Using PI Integrators to Improve the Value of Your PI System Data

Martin Bryant, Field Service

September 20, 2016

Seeking Value in a Sea of Buzz and Jargon

Machine Learning

Internet of Things

Advanced Analytics

Data Lakes

Predictive Analytics

Big Data

Process Efficiency

Data Warehouse

Operational Intelligence

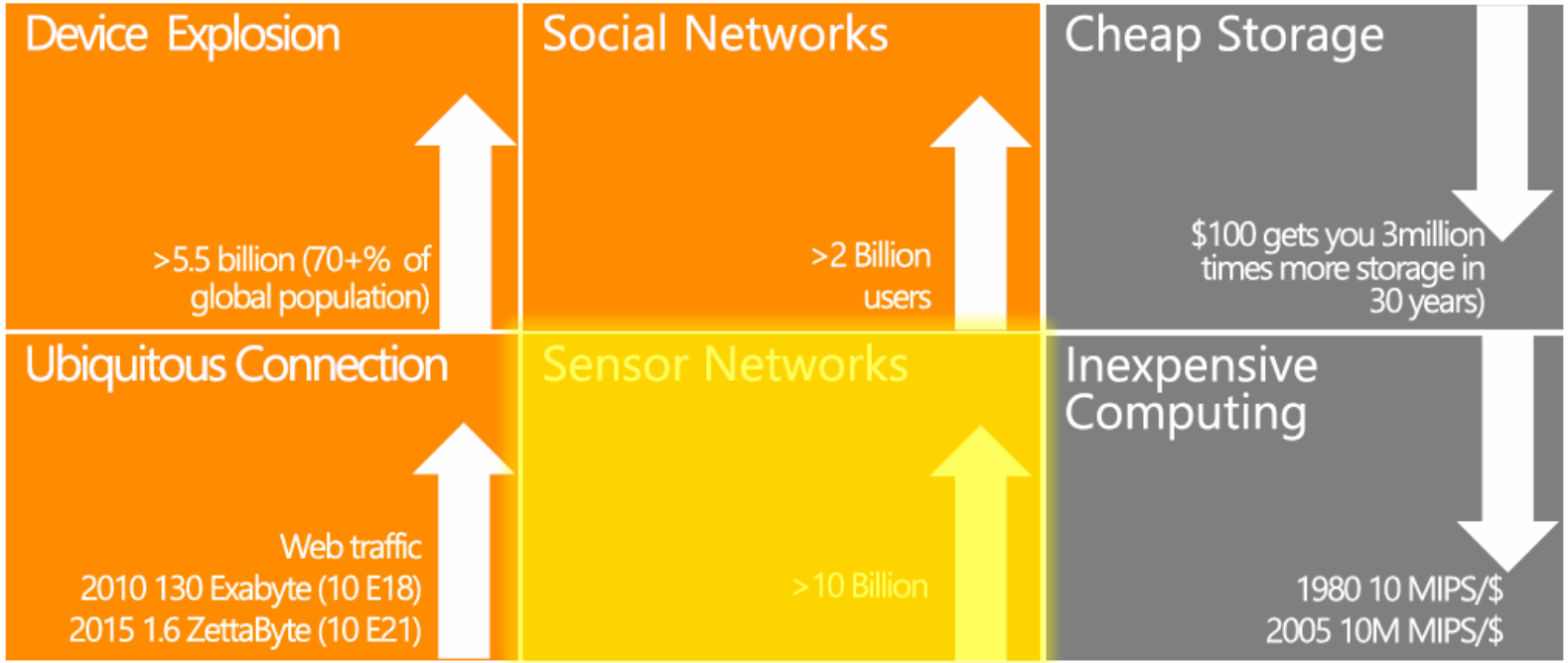
Data Science

Business Intelligence

Data Mining

Advanced Visualization

The Importance of Data (and Sensor Data) is Increasing



OSIsoft has Listened to Your Needs

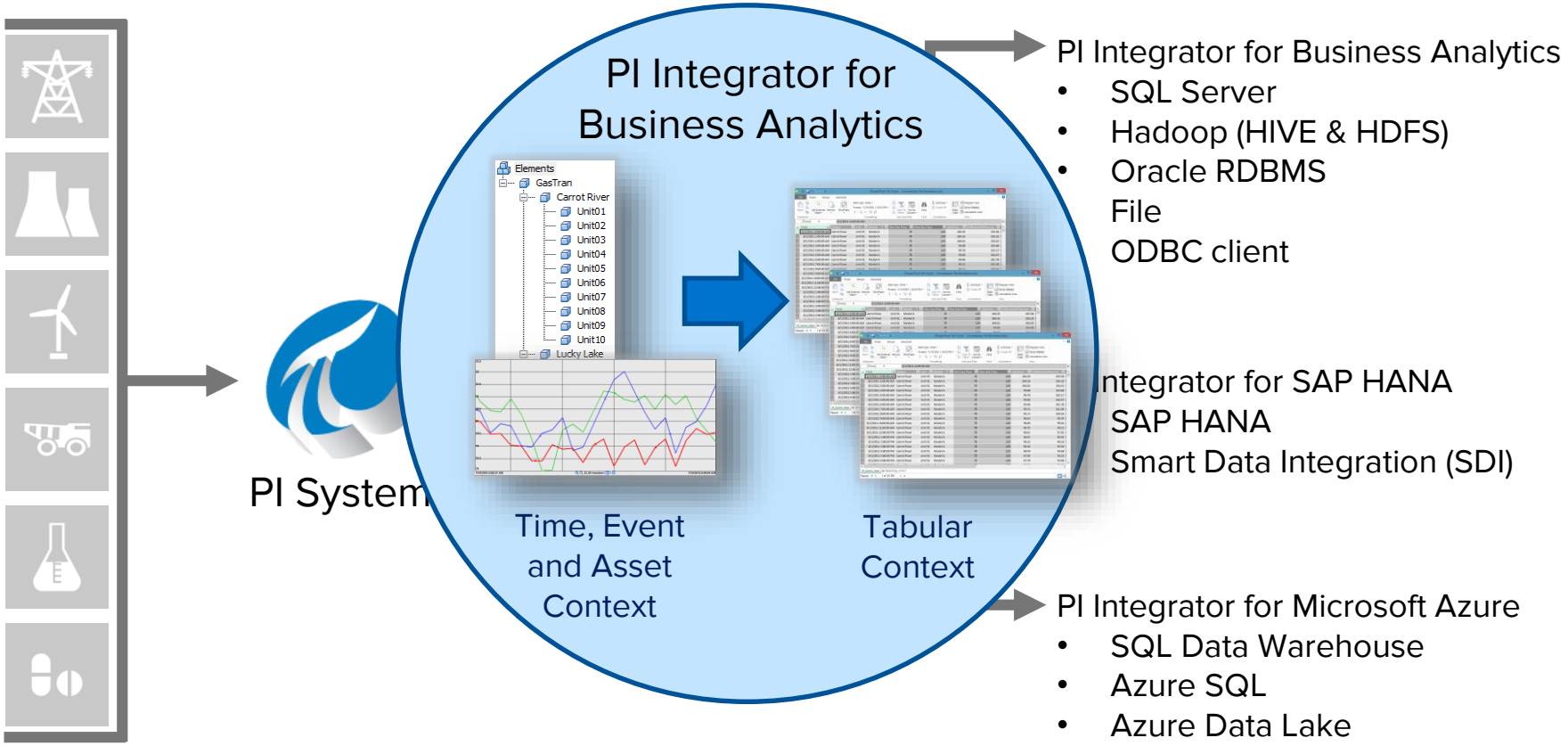
Summary of Needs:

Familiar tools

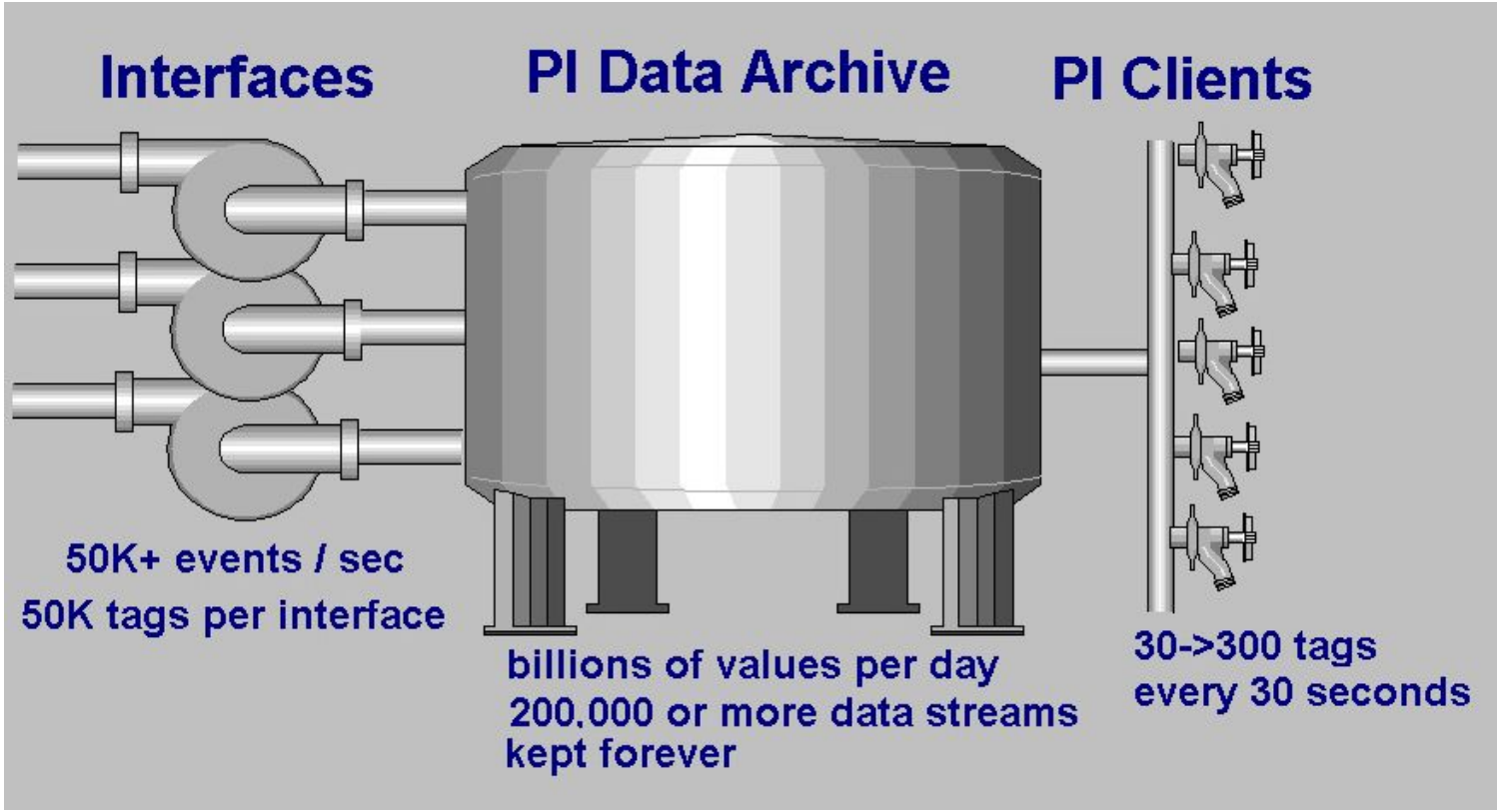
Scalability without code

Flexibility and trust

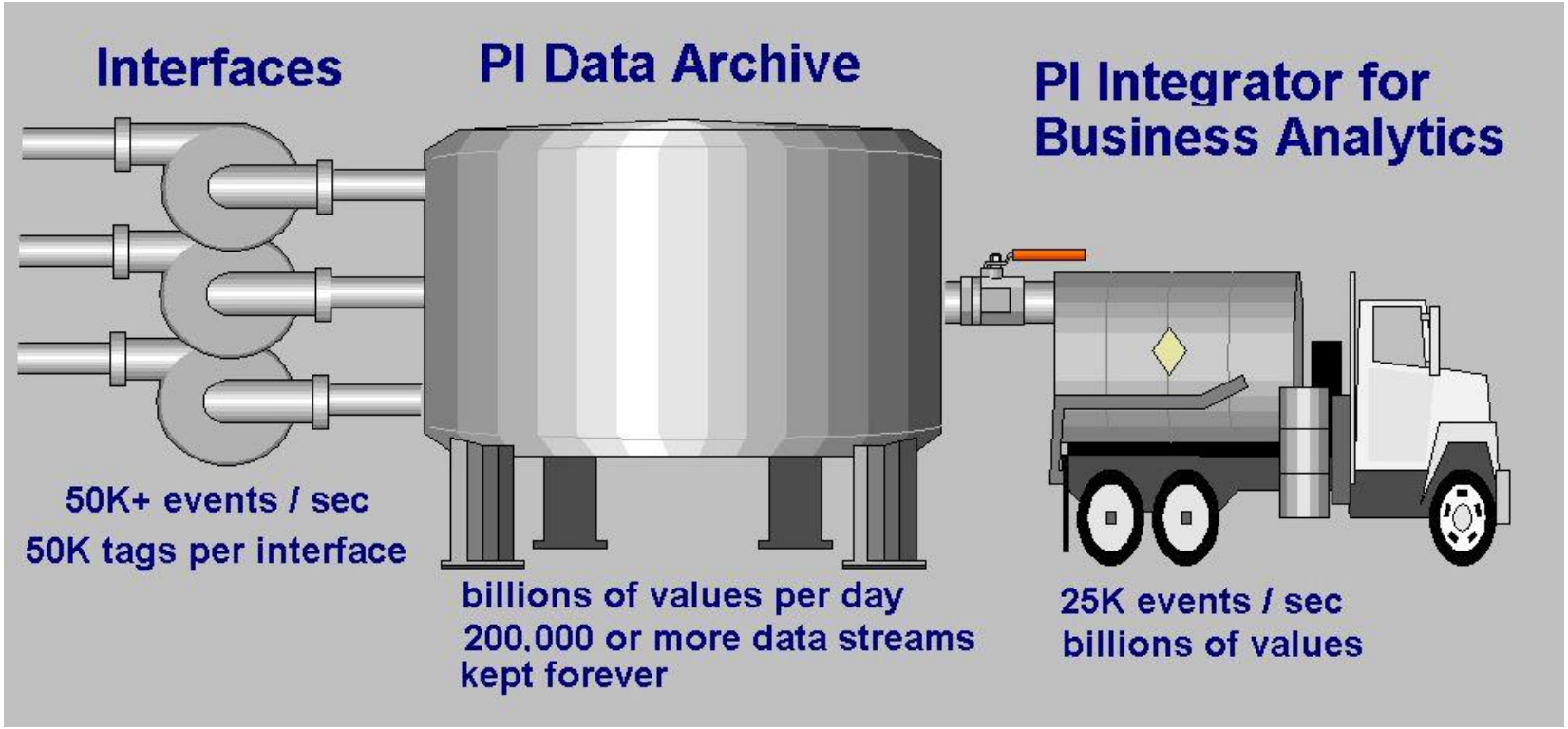
PI Integrators



The Traditional PI System

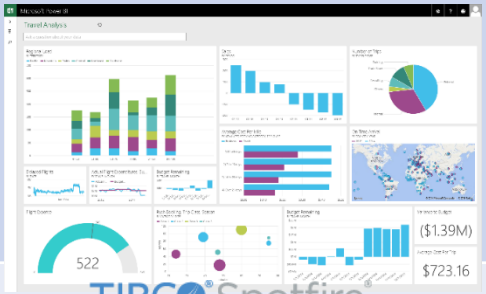


An Alternative Data Use Model



Getting Value…

Solving complex problems for a fleet	Dashboarding – visual reporting – real time & mobile	Integration to new I.T. projects and databases
Multivariate, other statistics & machine learning resources One time answers or Running models	Drill drown, rollup Anywhere anytime	The right way to bring operational data to I.T.'s Big Data party…



TIBCO Spotfire

Power BI

tableau

Microsoft SQL Server Reporting Services

hadoop

ORACLE BUSINESS INTELLIGENCE

SAP

Why? … complex problem solving

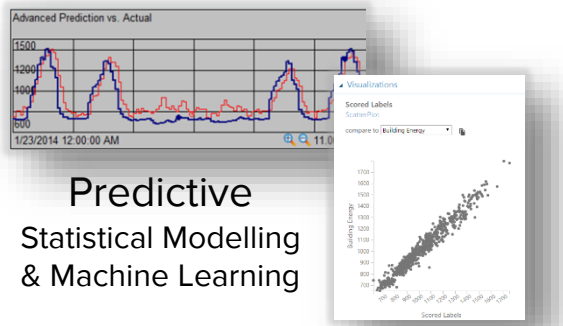
Statistical Analytics

- Identifying **patterns** and discovering problems through statistical methods that require **large** and **diverse** datasets

All PI Customers have a great deal of data.. Often too much for effective analysis in a spreadsheet. This data can be complex with many variables. Multivariable analysis and machine learning can provide interesting and invaluable answers to complex, big questions…

Multidimensional

Business Intelligence & Dashboards



Predictive

Statistical Modelling & Machine Learning

PI data is very large and complex.

This is about finding the answer to large, complex questions.

Complex Analyses Increase the Need for Deeper Integration

Complexity

Disparate assets
Interacting with assets on an **individual** basis

Interacting with **common** assets as a **fleet**

Monitoring

Real-time visibility

- Traditional HMI

Process Optimization

Real-time & historical views across any asset

- PI ProcessBook
- PI Coresight
- PI Datalink

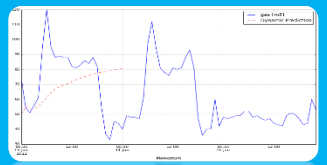
Benchmarking

Fleet-wide performance comparisons

- BI app (e.g. Tableau, Spotfire, Lumira)
- PI Integrator for Business Analytics
- PI Integrator for SAP HANA

System Optimization

Large scale multi-variate analysis



- Machine learning (Azure ML, R)
- PI Integrator for Business Analytics
- PI Integrator for SAP HANA

Applying Data to Maintenance…

Complexity

Disparate assets
Interacting with assets on an **individual** basis

Interacting with **common** assets as a **fleet**

Monitoring

Wait for failure

faster break & fix

Data aware
Usaged based

Using run times and not clock hours to schedule

Preventive Maintenance

and inspections

Performance

Compare current performance metrics, including vibration, temperature, & other KPIs to expected values

Predictive

Based on the history of like equipment and circumstances – build a model that predicts failure and triages maintenance

Results and ROI: Data Integration can Address Key Questions

Mining

- What material is being hauled?
- When was it raining?
- Are there holes in the road?
- What is the grade of the hill?
- When did breaks and downtime occur?
- How do driving behaviors vary by shift?

Oil & Gas

- When did the geology change?
- Which well was being drilled?
- What angle was the drill bit?
- Is production related to drill conditions?

Wind Power

- Was wind gusty or steady?
- Was the maintenance planned?
- How long does this issue usually take to fix?

Pharmaceuticals

- What product is being made?
- When is the equipment empty?
- Where was the instrument when I took that measurement?

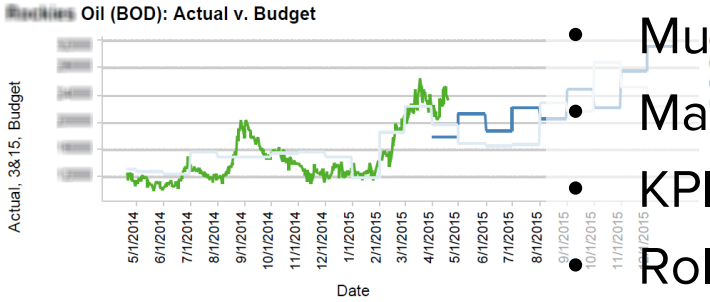
Transmission & Dist

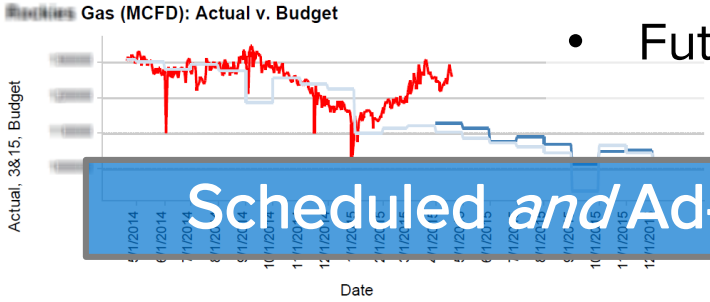
- How are renewables impacting the equipment?
- Was there a voltage violation?
- What are the changes in weather?

Why? Dashboarding

Visual Analytics

- **Visualizing diverse** sets of data sources to gain insights, create reports, and improve operations





- Automated daily reports
- Multiple data source views
- Management overviews
- KPIs and metrics
- Rollups by business unit
- Future Data (forecast)

Scheduled *and* Ad-Hoc Reporting

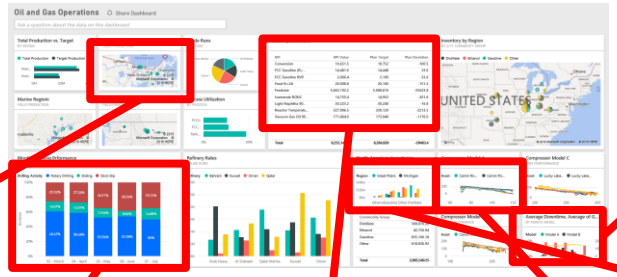
Don't wait for tomorrow to explore performance today

your operational data is a click or swipe away.

