

# TransCanada's Journey to Advanced Analytics

Mitchell Browning

Senior Developer, US Realtime Systems

Machine Learning & Analytics Platforms



# Forward-Looking Information and Non-GAAP Measures

This presentation includes certain forward looking information, including future oriented financial information or financial outlook, which is intended to help current and potential investors understand management's assessment of our future plans and financial outlook, and our future prospects overall. Statements that are forward-looking are based on certain assumptions and on what we know and expect today and generally include words like anticipate, expect, believe, may, will, should, estimate or other similar words.

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# Agenda

- TransCanada at a Glance
- Our Journey with the PI System
- Building a Foundation for Data Analytics
- Leveraging our Analytics Foundation
- Evolving to Advanced Analytics with AWS Machine Learning
- Perspectives, Best Practices, & Lessons Learned
- Future of Advanced Analytics at TransCanada

# TransCanada Corporation (TSX/NYSE: TRP)

## One of North America's Largest Natural Gas Pipeline Networks

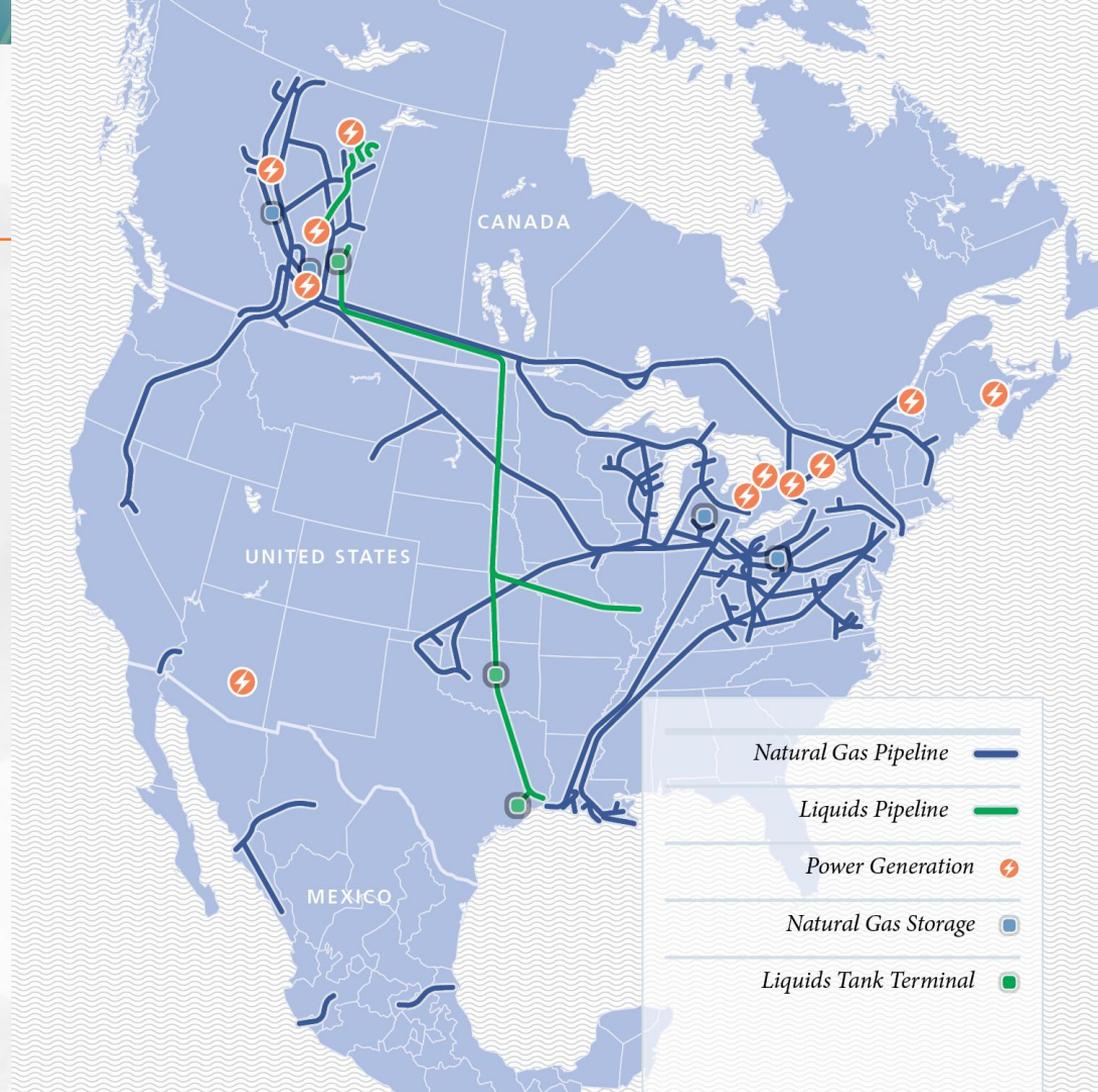
- Operate 91,900 km (57,100 mi.) of pipelines
- Transport ~25 per cent of continental demand
- Over 650 Bcf of gas storage capacity

