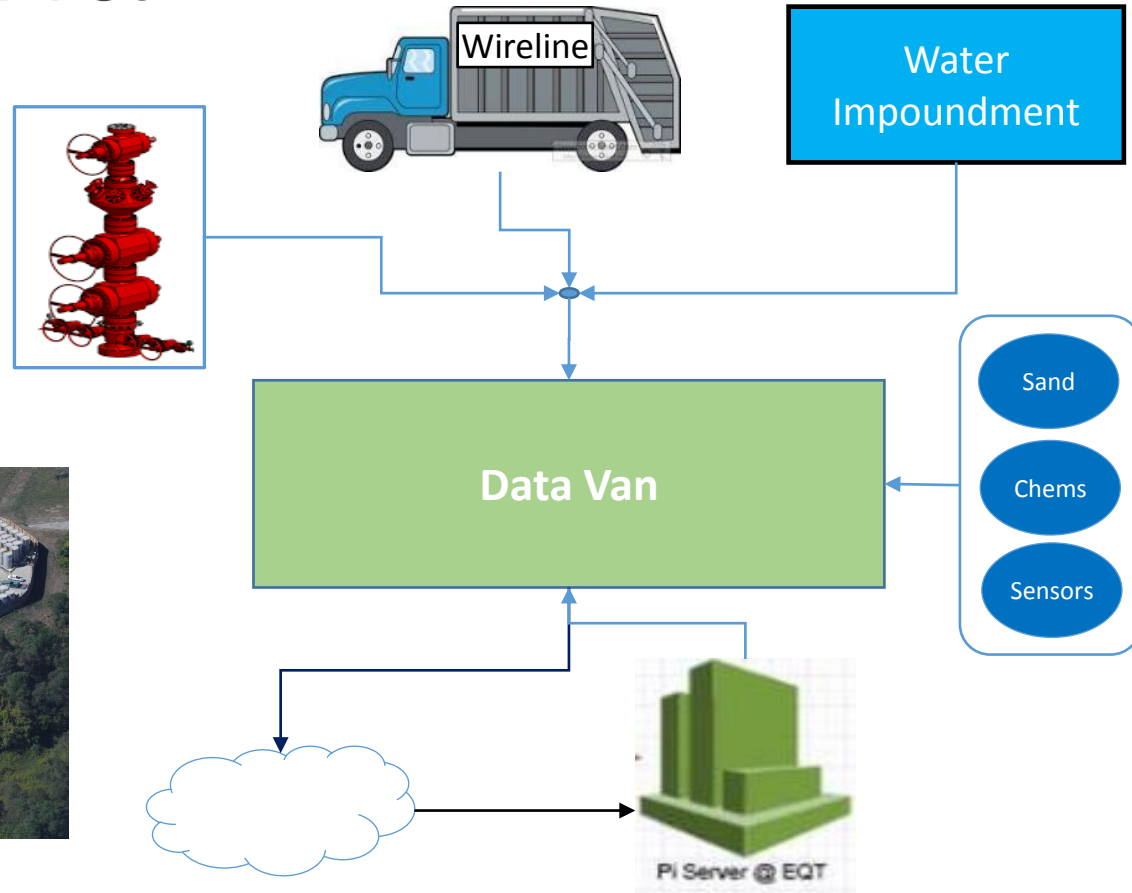


Optimization

- Reduce downtime when utilizing event frames coupled with Maximo data
- Employing Event Frames to automate artificial lift intervention including but not limited to tubing and plungers
- System volume optimization based on current conditions

Completions RTOC Pilot

- Data Collection
- Scoping Details
 - Chemical Optimization
 - Performance Roadmaps
 - Standardization
 - Basic Failure Prediction



Enabling EQT E&P's RT Operations Center with the PI System

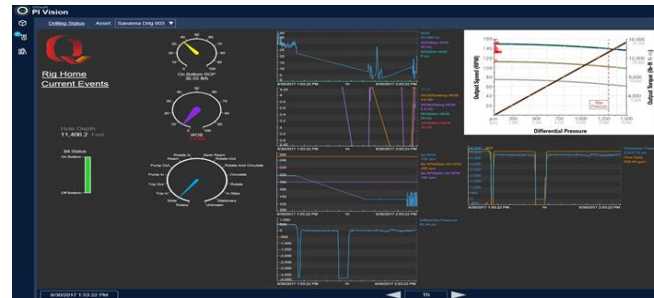
COMPANY AND GOAL



Where energy meets innovation.

Moving from reactive to proactive operations in EQT's E&P to drive transformative business value

Leverage the PI System and partnerships to **maintain and improvement upon low development cost model** through minimizing people on locations, optimize field resources, enhancing collaboration, reducing inefficiencies & failures, and improving consistency, while minimizing EHS and safety incidents.



CHALLENGE

Main challenges in implementing the RT Operations Center and accomplishing the E&P goals included:

- Cultural Change & Alignment
- Management of “issues”
- Data & IT Requirements
- Remote operations communications

SOLUTION

Leveraged the PI System and experience gained in EQT Midstream to expand into the E&P Division

- Conducted POCs in drilling
- Leverage PI AF to support decisions from new EQT Operations Center
- Developed PI AF templates, analytics, event frames, notifications, and PI Vision displays.

RESULTS

Validated the PI System's ability to support drilling and completions with real-time situational awareness, analytics, and decision support.

- Expanding portfolio of drilling functionality
- Expanding into Production & Completions
- Addressing challenges to enable a full use of the Real-time Operations Center

The Evolution of PI at EQT

- **Oscar Smith**
 - osmith@eqt.com
 - Senior Principle Engineer
 - EQT Midstream
- **Brian Morel**
 - bmorel@eqt.com
 - Director Drilling Engineering
 - EQT Production

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**



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Merci

谢谢

Спасибо

Danke

Gracias

Thank You

감사합니다

ありがとう

Grazie

Obrigado

Optional: Click to add a takeaway you
wish the audience to leave with.