Plains Midstream's Journey from Siloed Operational Data to Self-Serve Operational Intelligence at our NGL Facilities

Scott Klassen, PMC & Dapo Badmus, iSolutions

Our Story

- Plains Midstream Canada at a Glance
- Our History with the PI System
- Business Challenge, Solution, Results
- Illustrative Examples and Video
- Perspectives for Consideration
- Where are we going from Here?
- Summary

Plains Midstream Canada at a Glance

- Plains Midstream Canada (PMC) is a Calgary-based, Canadian subsidiary of Plains All American Pipelines (NYSE:PAA)
- Over 1,450 employees
- Crude oil storage and transportation in Canada
- NGL fractionation, storage and transportation in Canada and the U.S.
- PMC has completed over 35 strategic acquisitions since 2001 and associated diverse OT & IT Systems

Strategically Located Assets

PLAINS MIDSTREAM CANADA

Fast Facts

Transportation

- 4,500 KM of crude oil pipeline
- 2,600 KM of NGL pipeline
- 7,000 rail cars
- 800 truck trailers

Processing

- 4 gas processing/straddle plants
- 8 fractionation plants

Storage

- 42 active storage sites
- 5.2 MM BBL of crude storage
- 31 MM BBL of NGL storage

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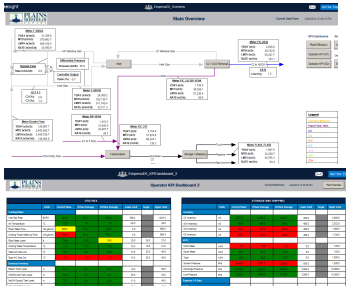
Our Journey with the PI System