## One of Canada's Largest Private Sector Power Generators

- 11 power facilities, approximately 6,600 MW
- Low-emissions portfolio includes nuclear and natural gas generation

## Premier Liquids Pipeline System

- 4,900 km (3,000 mi.) of pipelines
- Keystone System transports ~20 per cent of Western Canadian exports
- Safely delivered more than 2 billion barrels of Canadian oil to U.S. markets



# Our Journey with the PI System

1998



PI System Implemented  
Data Archive, ProcessBook, DataLink  
Single Data Source: SCADA

Expanded Data Sources  
IFIX Collecting directly from stations  
Significant increase in users and tags

2008



2010



Increased PI tag cap to meet demand  
Began Enterprise Agreement  
Shift from steady state to growth & learning

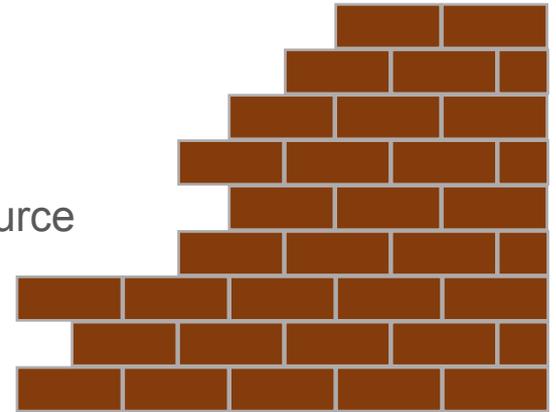
Began custom dashboard development  
Took advantage of AF and Event Frames  
Realized the need to create and train  
statistical models

2016



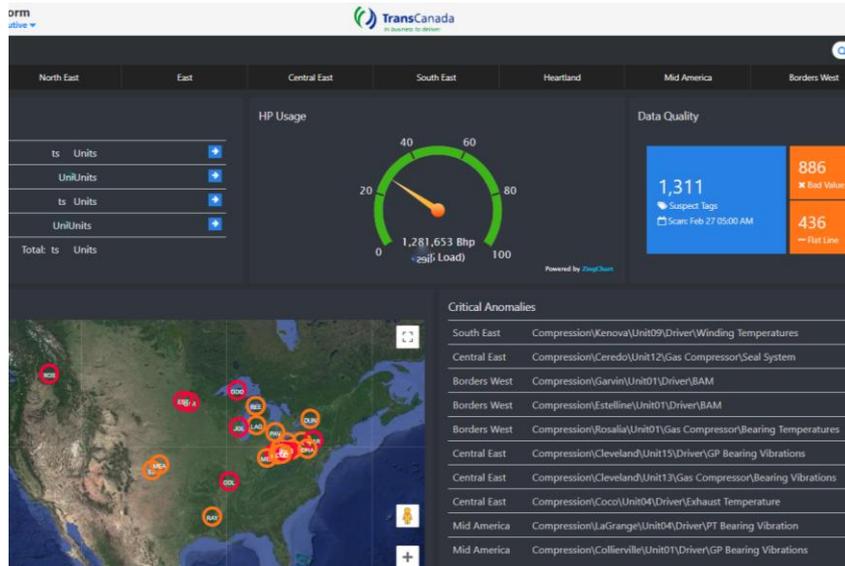
# Building a Foundation for Data Analytics

- **Starting with the Basics**
  - Data Culture
  - OT Analytics
  - Self Serve, Human Analytics
- **Understanding Data *as an Asset***
  - The world's most valuable resource
  - Create “pipelines” to collect, store and utilize that resource
  - Take advantage of AF, Vision to create value
- **Building Cross-functional Teams**
  - Subject Matter Experts
  - Engineers and Data Scientists

