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

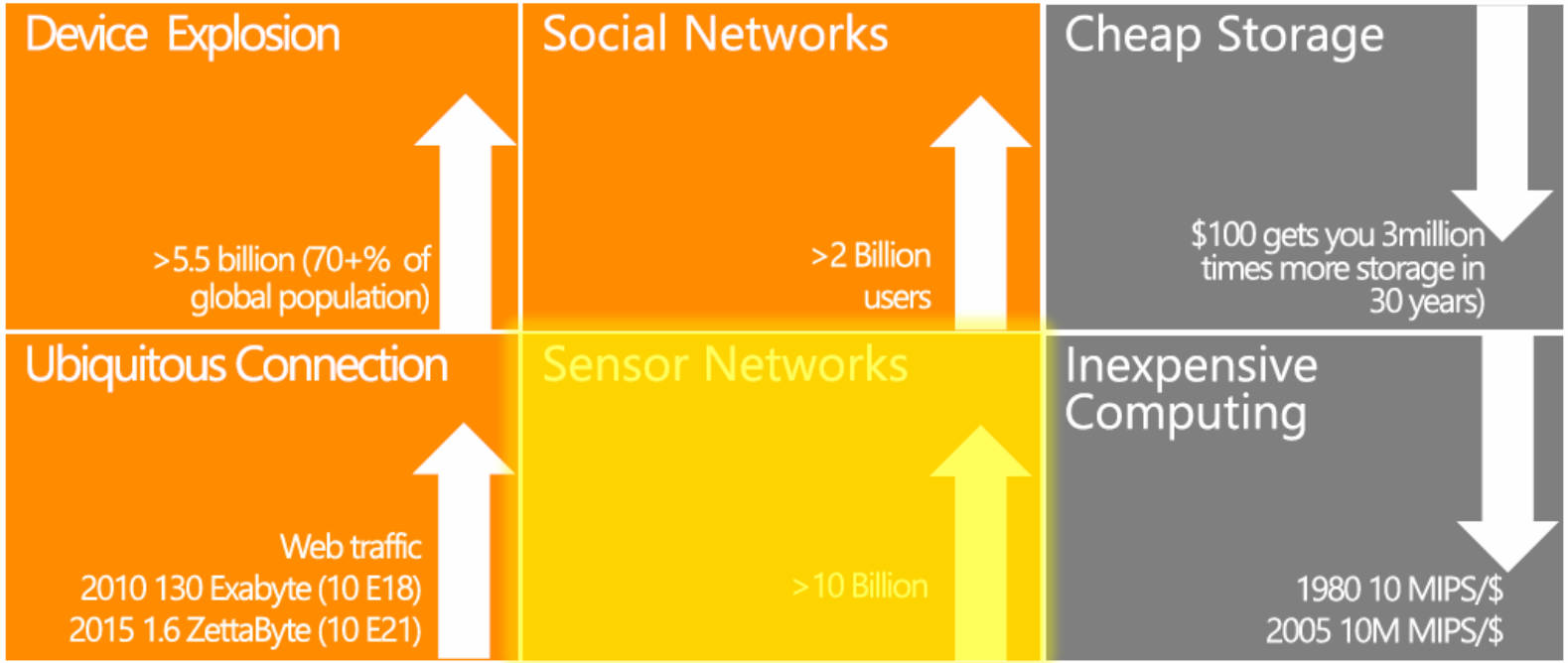
Data Science

Business Intelligence

Data Mining

Advanced Visualization