Support and enhance model

Deploy across Frac plants

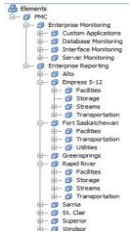
Std Facility KPIs and DBs

Build AF Structure



Legacy PI System Infrastructure

Upgrade Infrastructure



Build Central PI

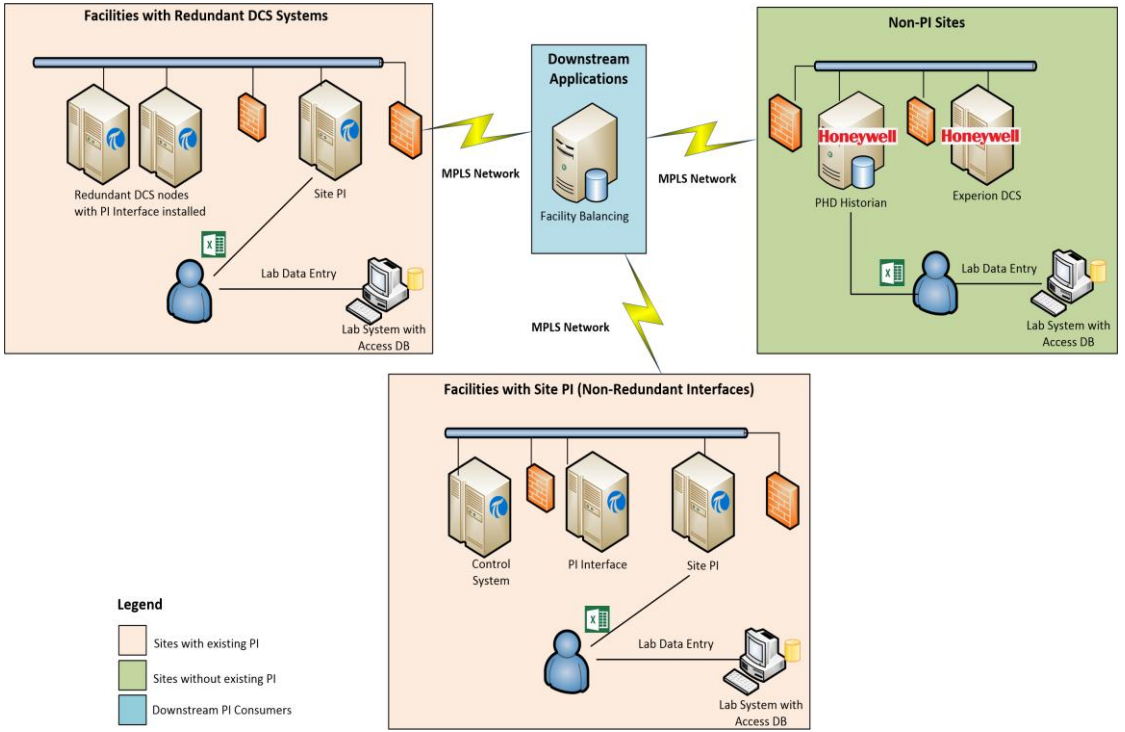
2017

2018

2019

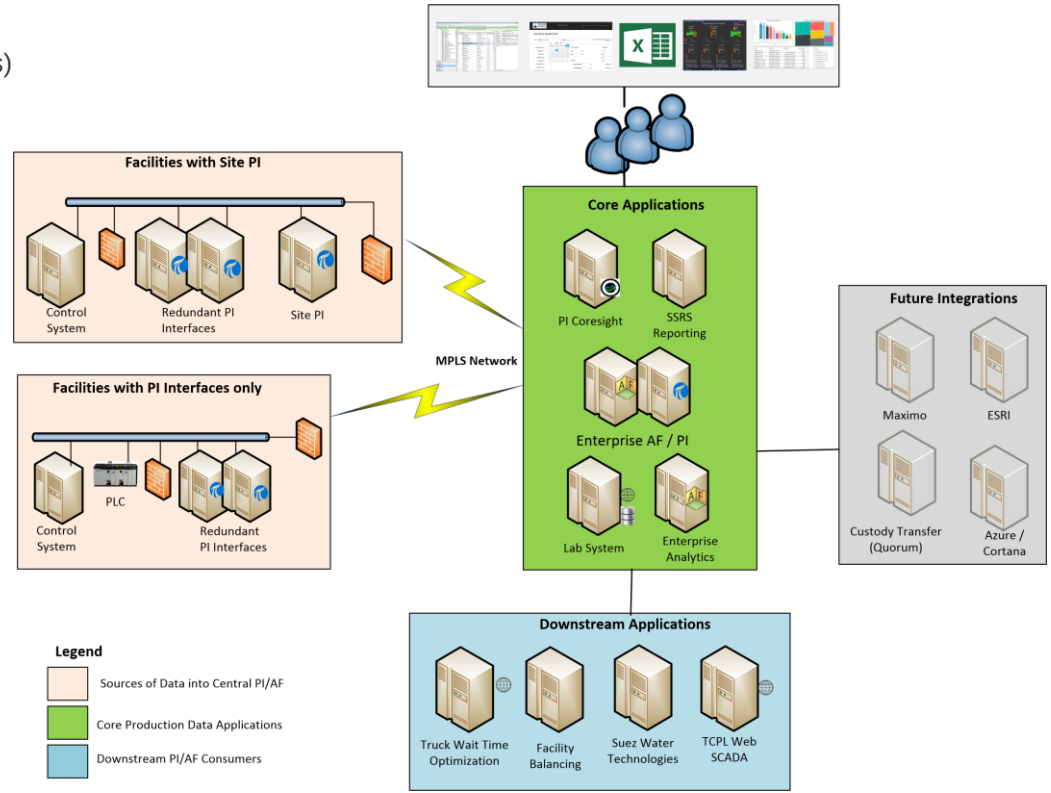
Our Original PI Environment

- **PI System Infrastructure**
  - 5 PI Archives ~75,000 tags
  - 25+ Interfaces with no standards
  - Different PI System versions (including 3.3)
- **Issues:**
  - Lack of information sharing
  - Disparate MS Access databases used by Lab systems
  - Antiquated HW/SW
  - No support / governance model
- **Integrations:**
  - ~2500 tags sent to Facility Balancing
  - Data exchange between PMC sites and TCPL (non standard)

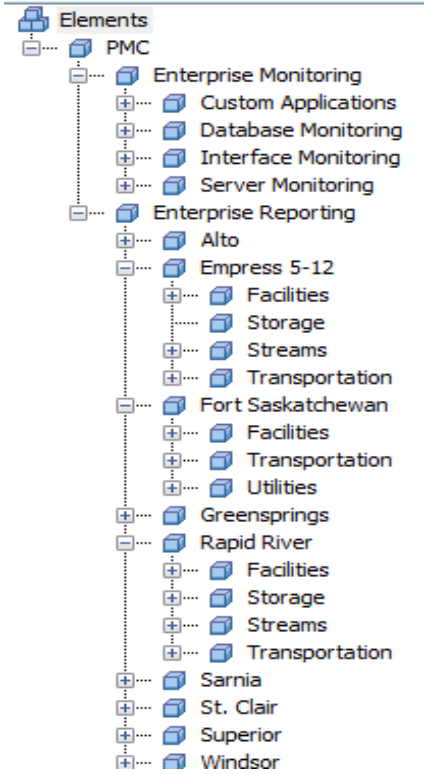


Our Current PI Environment

- **PI System Infrastructure**
  - 4 Site PI Systems and 1 Enterprise PI System (150,000 tags)
  - 30+ interfaces
  - 150 PI AF templates, 1,800 total elements (12x)
  - All site and data available in Enterprise PI System
  - Full replica QA environment setup for system & QA testing
  - Manual data entry for lab streamlined – central database server with web-based UI
- **Reporting:**
  - Subset of operational data modeled in PI AF
  - Centralized reporting from PI AF
  - 80+ reports with raw / calculated data
  - Lab data available via SSRS and PI AF
- **Integrations:**
  - Exports from Central PI System to Facility Balancing
  - Information exchange mechanism with TCPL (standardized)
  - Truck Wait Time Optimization (PI Web API)
  - MS Azure SQL DB with PowerBI reporting