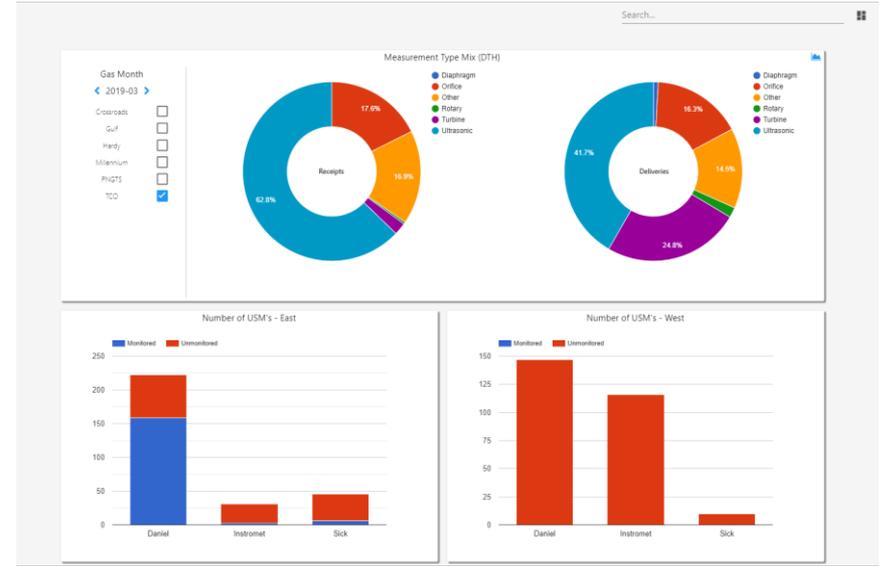


# Leveraging our Analytics Foundation

## Reliability Analysis Platform

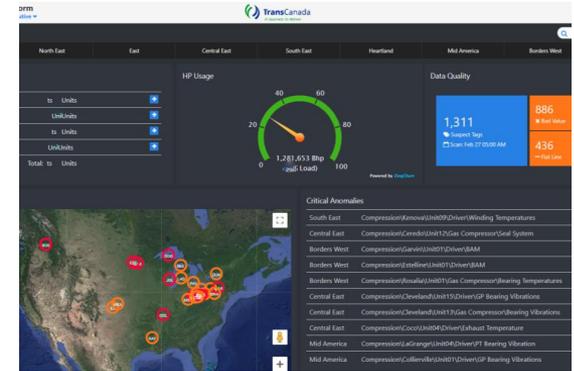


## Measurement Insights & Analytics



# TransCanada

## RELIABILITY ANALYSIS PLATFORM



### CHALLENGE

Manage and take action on anomalies identified by AF analyses and document findings

- Prioritization of anomalies
- Anomaly Management
- Take advantage of statistical models
- Document Findings
- Improve asset implementation time in AF

### SOLUTION

Redesign AF using modular approach and develop a custom platform to augment PI Asset Framework

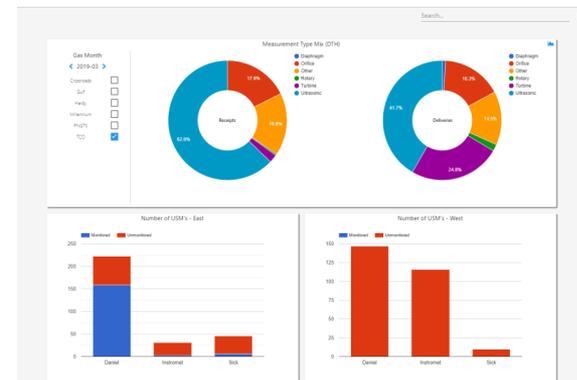
- Modular AF redesign
- Developed web platform to manage anomalies and findings
- Ability to train and retrain statistical models

### RESULTS

- Over 100% increase in findings from AF redesign
- 2018: over 250 corrective actions taken
- Significantly reduced time to implement assets

# TransCanada

## MEASUREMENT INSIGHTS & ANALYTICS



### CHALLENGE

Get more value out of our PI System by expanding beyond Compression assets and into Gas Measurement

- Improve measurement accuracy
- Provide insights into measurement equipment health
- Take advantage of PI Vision

### SOLUTION

Create a new AF structure and asset templates for full measurement system.

- Building existing knowledge into analyses
- Custom event frame and finding management
- Adding new measurement assets into existing Vision platform

### RESULTS

Improved measurement health and problem discovery time significantly reduced.

- Able to more readily pinpoint when problems begin
- Measurement data in PI more easily consumable by business users
- Centralized equipment diagnostic data interpretation