The Importance of Data (and Sensor Data) is Increasing



OSIsoft has Listened to Your Needs

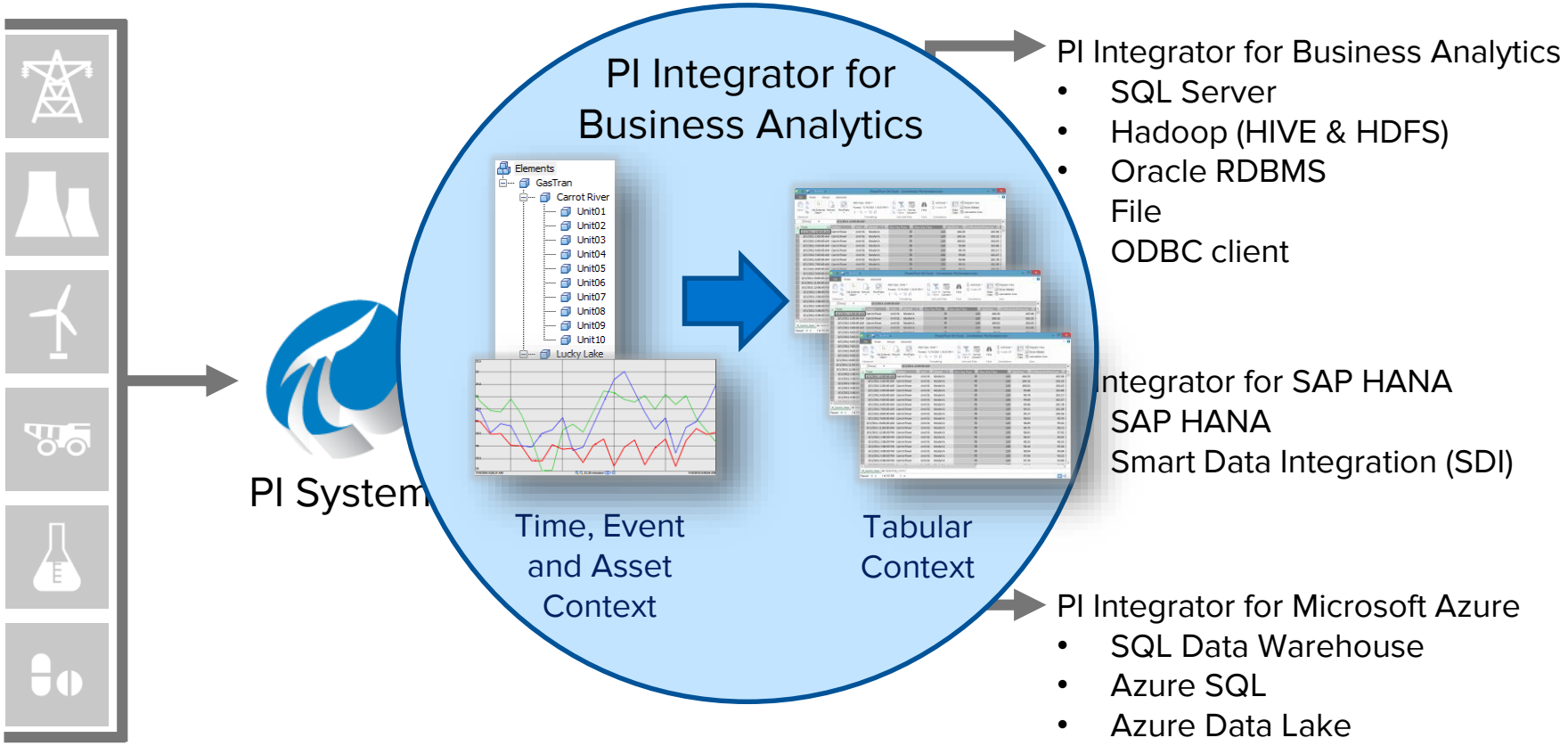
Summary of Needs:

Familiar tools

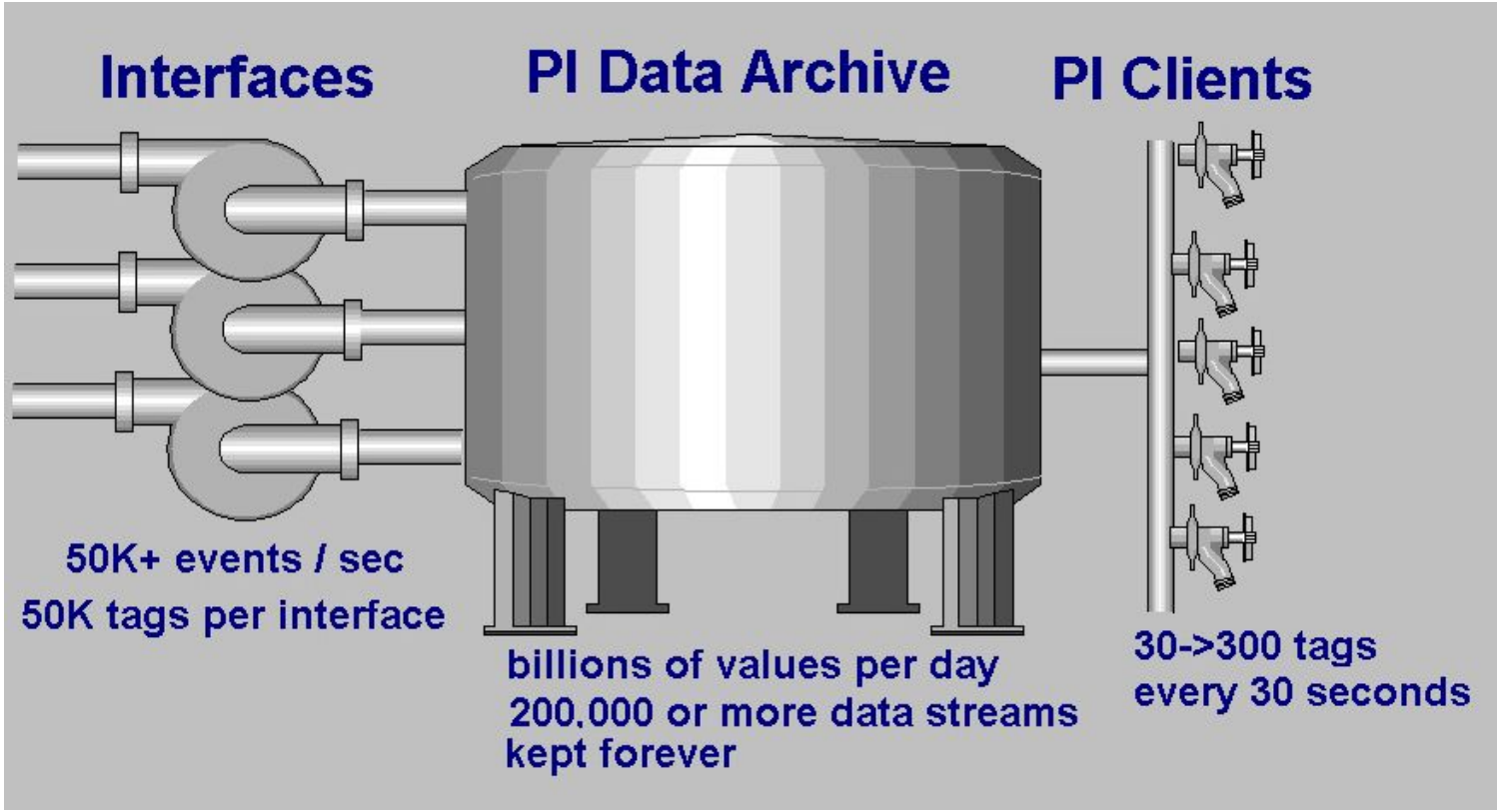
Scalability without code

Flexibility and trust

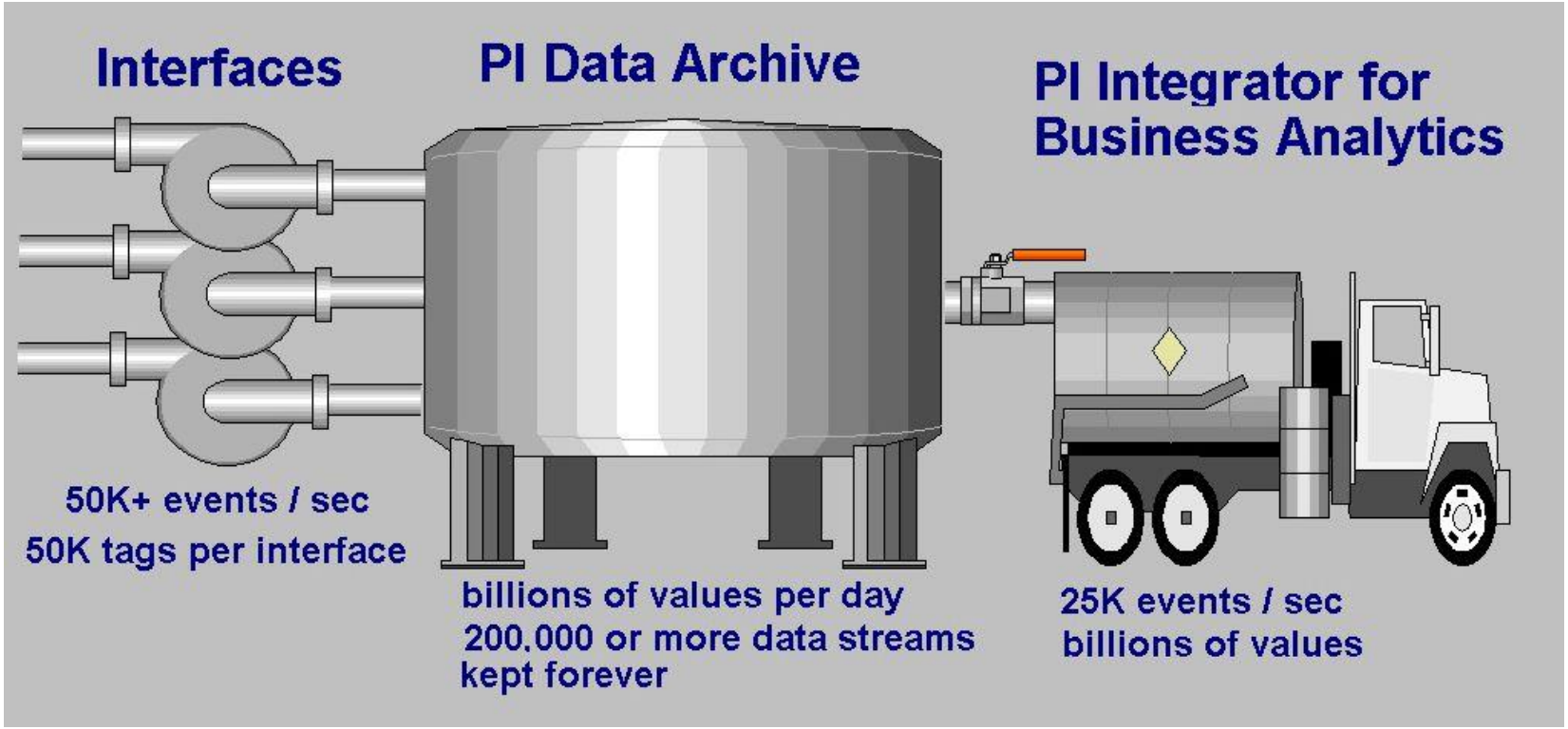
PI Integrators



The Traditional PI System

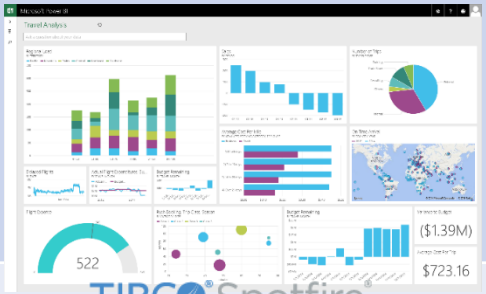


An Alternative Data Use Model



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? Big data … complex problem solving

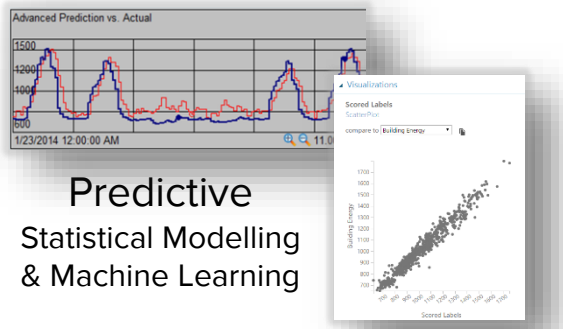
Statistical Analytics

- 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

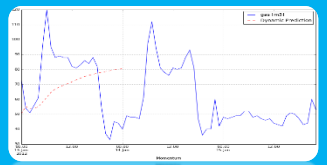
Benchmarking

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

Using run times and not clock hours to schedule

Preventive Maintenance

and inspections

Performance

Compare current performance metrics, including vibration 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?