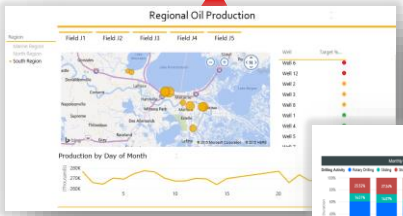
Even from your mobile devices

Result: Improved, Detailed Reporting and Analytics

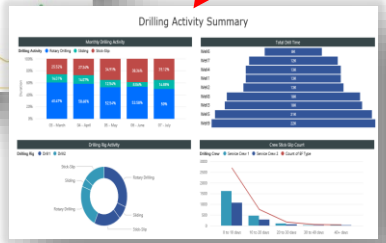
Dashboard drilldowns to detailed reports



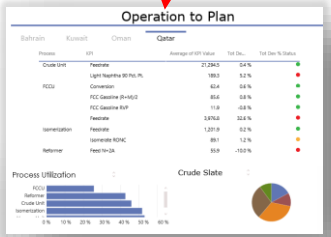
PI Coresight Displays



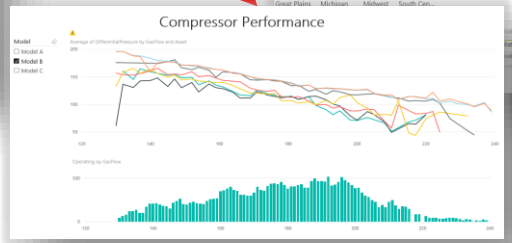
Production Summaries



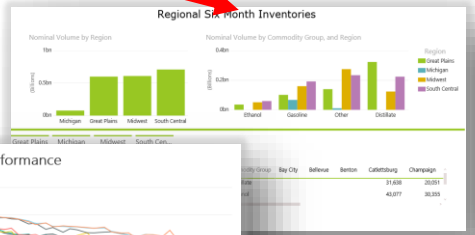
Drilling Activity Reports



Refinery KPI Scorecards



Asset Performance Displays



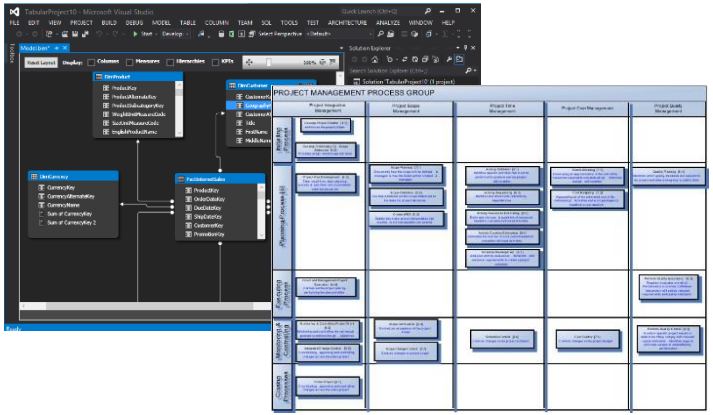
Regional Product Inventories

Why? I.T. Integration projects

Information systems have projects that provide enormous value – and those can benefit from the real-time process awareness of PI Data. But PI Data hasn't been easy to integrate – until now.

Data Warehousing

- **Centralizing data** from **different** business systems
- More effectively analyzing and reporting on business and building LOB applications



hadoop

Power BI

SAP

Structured PI data in a format readily consumable by the latest I.T. tools.

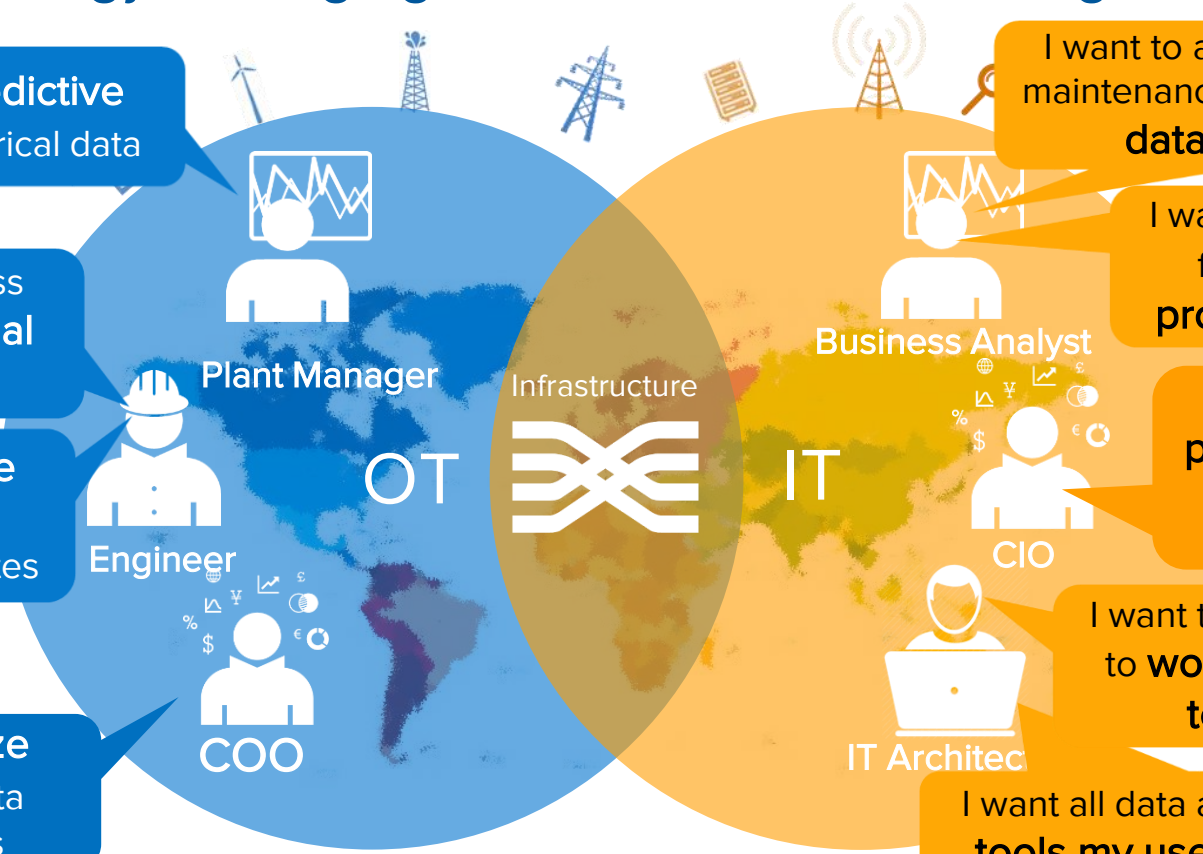
New Technology is bringing the IT and OT Worlds Together

I want to build **predictive models** from historical data

I want to spend less time on **operational reports**

I want to **compare my equipment** against our other sites

I want to **minimize risks** through data driven decisions



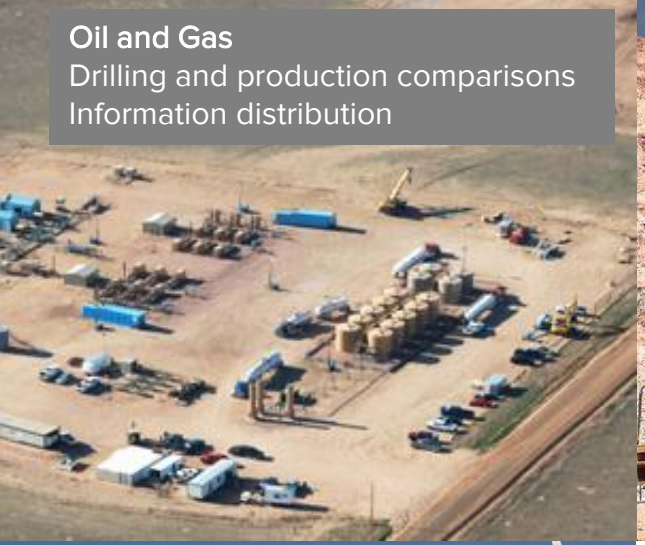
I want to analyze production, maintenance logs, and financial **data all together**

I want operational data for the **Big Data project** we're starting

I want **trusted production data**, to be confident in our decisions

I want the operational data to **work with our other technologies**

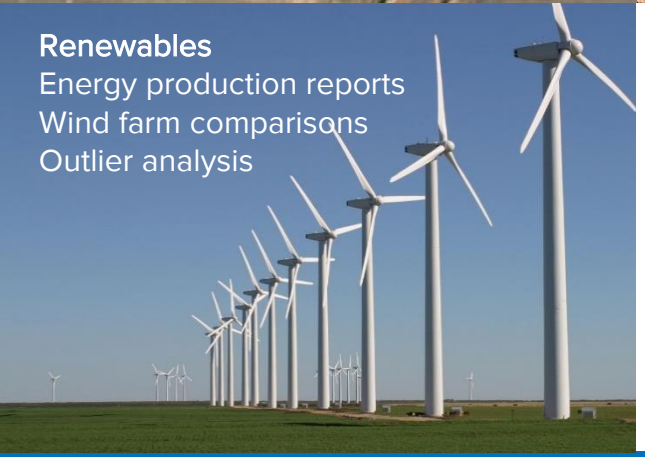
I want all data accessible by the BI **tools my users already know**



Oil and Gas
Drilling and production comparisons
Information distribution

Mining
Route optimization
Energy reduction
Across 300 haul trucks

Life Sciences
Reactor comparisons
Process scale-ups
(1L, 3L, 10L, 1kL, 10kL)



Renewables
Energy production reports
Wind farm comparisons
Outlier analysis

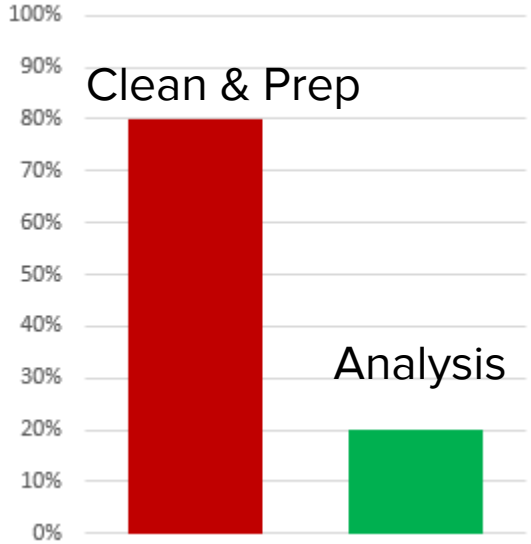
PI Integrator for Business Analytics is in use today!