# Evolving to Advanced Analytics with AWS



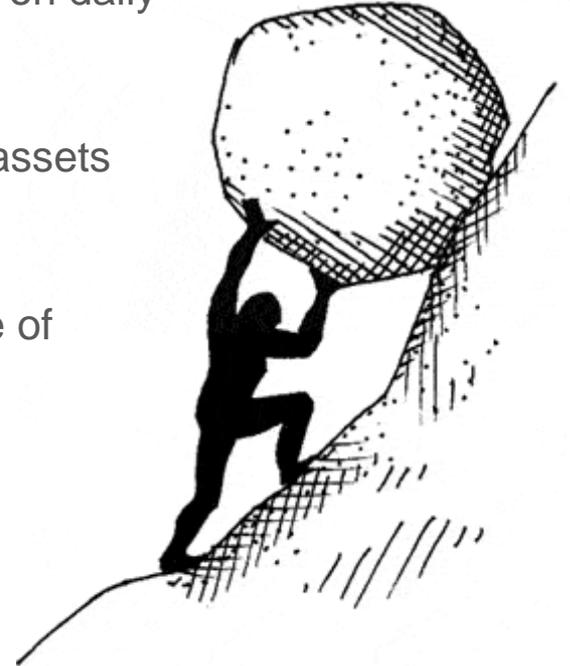
## Gas Day Forecasting

- Challenge
- Objectives
- Navigating the Sea of Data
- Feeding the Machine
- PI Integrator for Business Analytics Demo
- Automating the Demand Forecast
- Consuming the Results
- What else?

# Evolving to Advanced Analytics with AWS

## Challenge

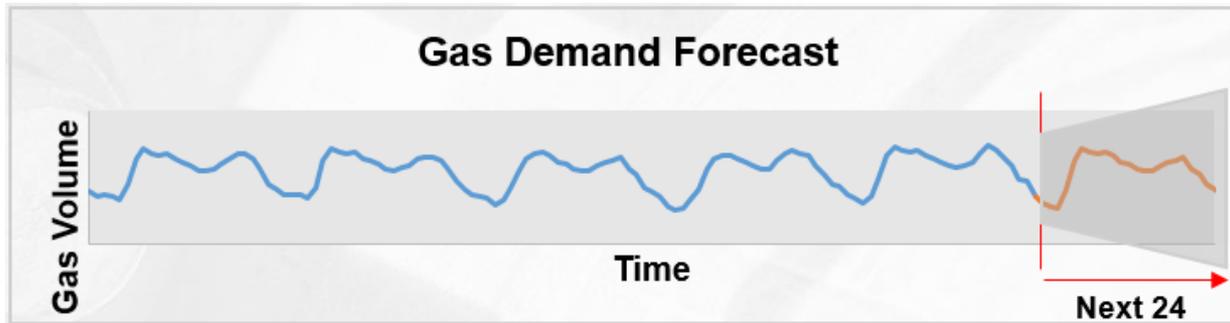
- Commercial operating decisions are currently made based on daily demand forecast.
- More accurate forecasting provides for optimal use of our assets and more flexibility for our customers.
- Current method of forecasting does not take full advantage of historical measurement, weather and load demand data.
- Scalable model to support full system load