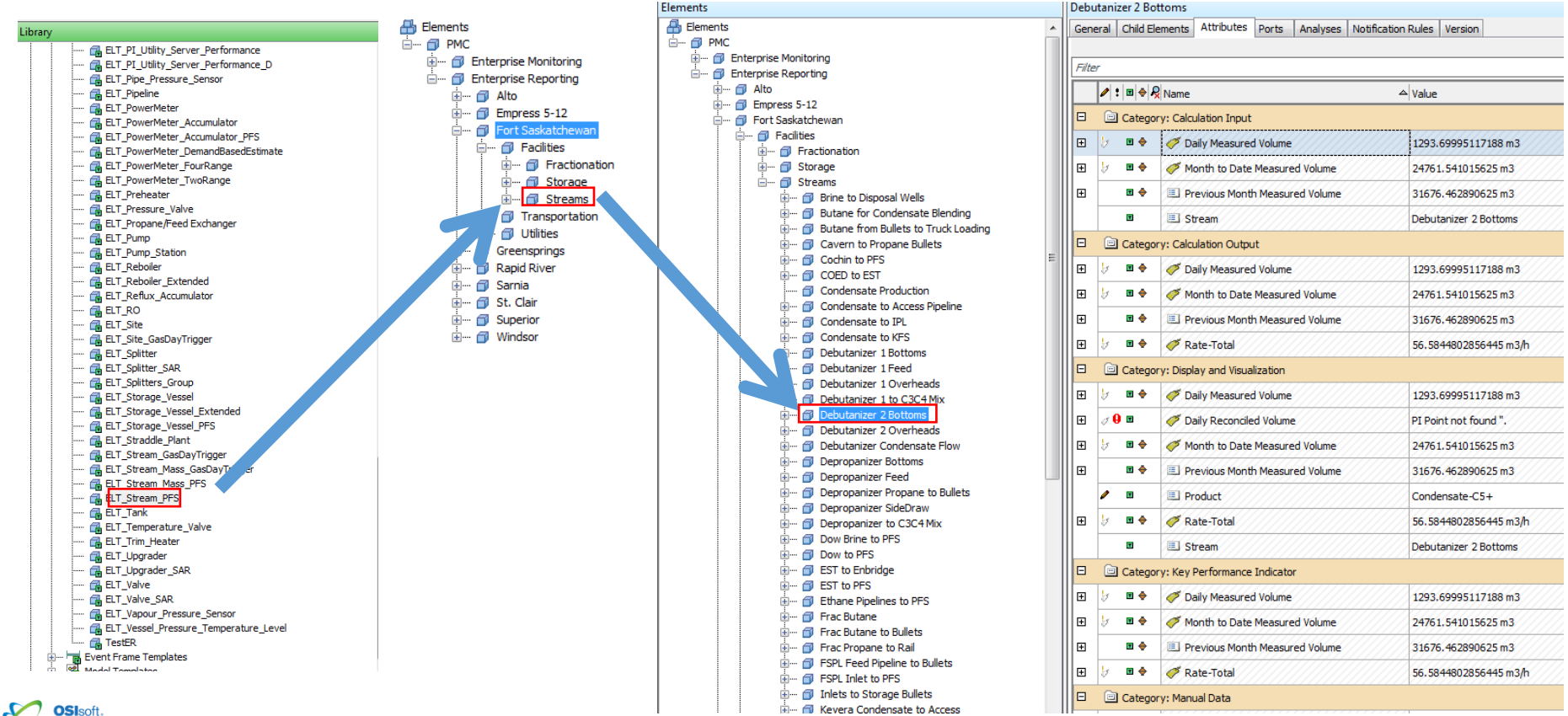


Developing PI AF – The PMC “AF Story”

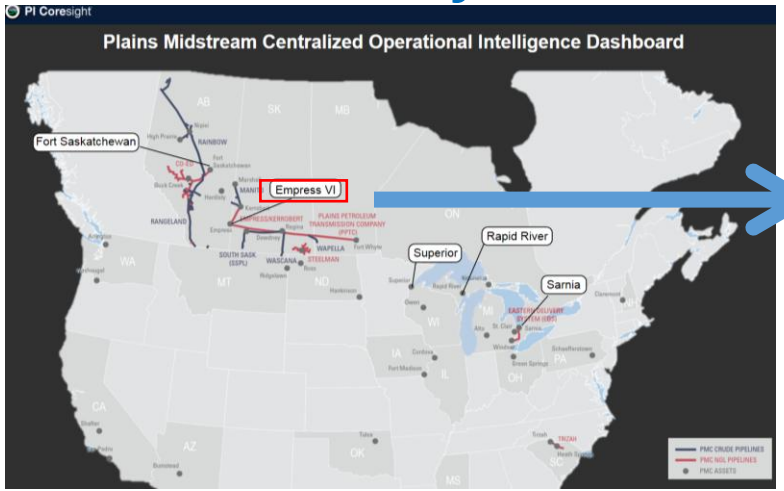


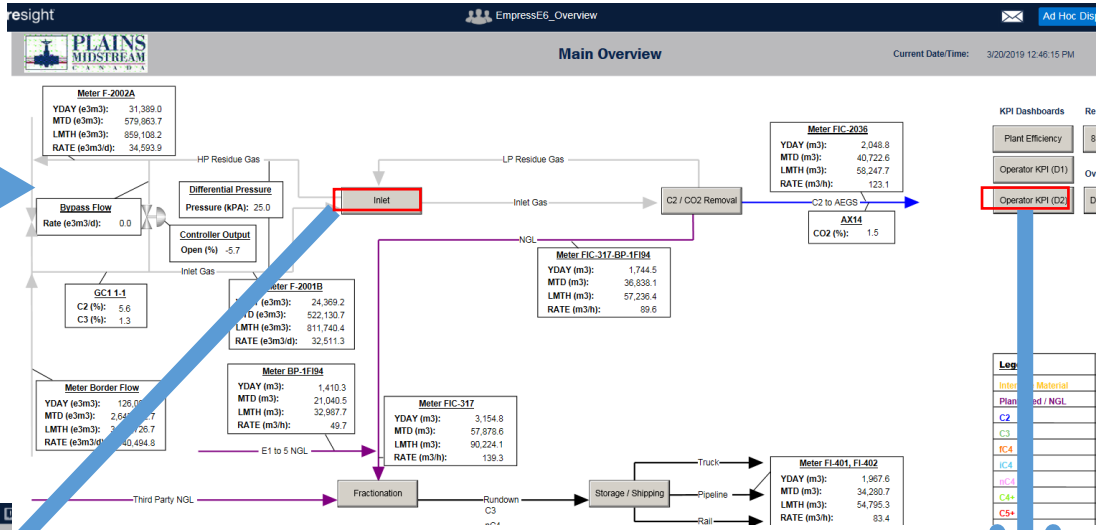
- **Reporting Hierarchy**
  - Project did not have the adequate time to model all assets from an operational view
  - “Fit for purpose” hierarchy that standardizes use of templates to enable cross-site comparisons
  - Hierarchy structure aligned with nomenclature and item types with enterprise GIS system
  - Operational asset view may be completed in the future
- **Monitoring and Notifications**
  - Many components now monitored through PI Notifications that were completely unmonitored before
  - Standard templates used for monitoring not only interfaces and servers but also custom applications
- **Event Frames and Analytics**
  - PI Analytics used heavily to augment real-time data with calculations
  - PI Event Frames used for asset downtime, product inventory & quality tracking and batch monitoring (more info to come)