- ✓ IT/ OT integration
- ✓ Business intelligence and reporting
- ✓ Data warehouse integration
- ✓ Supporting cross-platform projects

Food and Beverage
Utility usages
Process analytics

(Big) Data Projects: Sound Attractive … But There are Challenges

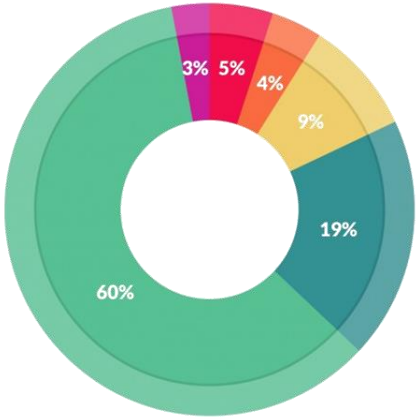
64% of large enterprises plan to implement a big data project.
85% will be unsuccessful.



Data cleansing and preparation tasks can take 50-80% of the development time and funds.

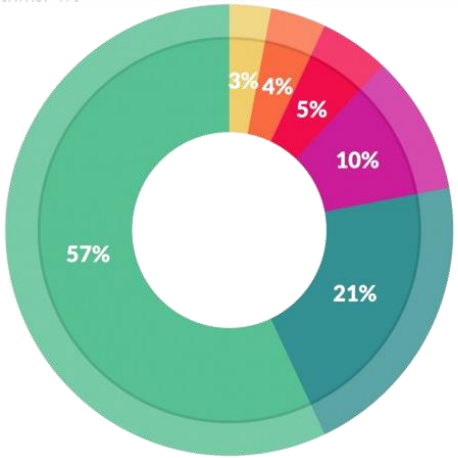
Source: https://hbr.org/2014/04/the-sexiest-job-of-the-21st-century-is-tedious-and-that-needs-to-change/

(Big) Data Projects: Time Spent in the Wrong Areas



What data scientists spend the most time doing

- *Building training sets: 3%*
- *Cleaning and organizing data: 60%*
- *Collecting data sets; 19%*
- *Mining data for patterns: 9%*
- *Refining algorithms: 4%*
- *Other: 5%*

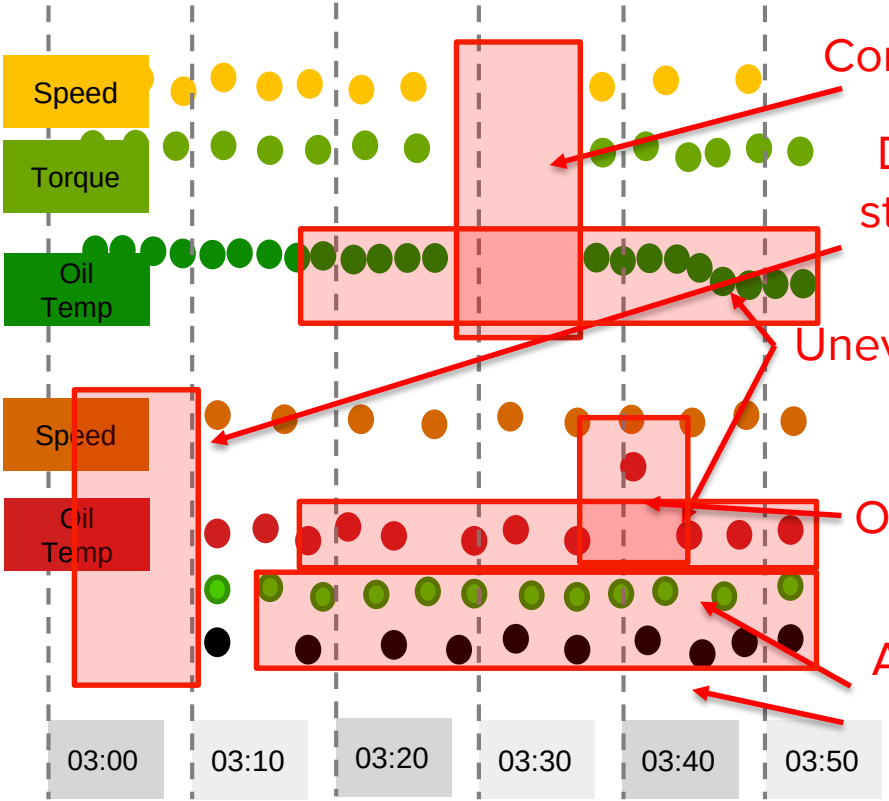


What's the least enjoyable part of data science?

- *Building training sets: 10%*
- *Cleaning and organizing data: 57%*
- *Collecting data sets: 21%*
- *Mining data for patterns: 3%*
- *Refining algorithms: 4%*
- *Other: 5%*

Source: http://www.forbes.com/sites/gilpress/2016/03/23/data-preparation-most-time-consuming-least-enjoyable-data-science-task-survey-says/#5481f6037f75

Cleaning & Preparing Sensor Data: It's Challenging



Comm Failure

Different start times

Uneven Spacing

Spike / Out of Range

Additional Measure

	Speed	Torque	Oil Temp	Speed	Oil Temp
03:00	9.8	25	50	X	X
03:10	10	24	50	10.0	60
03:20	10	25	50	10.2	60
03:30	X	X	X	9.8	60
03:40	9.9	25	50	10.0	120
03:50	9.9	25	45	10.1	60