# Evolving to Advanced Analytics with AWS

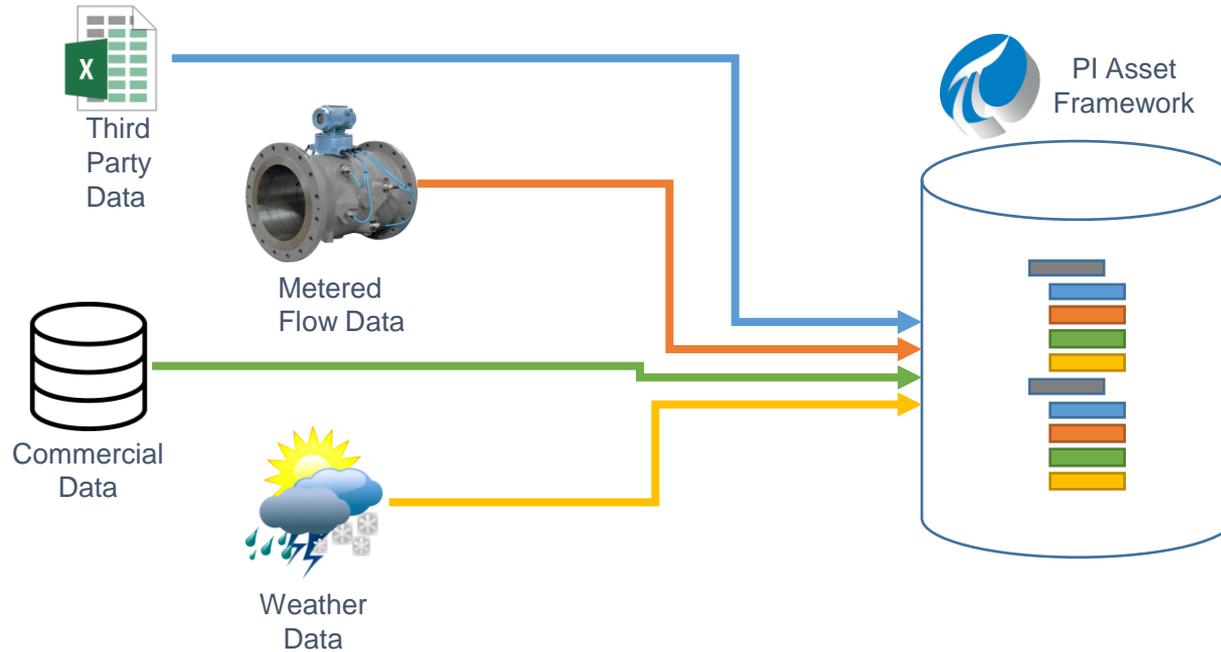
## Objectives

- Fully utilize our data to produce more accurate forecasts by modeling system performance against historic conditions.
- Utilize AWS to minimize up-front investment and on-going costs.
- Leverage key technology partnerships to prove out the concept in rapid fire fashion. Fail Fast, Succeed Faster.



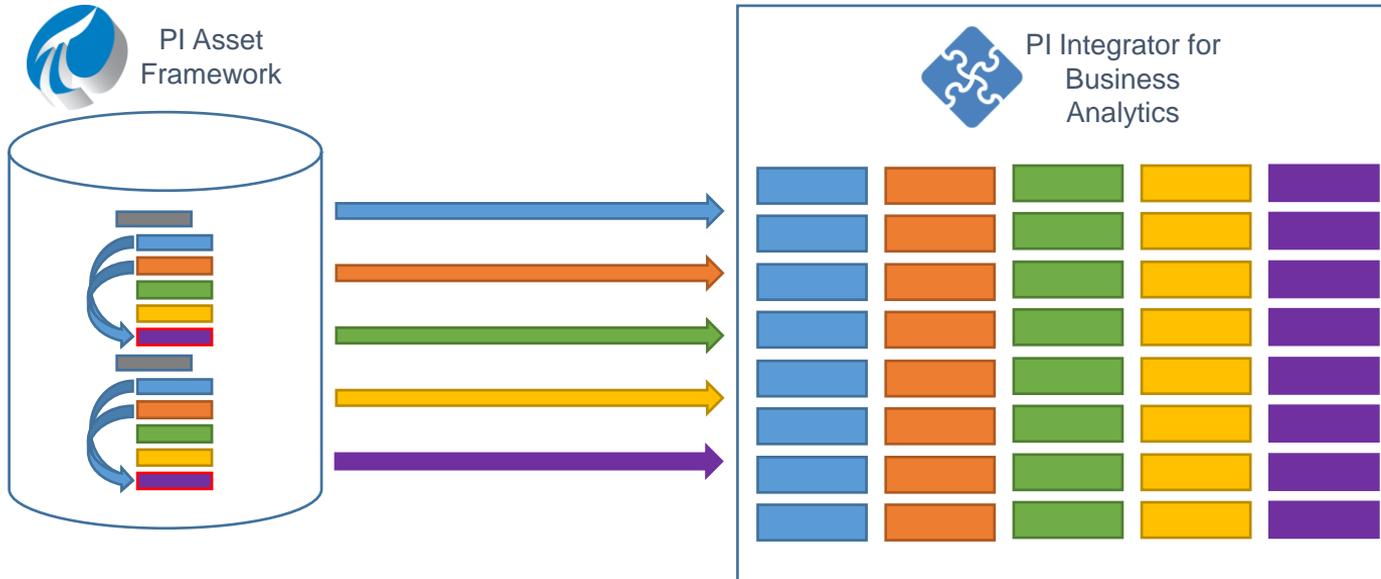
# Evolving to Advanced Analytics with AWS