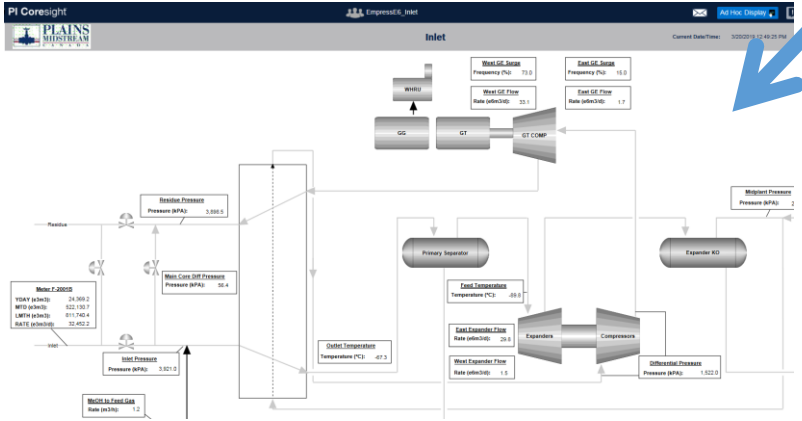
Our PI AF

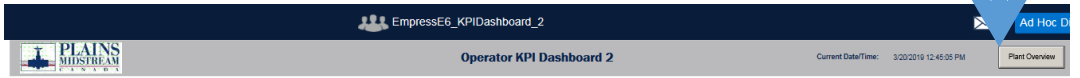


NGL Facility - Dashboard Navigation









UTILITIES

	Units	Current Value	8 Hour Average	24 Hour Average	Lower Limit	Target	Upper Limit
Cooling Water							
Inlet Gas Rate	BCFD	921.4	927.1	920.5	396.2		1,924.4
Air Temperature	°C	13.8	5.6	7.4	-20.0		30.0
River Water Flow	US gal/min	646.0	379.0	480.5	0.0		660.4
Cooling Tower Make Up Flow	US gal/min	704.9	454.6	459.1	0.0		660.4
Raw Water Level	ft	34.4	34.5	35.5	30.0	35.0	37.0
Cooling Water Temperature	°C	17.0	17.5	17.5	15.5	19.0	21.0
West A/C Gas Out	°C	30.5	29.6	29.9	16.5	35.0	40.0
East A/C Gas Out	°C	5.7	2.0	5.3	15.5	35.0	40.0
Chemical Inventory							
Bleach Tank Level	in	61.3	60.1	63.1	18.0		80.0
H2SO4 Acid Tank Level	%	35.0	34.7	35.1	20.0		53.0
NaOH Caustic Tank Level	in	38.2	39.3	39.3	17.0		48.0

STORAGE AND SHIPPING

	Units	Current Value	8 Hour Average	24 Hour Average	Lower Limit	Target	Upper Limit
Inventory							
C3 Inventory	m3	2,077.0	2,048.8	2,015.7	450.0		2,890.0
nC4 Inventory	m3	592.9	556.9	504.3	400.0		2,322.0
iC4 Inventory	m3	142.0	325.4	299.0	400.0		1,590.0
C5 Inventory	m3	125.2	175.2	183.5	400.0		1,729.0
PPTC							
North Meter	m3/h	0.0	0.0	0.0	0.0		105.0
South Meter	m3/h	83.4	83.0	82.0	0.0		105.0
Total	m3/h	83.4	83.0	82.0	0.0		1,056.0
Suction Pressure	kPa	2,056.0	1,967.1	2,035.6	850.0		1,500.0
Discharge Pressure	kPa	6,910.0	6,940.2	6,888.0	3,000.0		12,000.0
Line Pressure	kPa	6,700.0	6,656.0	6,799.2	3,000.0		12,000.0
Empress I-5 Data							

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Batch Monitoring

Using PI AF Analytics, Vision and SSRS to Monitor Batch Data

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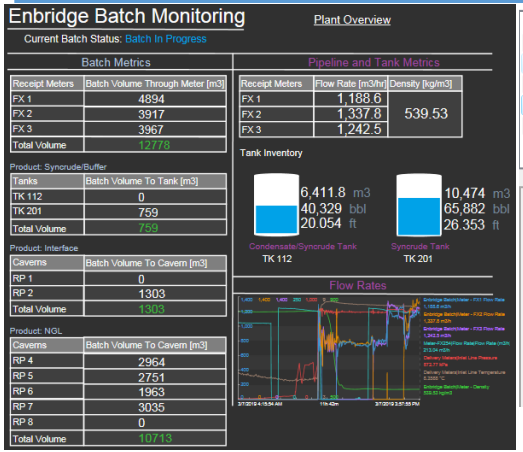
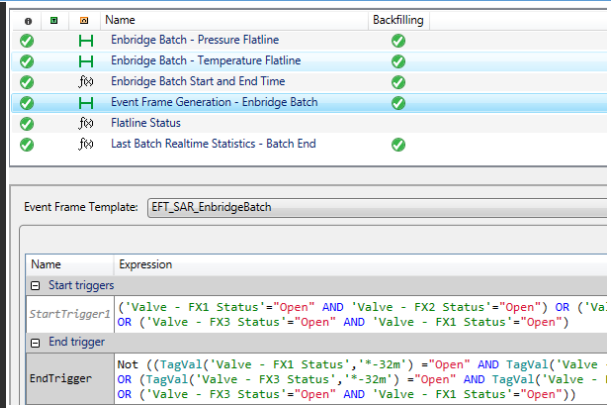
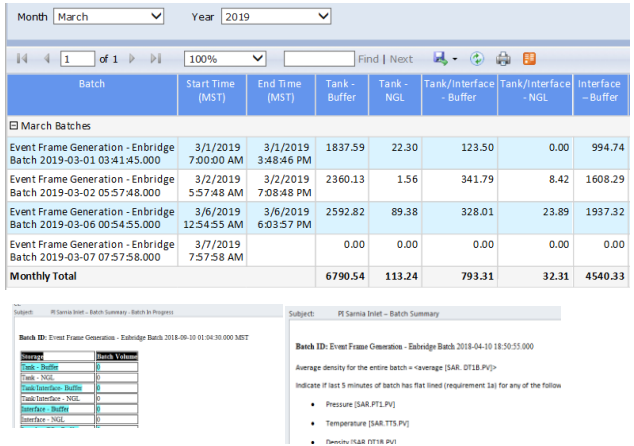
Case Study: Raw Batch Tracking – Accurately account for raw products into feed Caverns







Background

- No timely visibility to raw product batches as its being delivered to the facility leading to loss of revenue and unaccounted volumes at the facility
- Significant effort and time spent by measurement team to account for raw products received
- Data reporting process was time-consuming, manual and error-prone

Solution

- Implemented PI AF and PI Analytics in conjunction with event frames to keep track of batch statistics in real-time
- PI Vision display setup to report live data, along with PI Notification to inform users that batch is in progress
- Developed MS SSRS reports for batch details reporting