PI Integrators Let You Clean and Prepare PI System Data

for your business intelligence tools, data warehouses, and data lakes

Assets
Events

Cleanse
Data quality

Augment
Aggregation

Shape
Model

Transmit
Normalization

Clean & Prepare

TIBCO Spotfire

Power BI

COGNOS

+ableau

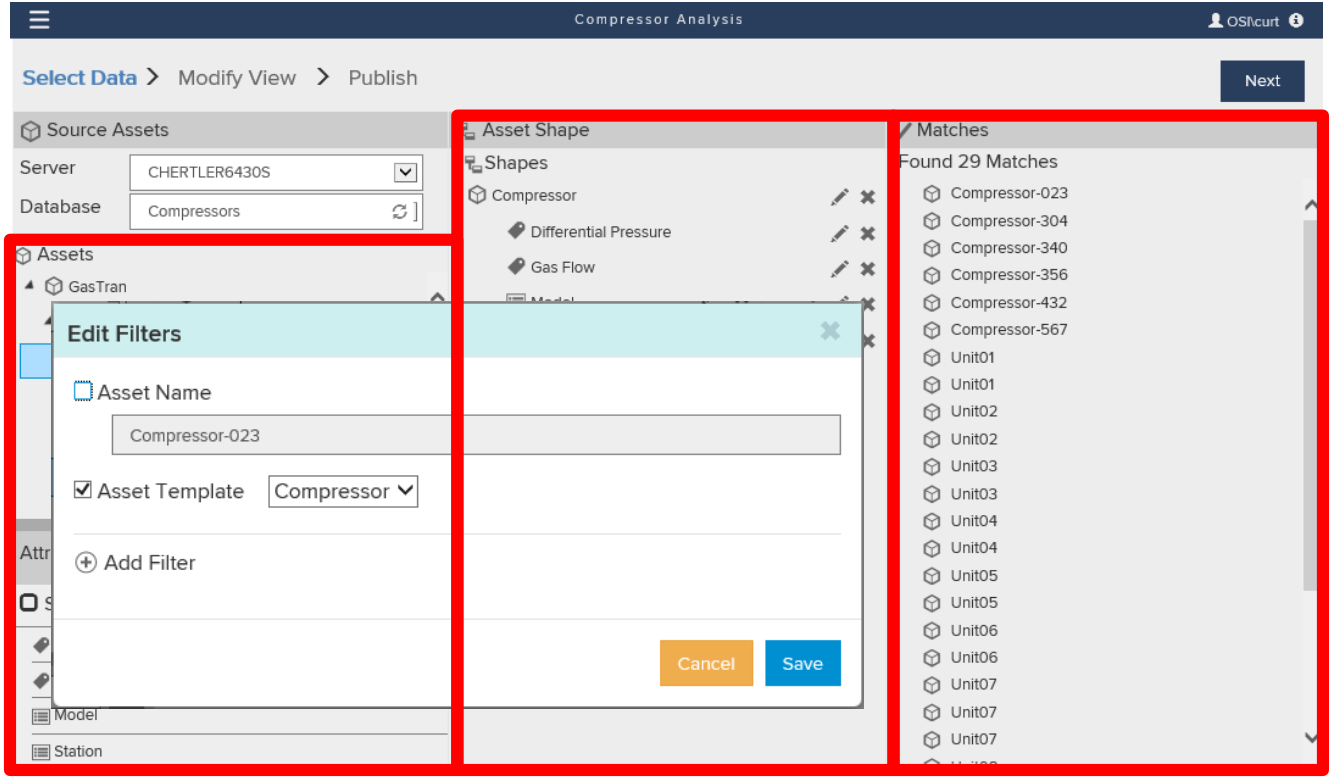
Microsoft SQL Server Reporting Services

hadoop

Analyze

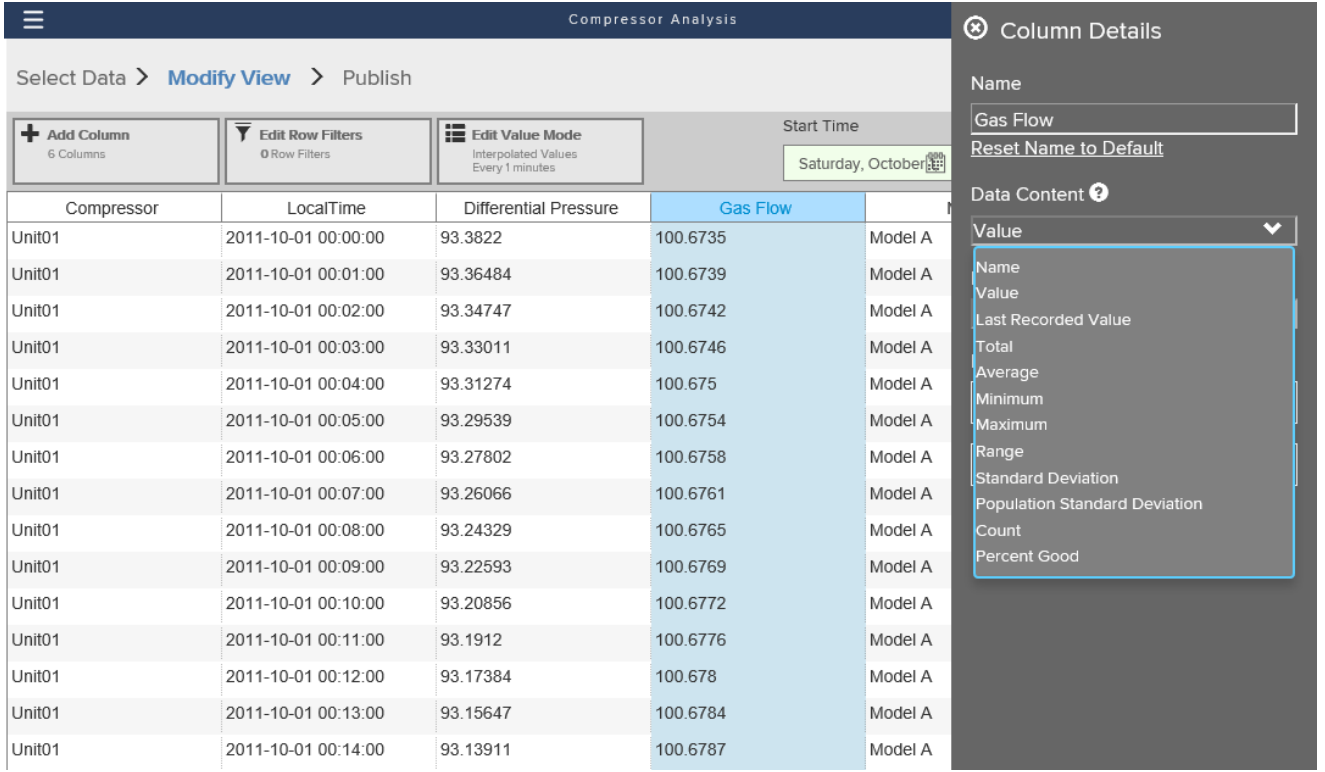
PI Integrator for Business Analytics - “Select Data”

- Intuitive way to create tabular content in “PI Views”
- Requires AF Hierarchy
- Select AF Elements and Attributes
- Scale up leveraging name, hierarchy, or category



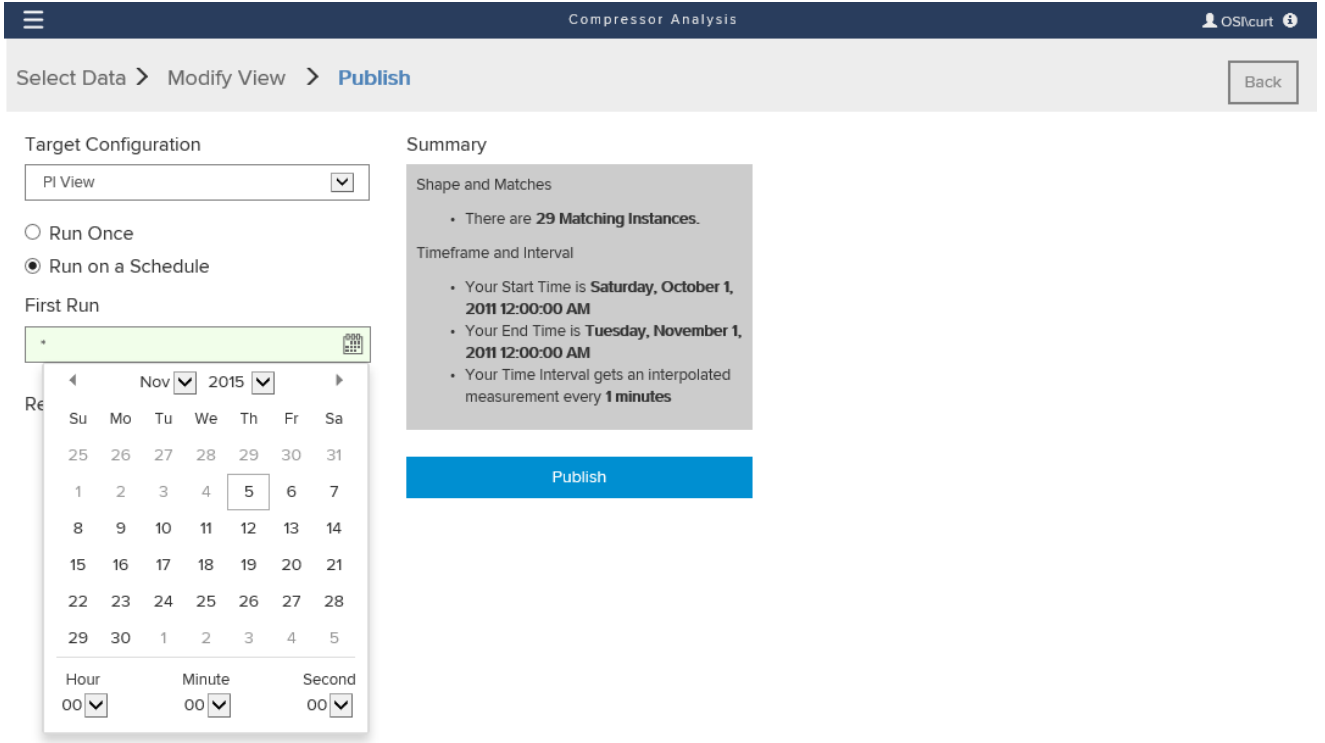
PI Integrator for Business Analytics - “Modify View”

- Select any time range and interval
- Add columns for proper aggregating PI System data
- Add columns for common time and date functions



PI Integrator for Business Analytics - “Publish”

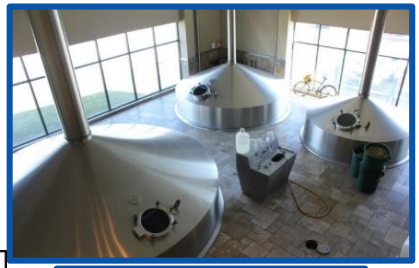
- Select targeted endpoint “PI View”, MS SQL, text file, more to come….
- Publish once or on a scheduled bases



Deschutes Brewery

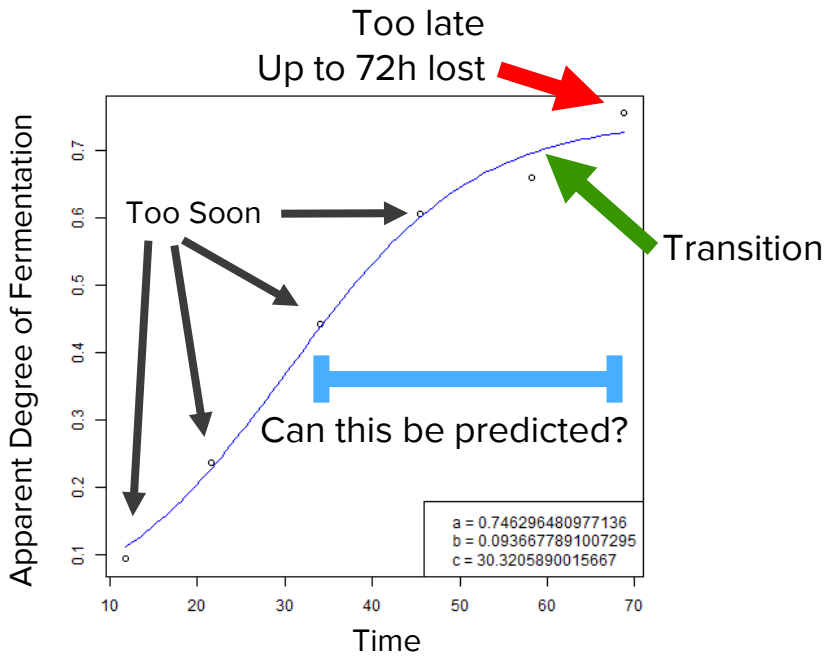
- Located in Bend, OR
- Founded in 1988
- Pub opened in Portland, OR in 2007

- 2 brewhouses
- 50+ vessels
- Bottling and kegging
- 7th largest craft brewer in the U.S.



Production Challenges

Filing ▶ Fermentation ▶ Free Rise ▶ •••



Options

- Invest $750k into inline density meters
- Manually predict transition in spreadsheets

Constraints

- CAPEX not an option
- One manual density measurement per vessel every 8-10h

Challenge

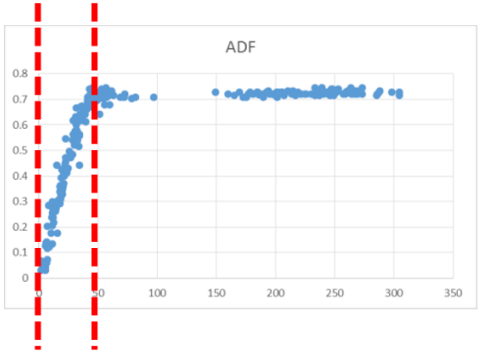
- Transition occurs between manual density measurements
- Automate & operationalize predictions
- Continuously improve accuracy of predictions

Predictive Analytics in a Spreadsheet

Bring Raw Data In

	A	B	C	D	E	F	G	H
1	FV	Brand	FV Full	FV Full °P	°P Timestamp	°P	Hours since FV Full	ADF
2	FV43	Fresh Squeezed	10/20/15 7:48 PM	16.50142	10/20/15 9:31 PM	15.4	1.720277778	0.066747
3	FV44	Fresh Squeezed	9/29/15 7:31 AM	16.50996	9/29/15 9:17 AM	16	1.767777778	0.030888
4	FV39	Fresh Squeezed	8/13/15 4:16 AM	16.5059	8/13/15 7:52 AM	15.8	3.595555556	0.042767
5	FV39	Fresh Squeezed	10/11/15 3:05 AM	16.5057	10/11/15 7:43 AM	15.6	4.632777778	0.054872
6	FV46	Fresh Squeezed	7/10/15 3:44 AM	16.51289	7/10/15 8:34 AM	15.6	4.834722222	0.055284
7	FV40	Fresh Squeezed	8/27/15 3:01 AM	16.49278	8/27/15 8:11 AM	15.6	5.175555555	0.054132
8	FV40	Fresh Squeezed	7/15/15 2:05 AM	16.52212	7/15/15 7:30 AM	15.8	5.411944444	0.043706
9	FV42	Fresh Squeezed	8/31/15 2:53 PM	16.50258	8/31/15 8:20 PM	16	5.466388889	0.030454
10	FV43	Fresh Squeezed	10/7/15 2:55 AM	16.50425	10/7/15 8:24 AM	14.4	5.494722222	0.127498
11	FV38	Fresh Squeezed	10/1/15 1:38 AM	16.49718	10/1/15 7:54 AM	14.2	6.263611111	0.139247
12	FV46	Fresh Squeezed	7/23/15 3:29 PM	16.50286	7/23/15 10:06 PM	15.5	6.626944444	0.060769
13	FV43	Fresh Squeezed	12/3/15 1:46 AM	16.50147	12/3/15 8:24 AM	14.2	6.6375	0.139471
14	FV40	Fresh Squeezed	11/15/15 1:52 AM	16.30823	11/15/15 8:31 AM	14	6.650833333	0.141538
15	FV40	Fresh Squeezed	7/3/15 1:39 AM	16.51333	7/3/15 8:44 AM	14.6	7.079722222	0.115866
16	FV38	Fresh Squeezed	10/28/15 11:49 PM	16.53811	10/29/15 [illegible]			[illegible]1844
17	FV39	Fresh Squeezed	7/27/15 1:55 PM	16.4914				
18	FV42	Fresh Squeezed	7/31/15 11:41 PM	16.50569				
		Fresh Squeezed	8/5/15 10:30 PM					