## Navigating the Sea of Data



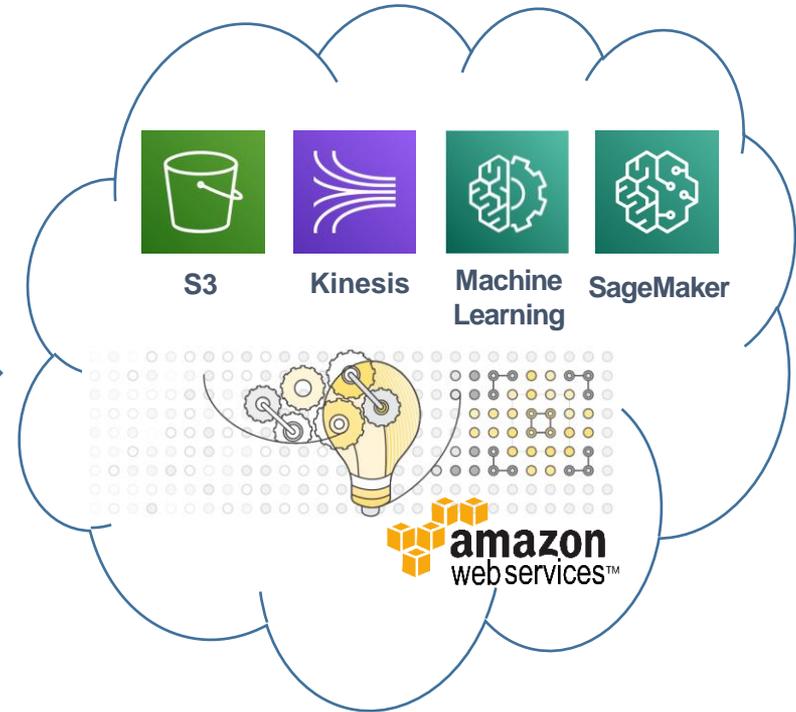
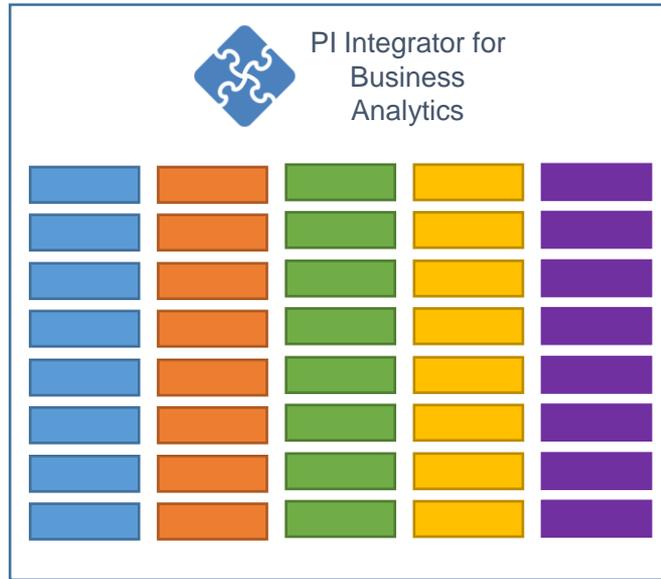
# Evolving to Advanced Analytics with AWS

## Navigating the Sea of Data



# Evolving to Advanced Analytics with AWS

## Feeding the Machine



# DEMO

PI Business Integrator

Elements

- Elements
  - AWSExample
    - Ex1
    - Ex2
    - AWSTestS3\_1
    - Gulf
    - MLIs
    - Navigation
    - PI Data Archive
    - Test
  - Element Searches
    - Element Attribute Search Results 1
    - Element Attribute Search Results 2
    - Element Search 1

Elements

- Event Frames
- Library
- Unit of Measure
- Contacts
- Management

AWSExample

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

Filter

Name	Value
There are no attributes configured for this element. Attributes represent a single value that is used to represent a specific piece of information that is part of an element, event frame, transfer, case, or notification.	
<a href="#">New Attribute</a>	

Group by:  Category  Template

Name:

Description:

Properties:

Categories:

Default UOM:

Value Type:

Value:

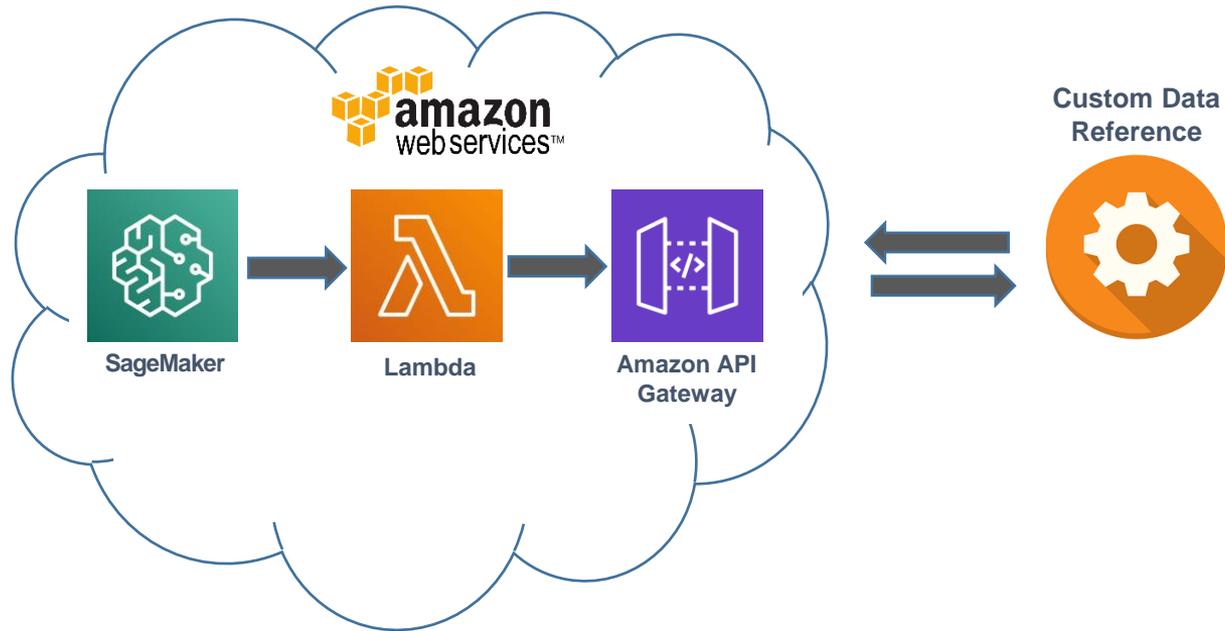
Data Reference:

Settings...

Limits Forecasts

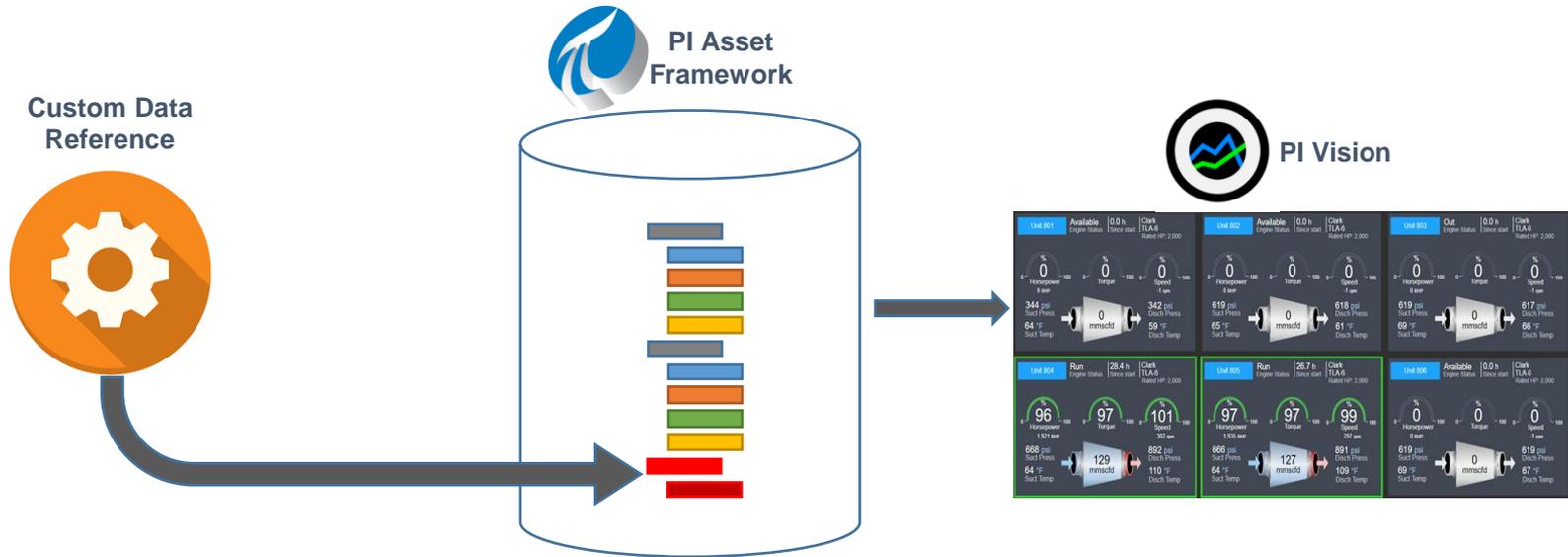
# Evolving to Advanced Analytics with AWS

## Automating the Demand Forecast



# Evolving to Advanced Analytics with AWS

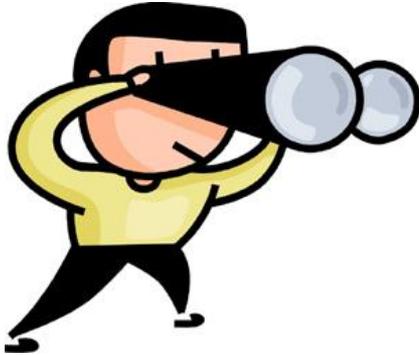
## Consuming the Results



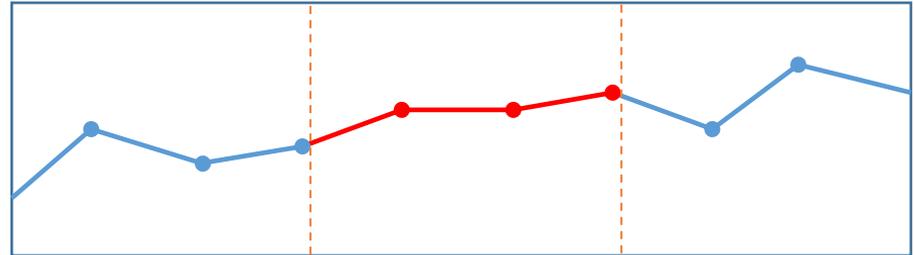
# Evolving to Advanced Analytics with AWS