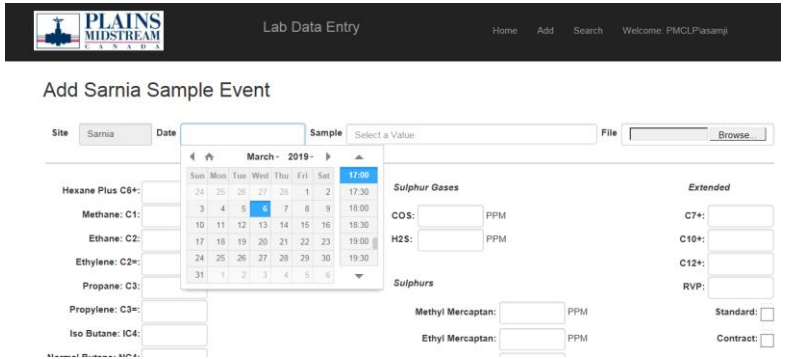
Results

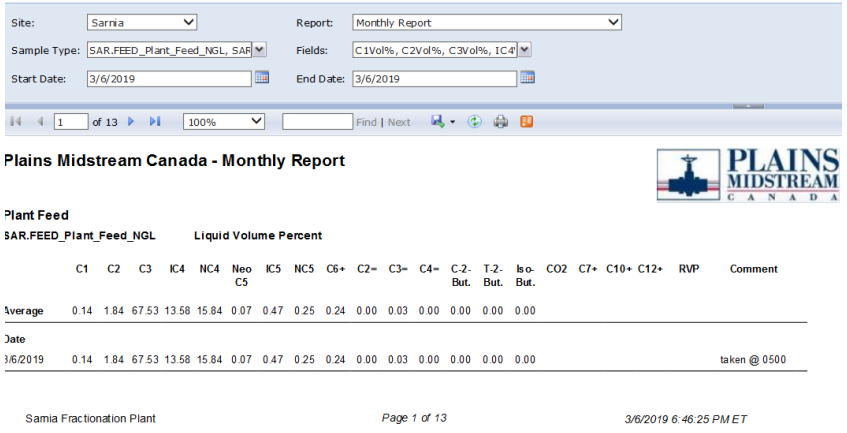
- Enabled proactive monitoring of raw product batches received in real-time
- Reduced effort to track received product volumes
- Provided the ability to linearize / prorate batches into individual components (density)
- Helped the business resolve a dispute with a 3rd provider on Syncrude losses amounting to over 2 million dollars recovery

Lab Manual Data Entry

Centralizing and Exposing Disparate Manual Data through PI Asset Framework

Case Study: Centralization of Lab Sample Data Mgmt. and Reporting through PI AF and SSRS





Background

- Lab data at the Eastern facilities were managed via several disparate MS Access database systems
- Inability to correlate data from lab samples with other operational data
- Each system had dozens of Access Reports
- Data was shared ad-hoc with business users via email (slow process)

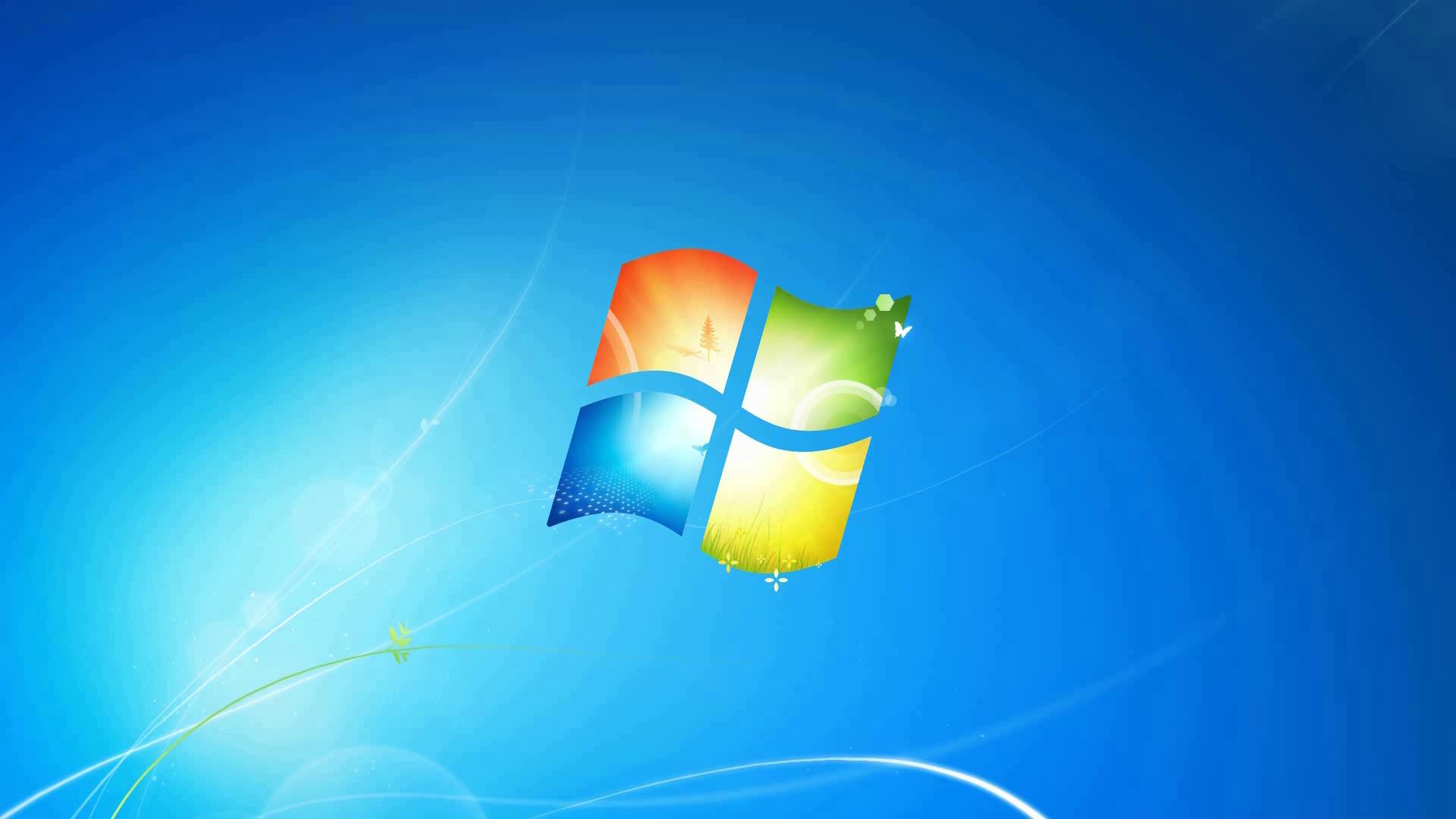
Solution

- Designed RDBMS database to house lab data, as well as data entry UI and SSRS reports
- Developed a PI AF hierarchy to co-mingle Lab data with real-time historian data
- SSRS report combined more than 60 reports into 1 parameterized report
- PI Datalink for self-serve reporting on Lab data