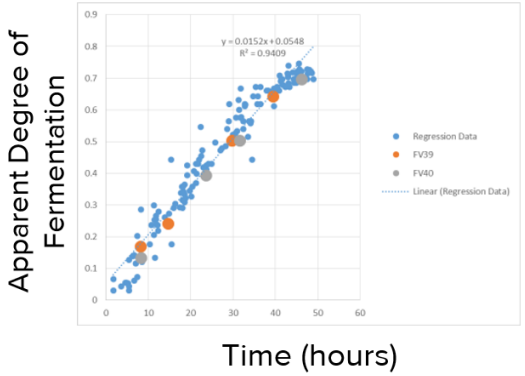
Clean it Up



New Challenges

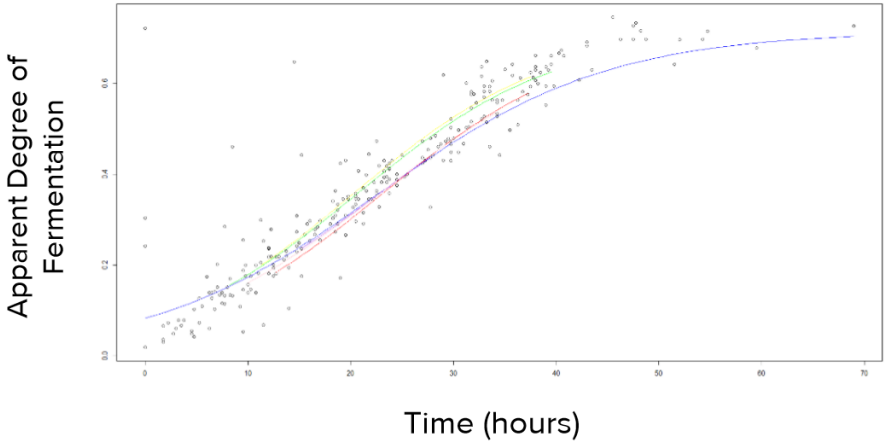
- How can the **data preparation** be **automated**?
- How can the **predictions** be **operationalized**?
- How can the **predictions** become **more accurate** over time?

Fit to a Line

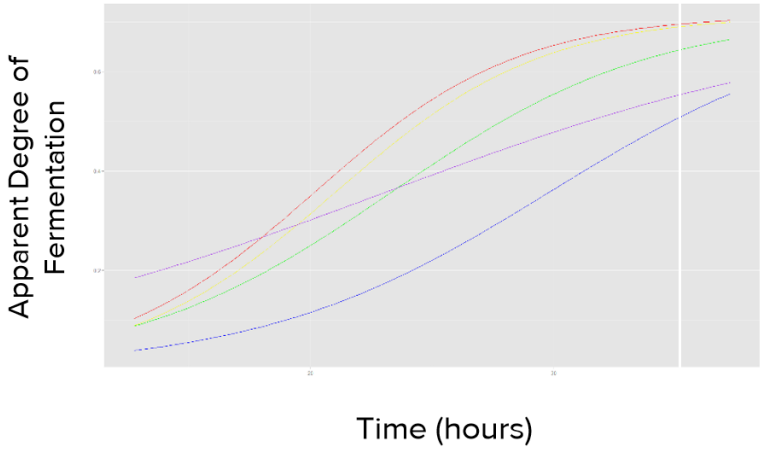


Beer Brand Portfolio Complicates Predictability

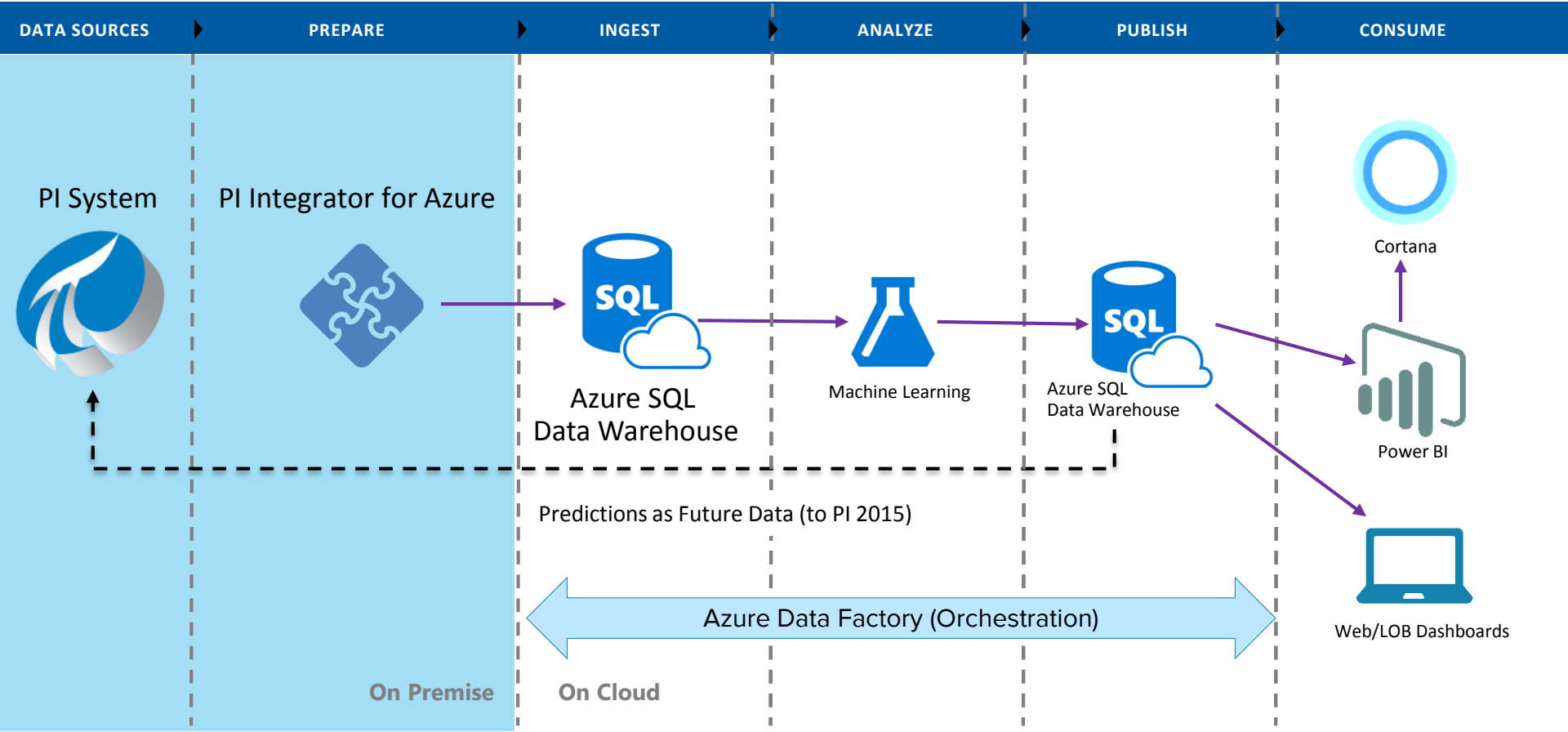
Variety within Batches for a Brand



Diversity in Beer Brands



How to Operationalize Predictions



Machine Learning Model

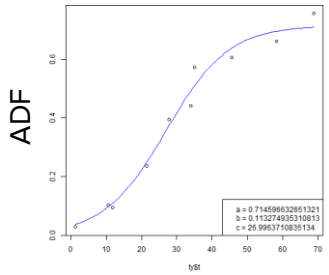
Proposal

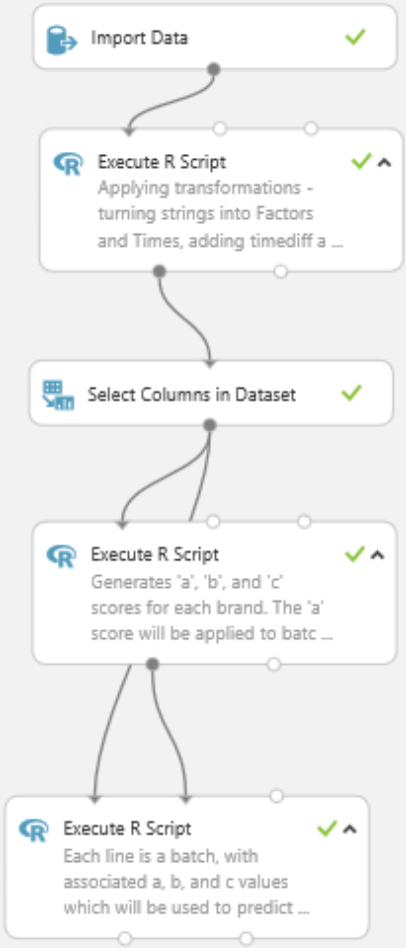
Early Density Readings → Transition Time

Hypothesis

Transition Time influenced by

- Brand of Beer
- Fermentation dynamics (Temperatures, pressures,..)
- Vessel's dimensions & volume



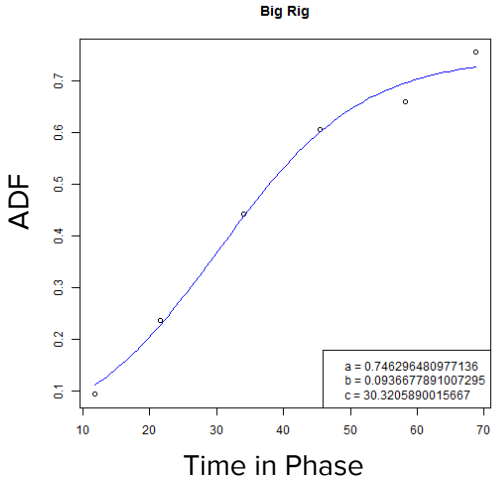


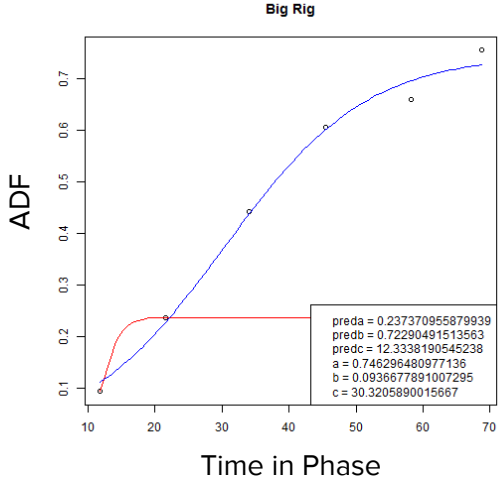
Azure ML Predicts Accurate Transition Time