## What else?

Lost and Unaccounted For Gas



Gas Measurement Volume Estimation



# Perspectives, Best Practices, & Lessons Learned

- **Layers of Analytics Approach**
  - Use tools already available
  - Enable self-serve analytics & visualization
  - Asset Framework, Vision
- **Data Quality**
  - Poor quality data is a damaged asset
  - Bad results reduce confidence
- **Feature Engineering**
  - Can be done in AF and historized
  - Increase the value of your asset
- **The Value of Experimentation**
  - Data Science is experimental
- **Be Agile**



# Future of Analytics at TransCanada

- **Project Expansion**
  - Scale out all models
  - Fully automate training/evaluation
- **Predictive Modeling for Measurement**
  - Extension for MIA
  - Enhance anomaly detection by predicting flows
- **Making Advanced Analytics Accessible**
  - Joint prototype between RAP and MIA teams
  - Generic machine learning models
  - Management interface for data and model management
  - Leverage PI System and AWS



# Summary

- **Build an Analytics Foundation**
  - Start simple
  - Data as an Asset
  - Cross-functional teams
- **Leverage the Foundation**
  - Build platforms with tools on hand
  - Enable users to create analytics and visualize data
- **Evolve with rapid prototyping**
  - Agile, Proof of Concept projects
  - Fail fast, succeed faster



## Mitchell Browning

Senior Developer, Machine Learning &  
Analytics Platforms

TransCanada PipeLines Limited

[mitchell\\_browning@transcanada.com](mailto:mitchell_browning@transcanada.com)

# Questions?

Please wait for  
the **microphone**

State your  
**name & company**



# Please remember to...

**Complete Survey!**  
Navigate to this session in  
mobile agenda for survey

An advertisement for the OSISOFT PI World app. The background is dark blue with a subtle pattern. On the right is a smartphone displaying the app's logo, which consists of a stylized white atom symbol above the text "OSISOFT PI World". To the left of the phone, the text "TO DOWNLOAD APP, SEARCH OSISOFT PI WORLD" is written in white. Below this text are two black buttons: one with the Apple logo and the text "Download on the App Store", and another with the Google Play logo and the text "GET IT ON Google Play".

TO DOWNLOAD APP,  
SEARCH OSISOFT  
PI WORLD

Download on the  
App Store

GET IT ON  
Google Play

OSISOFT  
PI World

謝謝 KEA LEBOHA  
 TAPADH LEIBH 고맙습니다  
 БАЯРЛАЛАА MISAOTRA ANAO  
 DZIĘKUJĘ CI NGIYABONGA TEŞEKKÜR EDERIM GRACIES OBRIGADO شكرا SALAMAT  
 DANKON TANK TAPADH LEAT SALAMAT  
 KÖSZÖNÖM DANKIE TERIMA KASIH GRACIES  
 СПАСИБО  
 ПАКМЕТ СІЗГЕ  
 GO RAIBH MAITH AGAT  
 БЛАГОДАРЯ GRACIAS MAHADSANID  
 ТИ БЛАГОДАРАМ  
 TAK DANKE MAHADSANID  
 RAHMAT MERCI  
 HATUR NUHUN  
 GRAZZI ПAKKA PĒR  
 ПАХМАТ САГА  
 CẢM ƠN BẠN  
 WAZVIITA  
 FALEMINDERIT  
 TI БЛАГОДАРАМ  
 СИПОС  
 DANK JE ΕΥΧΑΡΙΣΤΩ GRATIAS TIBI  
 AČIŪ SALAMAT MAHALO IĀ 'ŌE TAKK SKALDU HA  
 GRAZZI ПAKKA PĒR  
 ПАХМАТ САГА  
 SIPAS JI WERE TERIMA KASIH  
 UA TSAUG RAU KOJ  
 TI БЛАГОДАРАМ  
 СИПОС  
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 HVALA FAAFETAI  
 ESKERRIK ASKO  
 HVALA ХВАЛА ВАМ  
 TEŞEKKÜR EDERIM  
 GRAZIE  
 DI OU MÈSI  
 ĎAKUJEM  
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THANK YOU