Results

- Reduced recycle / reruns and overall asset performance by correlating real-time data with lab data
- Minimize process upsets due to feed composition monitoring
- Simplified reporting and access to lab data by making it available via PI AF
- Support commercial group against claims related to off-spec product delivery

DEMO



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Enabling Digital Transformation

- Simplifying and modernizing the way we work by taking advantage of technology and automation
- Implementing tools so we spend less time completing transactional activities and more time on meaningful, value-added work
- Making the company more efficient, increasing employee impact and improving our profitability

Food for Thought

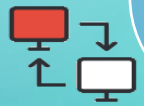
- Think BIG, act small, scale *fast*
- Create vision, build awareness and maintain momentum
- Build an internal PI community for SME knowledge sharing
- Cross functional teams involving IS, Operations & Engineering
- Find the right system integration team

Enabling the Self-Serve Intelligent Organization

Improved communication between field and head office personnel

Improved work prioritization from timely awareness of production impacts

Makes results visible for continuous improvement



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Real-Time Asset Throughput Dashboards

Availability - Asset Uptime Status

- Real-time indicator of whether a production unit is up or down
- Analytics on total downtime over last 60 days
- Analysis on counts and duration of downtime

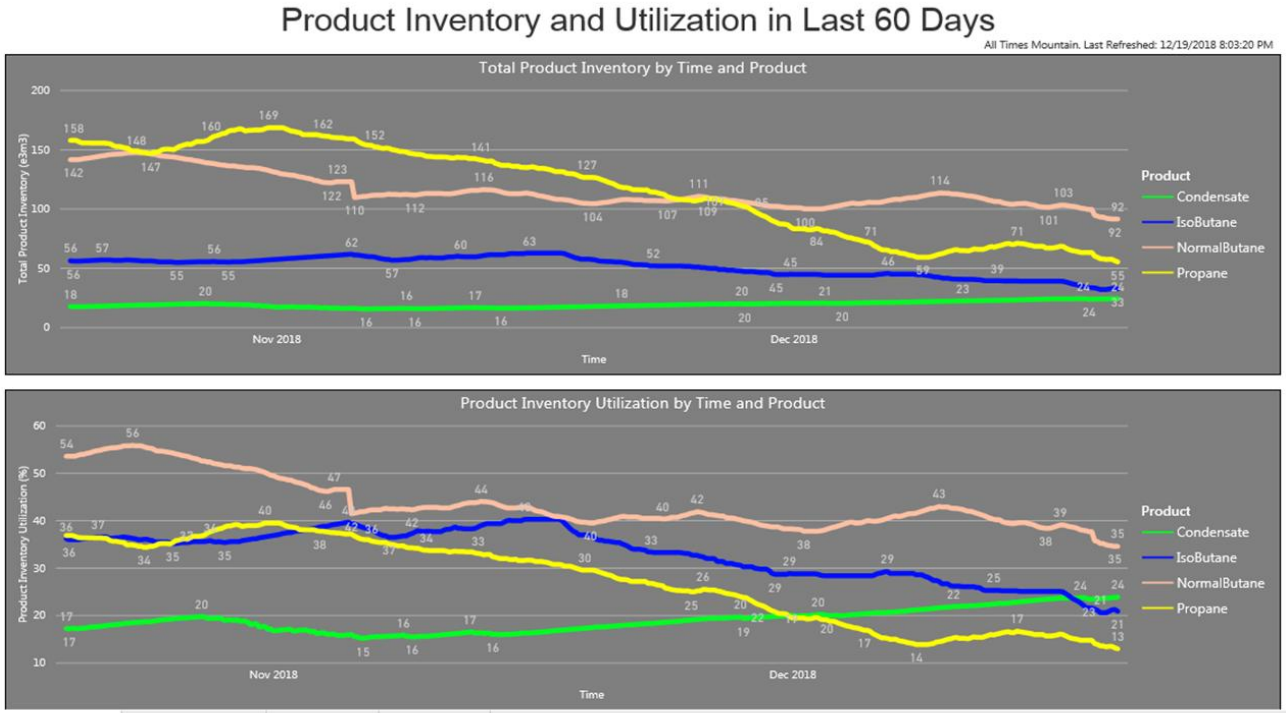
Utilization and Product Inventory

- Analysis of volumes, inflows and outflows to determine capacity utilization
- Leading indicators to determine how many days to tank empty or full based on flow rates

Plant Production Quality

- Occurrence and volume of re-run flows
- Analysis on duration and counts of re-run events