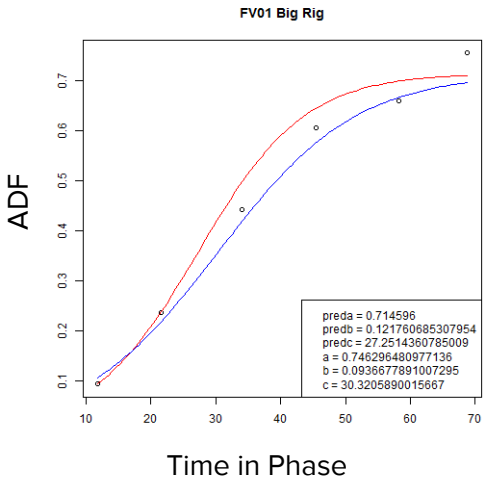
Benchmark: Measure accuracy against a standard (based on historical data)

Predict: use 2 early densities to estimate transition time

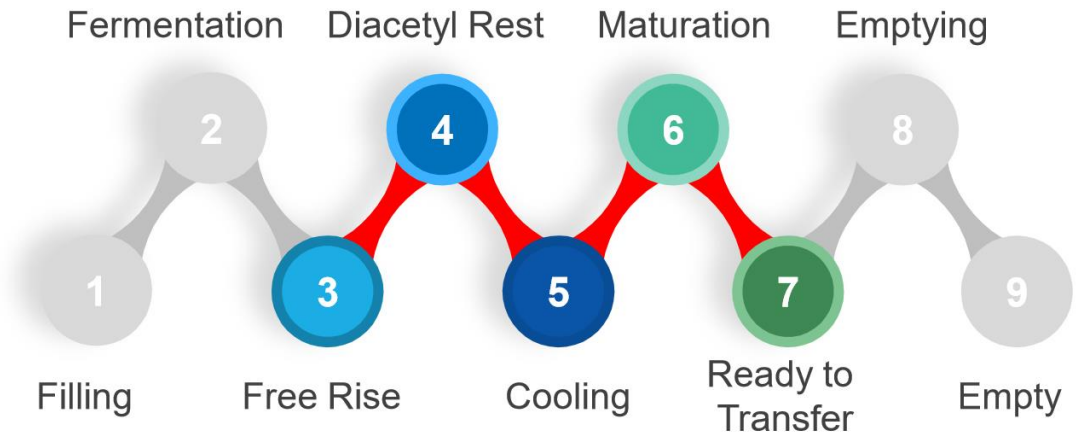
Refine: base predictions on brand for greater accuracy







Future Opportunities



- Incorporate predictions into beer making process
- Roll out predictions for more beer brands
- Test if predictions can cue a batch that is deviating
- Apply similar predictive methods to other transitions

Leveraging the PI System and Cortana Intelligence to Increase Process Efficiency

COMPANY and GOAL

Deschutes Brewery is the 7th largest craft brewery in US, and wanted to maximize production with its existing infrastructure to fund construction of a 2nd brewery in Roanoke, VA

CHALLENGE

Batch's phase transition happens between manual density measurements occurring every 8-10 hours

- Impact: Losing up to 72 hours in production time

SOLUTION

Use data science to achieve accurate predictive analytics for determining a batch's density measurements

- PI System
- PI Integrator for Microsoft Azure
- SQL Data Warehouse
- Azure Machine Learning
- Azure Data Factory

RESULTS

Ability to eliminate production time losses and increase production capacity

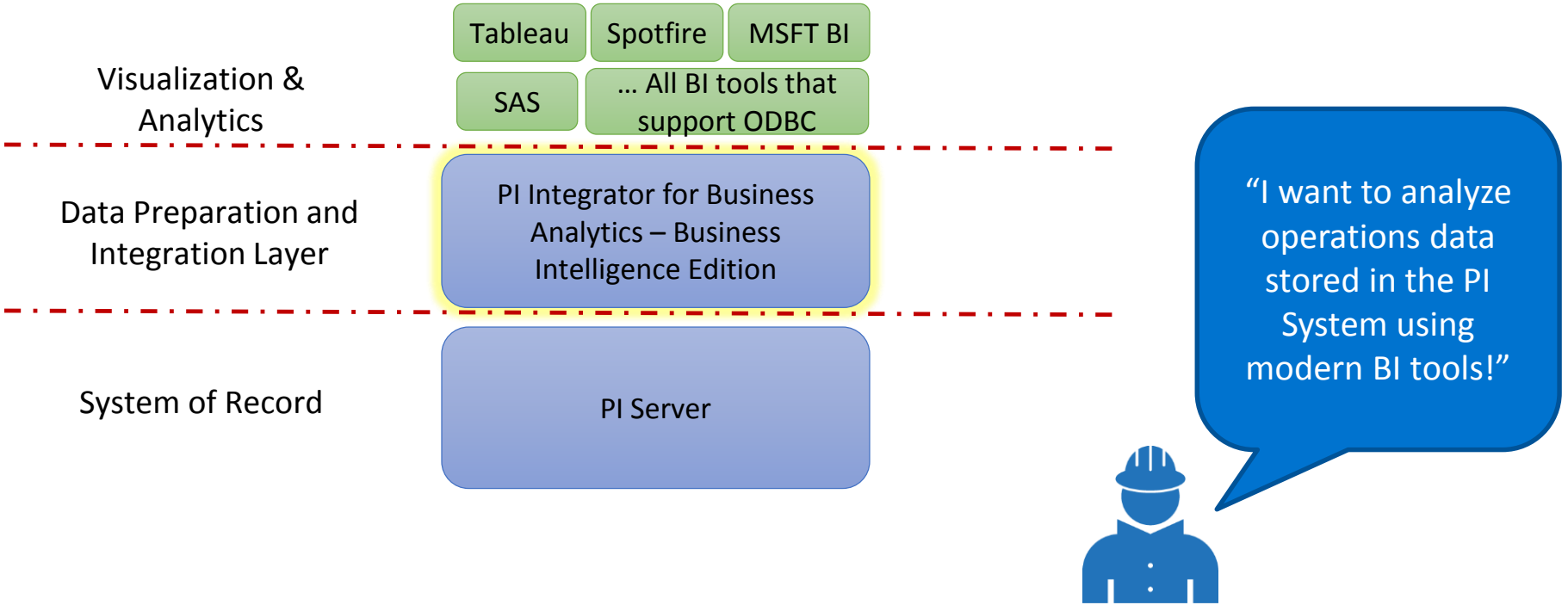
- Accurate predictions of when a batch's phase transitions from fermentation to free rise

You can see Tim & Brian do this talk

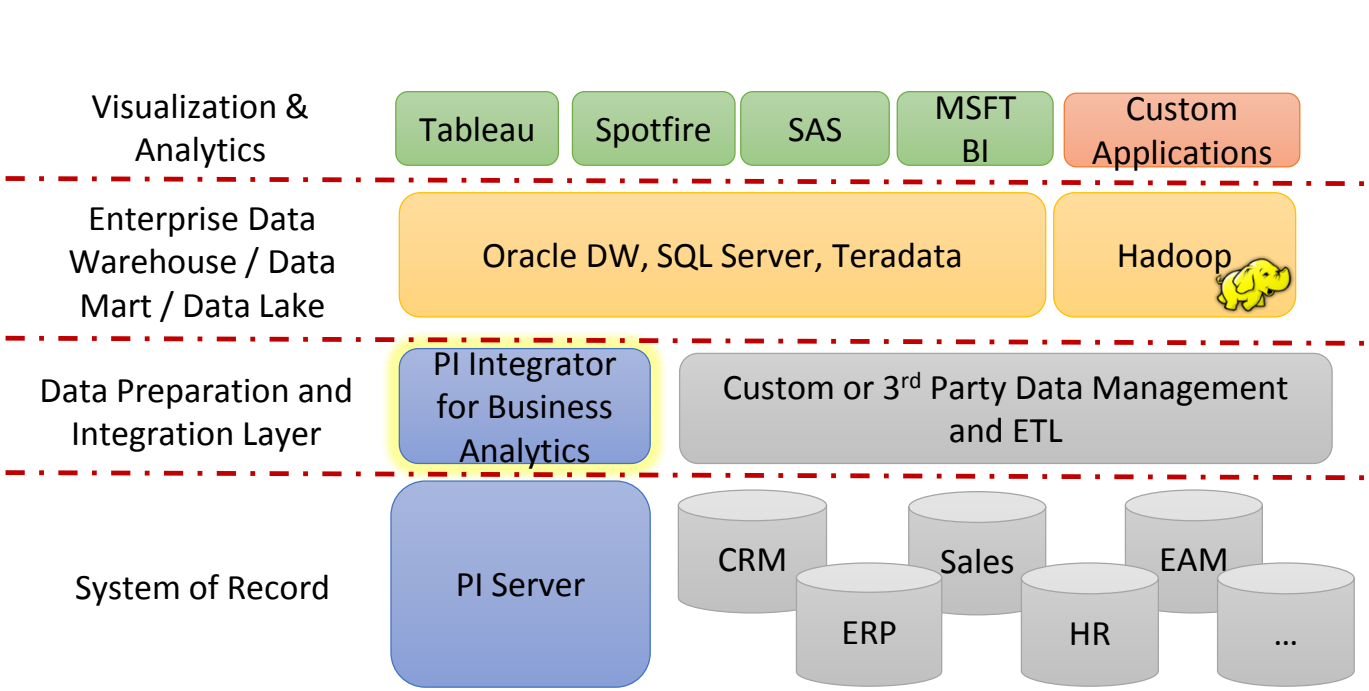
- Go to OSIsoft.com
- Select Events / Past Events / Event Presentations
- Select EMEA 2016 Berlin
- Look for “Reducing Beer Production Time with Predictions”