Historical Asset Throughput



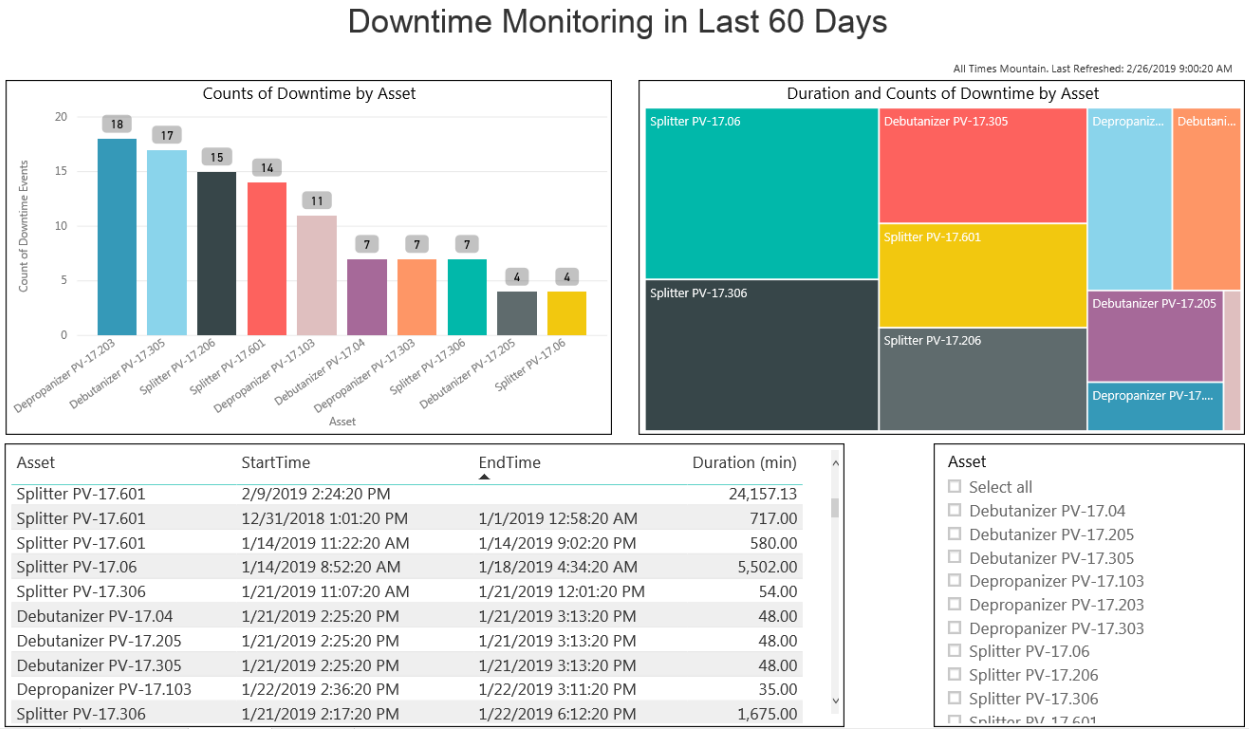
Analytics on total operational production and inventory over last 60 days by finished product

Analysis on volumes, inflows and outflows to determine capacity utilization

Data is captured and calculated in PI AF and sent to Azure

Power BI for self service historical trend analysis

Asset Downtime Monitoring



Asset	StartTime	EndTime	Duration (min)
Splitter PV-17.601	2/9/2019 2:24:20 PM		24,157.13
Splitter PV-17.601	12/31/2018 1:01:20 PM	1/1/2019 12:58:20 AM	717.00
Splitter PV-17.601	1/14/2019 11:22:20 AM	1/14/2019 9:02:20 PM	580.00
Splitter PV-17.06	1/14/2019 8:52:20 AM	1/18/2019 4:34:20 AM	5,502.00
Splitter PV-17.306	1/21/2019 11:07:20 AM	1/21/2019 12:01:20 PM	54.00
Debutanizer PV-17.04	1/21/2019 2:25:20 PM	1/21/2019 3:13:20 PM	48.00
Debutanizer PV-17.205	1/21/2019 2:25:20 PM	1/21/2019 3:13:20 PM	48.00
Debutanizer PV-17.305	1/21/2019 2:25:20 PM	1/21/2019 3:13:20 PM	48.00
Depropanizer PV-17.103	1/22/2019 2:36:20 PM	1/22/2019 3:11:20 PM	35.00
Splitter PV-17.306	1/21/2019 2:17:20 PM	1/22/2019 6:12:20 PM	1,675.00

Asset
- Select all
- Debutanizer PV-17.04
- Debutanizer PV-17.205
- Debutanizer PV-17.305
- Depropanizer PV-17.103
- Depropanizer PV-17.203
- Depropanizer PV-17.303
- Splitter PV-17.06
- Splitter PV-17.206
- Splitter PV-17.306

Analytics on total downtime over last 60 days

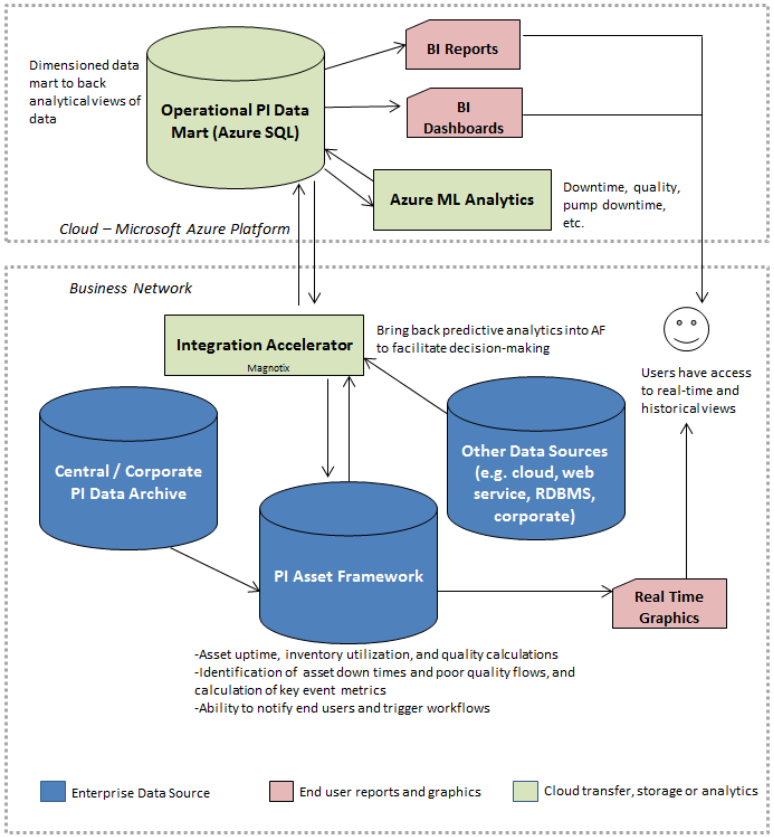
Analysis on counts and duration of downtime