Tim Alexander – Assistant Brewmaster – Data Wrangler
Brian Faivre - Brewmaster

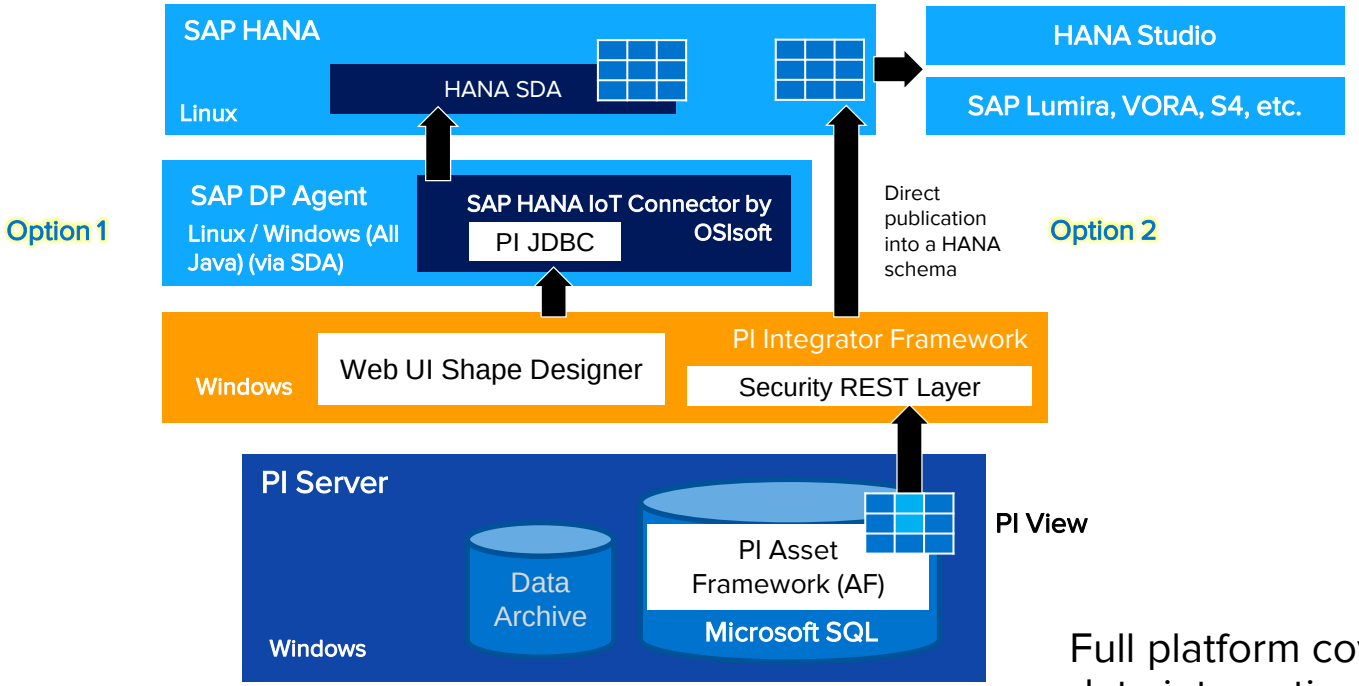
Operational Reporting & Analysis Architecture



Enterprise Data Warehouse Architecture

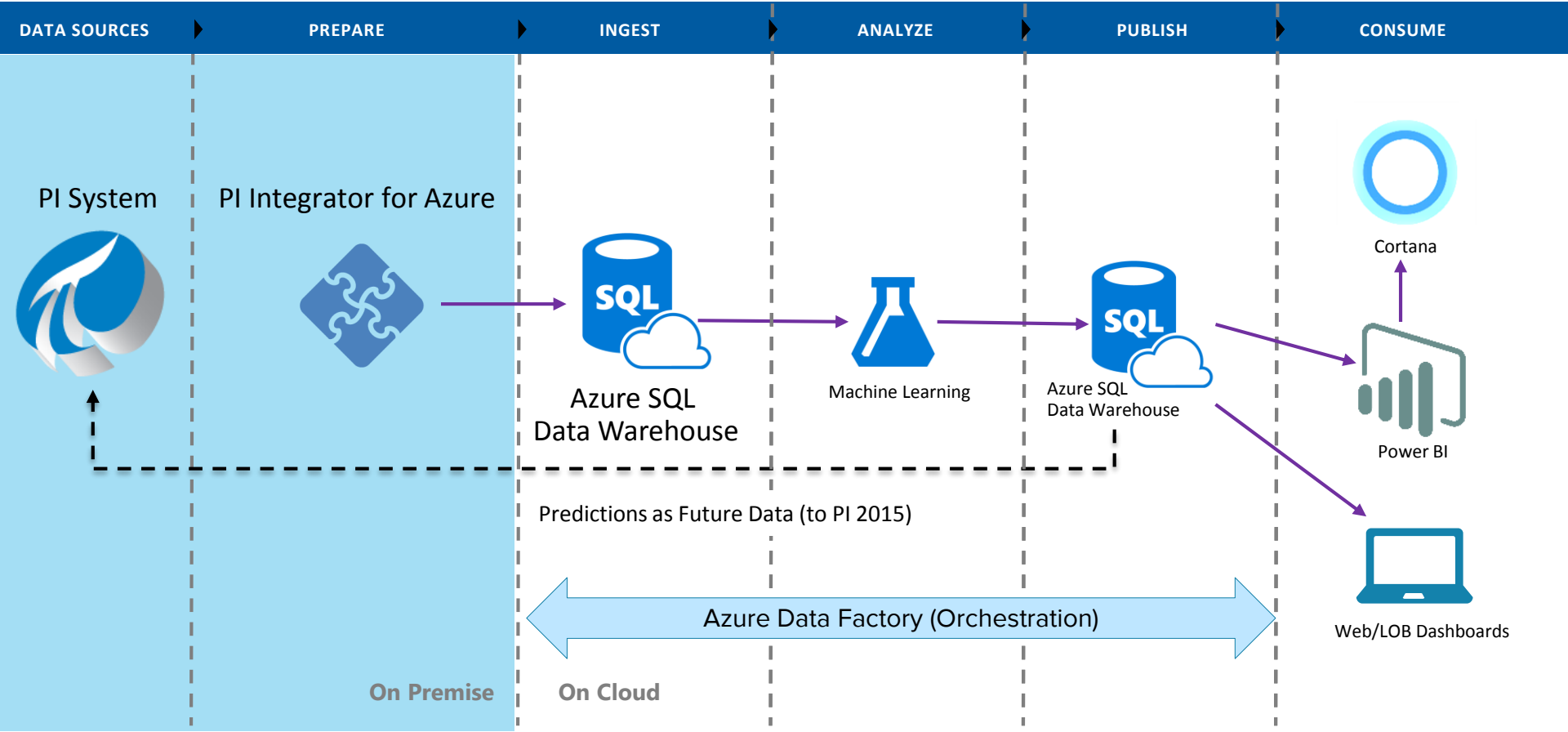


PI Integrator for SAP HANA Architecture



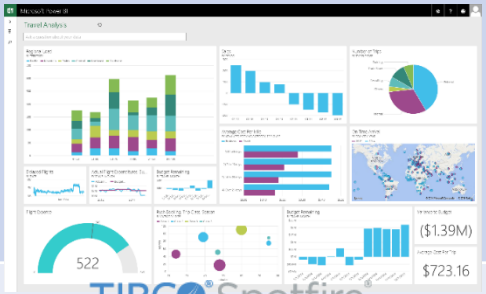
Full platform coverage for all data integration scenarios!

Soon… PI Integrator for Azure SQL Datawarehouse



Getting Value…

Solving complex problems for a fleet	Dashboarding – visual reporting – real time & mobile	Integration to new I.T. projects and databases
Multivariate, other statistics & machine learning resources One time answers or Running models	Drill drown, rollup Anywhere anytime	The right way to bring operational data to I.T.'s Big Data party…



TIBCO Spotfire

Power BI

tableau

Microsoft SQL Server Reporting Services

hadoop

ORACLE BUSINESS INTELLIGENCE

SAP

Move the Needle with PI Integrators

- Start the conversation!
  - Could a colleague make a **better decision** with **data you see daily**?
  - What **business intelligence tools** could you leverage further?
- Visit **YouTube** or osisoft.com to see which PI Integrator works for you

PI Integrator for Business Analytics
PI Integrator for SAP HANA
PI Integrator for Microsoft Azure

Contact Information

Martin Bryant

MBryant@osisoft.com

Field Service Engineer

OSIsoft, LLC

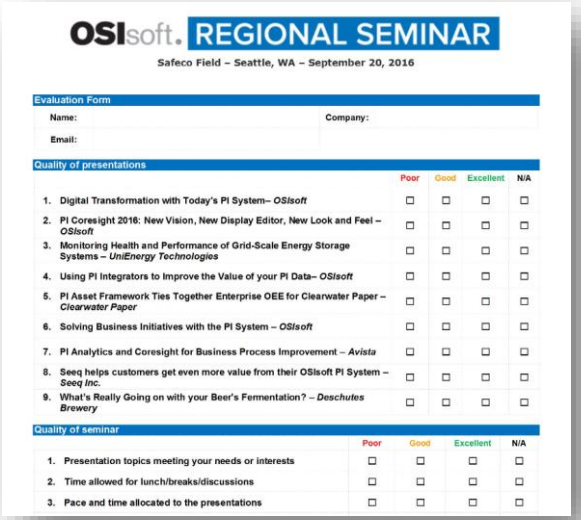
Questions

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

State your
name & company

Please remember to…

Complete the Survey
for this session



OSIsoft. REGIONAL SEMINAR

Safeco Field – Seattle, WA – September 20, 2016

Evaluation Form

Name: Company:

Email:

Quality of presentations

	Poor	Good	Excellent	N/A
1. Digital Transformation with Today's PI System– *OSIsoft*	☐	☐	☐	☐
2. PI Coresight 2016: New Vision, New Display Editor, New Look and Feel – *OSIsoft*	☐	☐	☐	☐
3. Monitoring Health and Performance of Grid-Scale Energy Storage Systems – *UniEnergy Technologies*	☐	☐	☐	☐
4. Using PI Integrators to Improve the Value of your PI Data– *OSIsoft*	☐	☐	☐	☐
5. PI Asset Framework Ties Together Enterprise OEE for Clearwater Paper – *Clearwater Paper*	☐	☐	☐	☐
6. Solving Business Initiatives with the PI System – *OSIsoft*	☐	☐	☐	☐
7. PI Analytics and Coresight for Business Process Improvement – *Avista*	☐	☐	☐	☐
8. Seeq helps customers get even more value from their OSIsoft PI System – *Seeq Inc.*	☐	☐	☐	☐
9. What's Really Going on with your Beer's Fermentation? – *Deschutes Brewery*	☐	☐	☐	☐

Quality of seminar

	Poor	Good	Excellent	N/A
1. Presentation topics meeting your needs or interests	☐	☐	☐	☐
2. Time allowed for lunch/breaks/discussions	☐	☐	☐	☐
3. Pace and time allocated to the presentations	☐	☐	☐	☐

Thank You