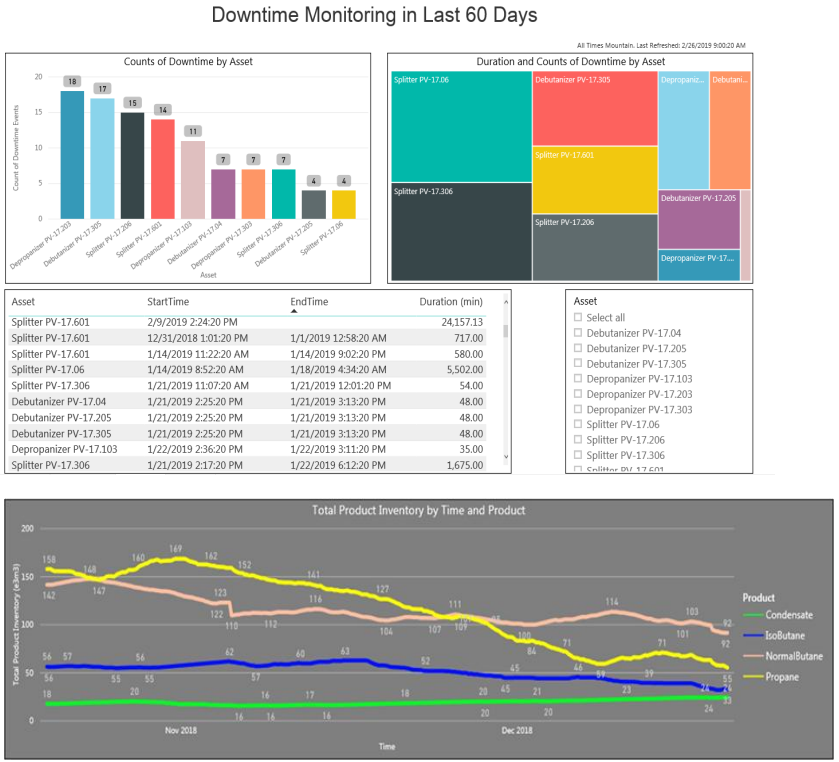
Downtime events are captured by PI Event Frames

Events are sent to Azure and displayed in Power BI for self service analysis of problem assets

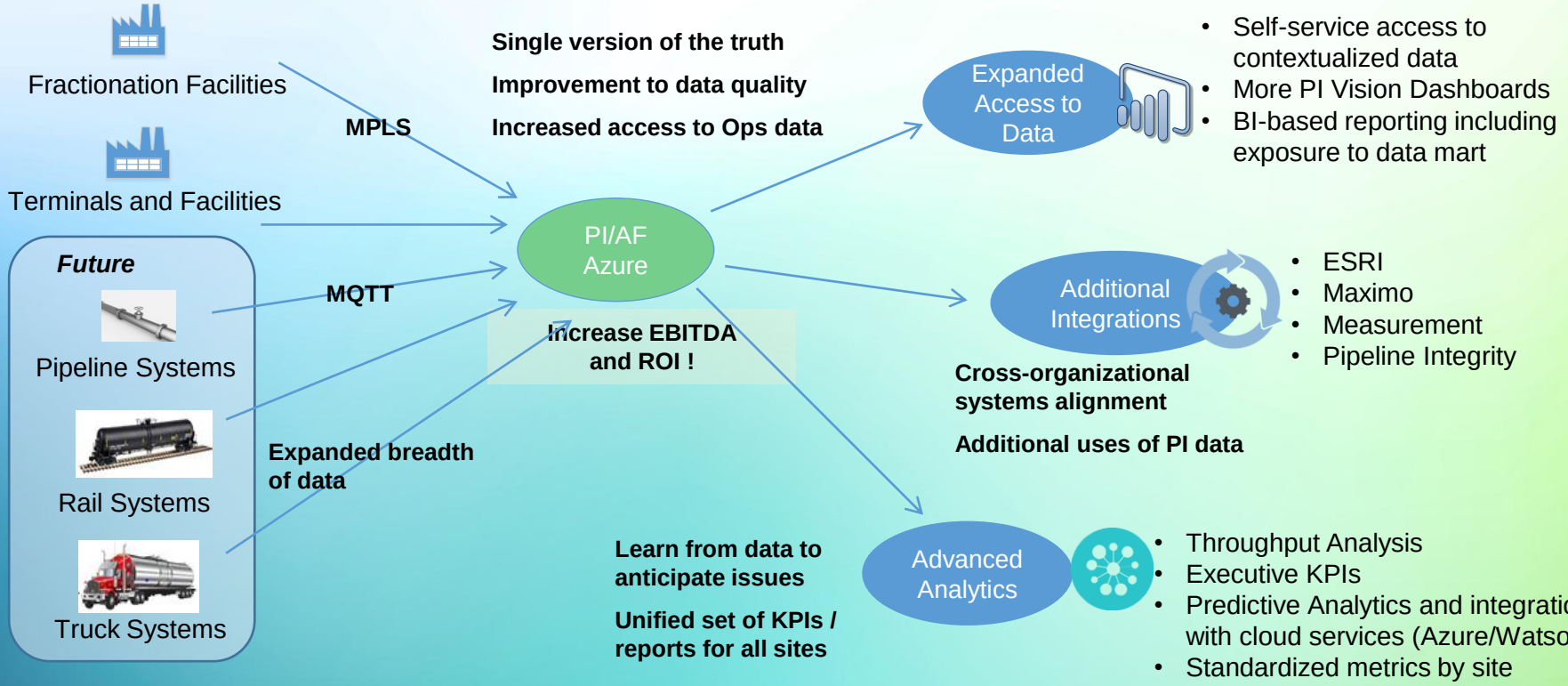
*Limitation: no discrepancy between planned vs unplanned outages

Asset Throughput Pilot – Historical (To-Be)





Future – Getting More from PI



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Plains Midstream Canada

Evolution to Self-Service Access to Contextualized Operational Intelligence

CHALLENGE

Diverse operational systems from 35+ acquired assets including multiple PI Systems

- No tag and asset standardization
- Diverse applications and solutions
- Tag-based, manual, excel culture
- Reactive, inefficient, siloed solutions

SOLUTION

Consolidated and standardized the PI Systems; use as an operational data integration, applications, & analytics infrastructure (OT Data Lake)

- Centralized/HQ PI System
- Standardized AF Structure
- PI Event Frames, PI Notifications, PI Vision
- PI System based applications and solutions with SSRS, ect.

RESULTS

Simplifying and modernizing the way we work to become more efficient and profitable

- Company wide access to contextualized Ops data
- Improved situational awareness
- Increased visibility and accountability
- Automated reporting

Speaker Information

Scott Klassen

Scott.Klassen@plainsmidstream.com

Manager, Operations Service Delivery

Plains Midstream Canada

Dapo Badmus

dbadmus@isolutions.com

Principal Consultant

iSolutions Inc. (Emerson OCC)

Questions?

Please wait for the **microphone**

State your **name & company**

Please remember