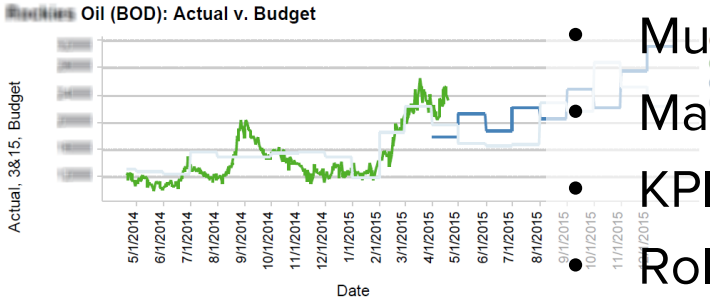
Transmission & Dist

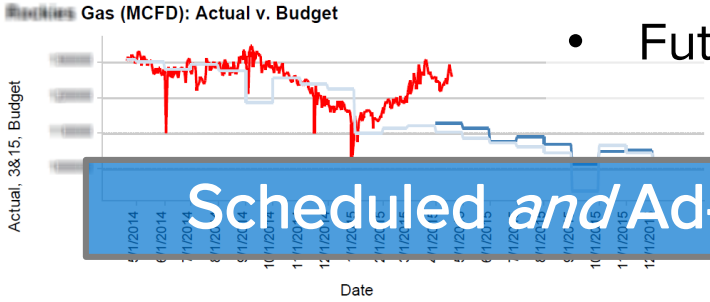
- How are renewables impacting the equipment?
- Was there a voltage violation?
- What are the changes in weather?

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

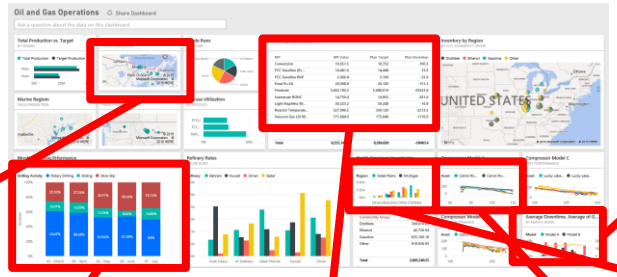
Don't wait for tomorrow to explore performance today

your operational data is a click or swipe away.

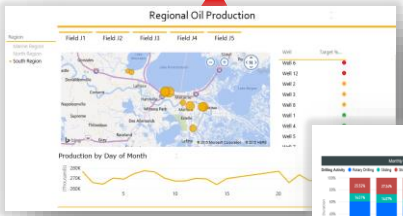
Even from your mobile devices

Result: Improved, Detailed Reporting and Analytics

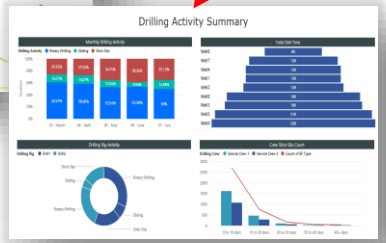
Dashboard drilldowns to detailed reports



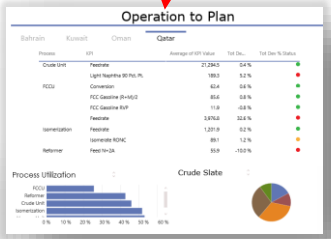
PI Coresight Displays



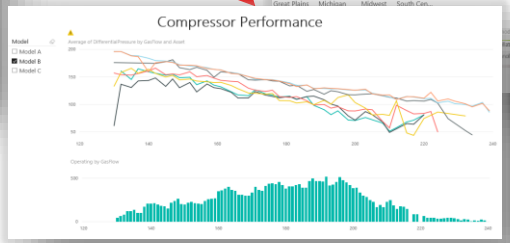
Production Summaries



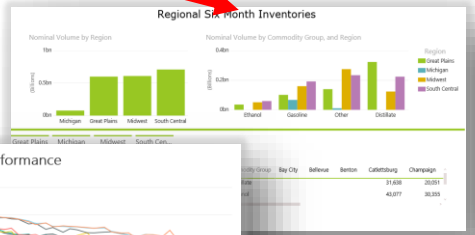
Drilling Activity Reports



Refinery KPI Scorecards



Asset Performance Displays



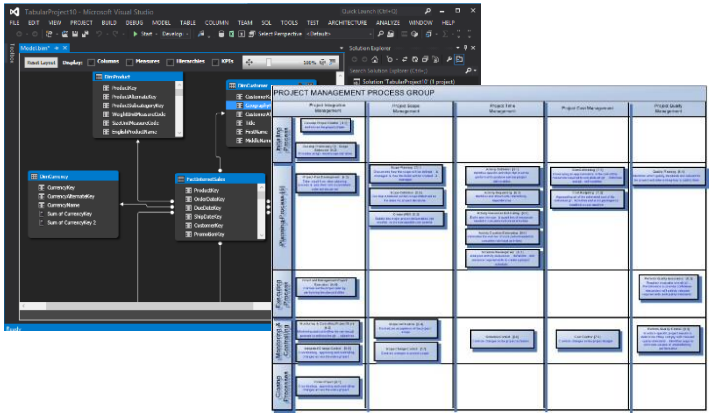
Regional Product Inventories

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



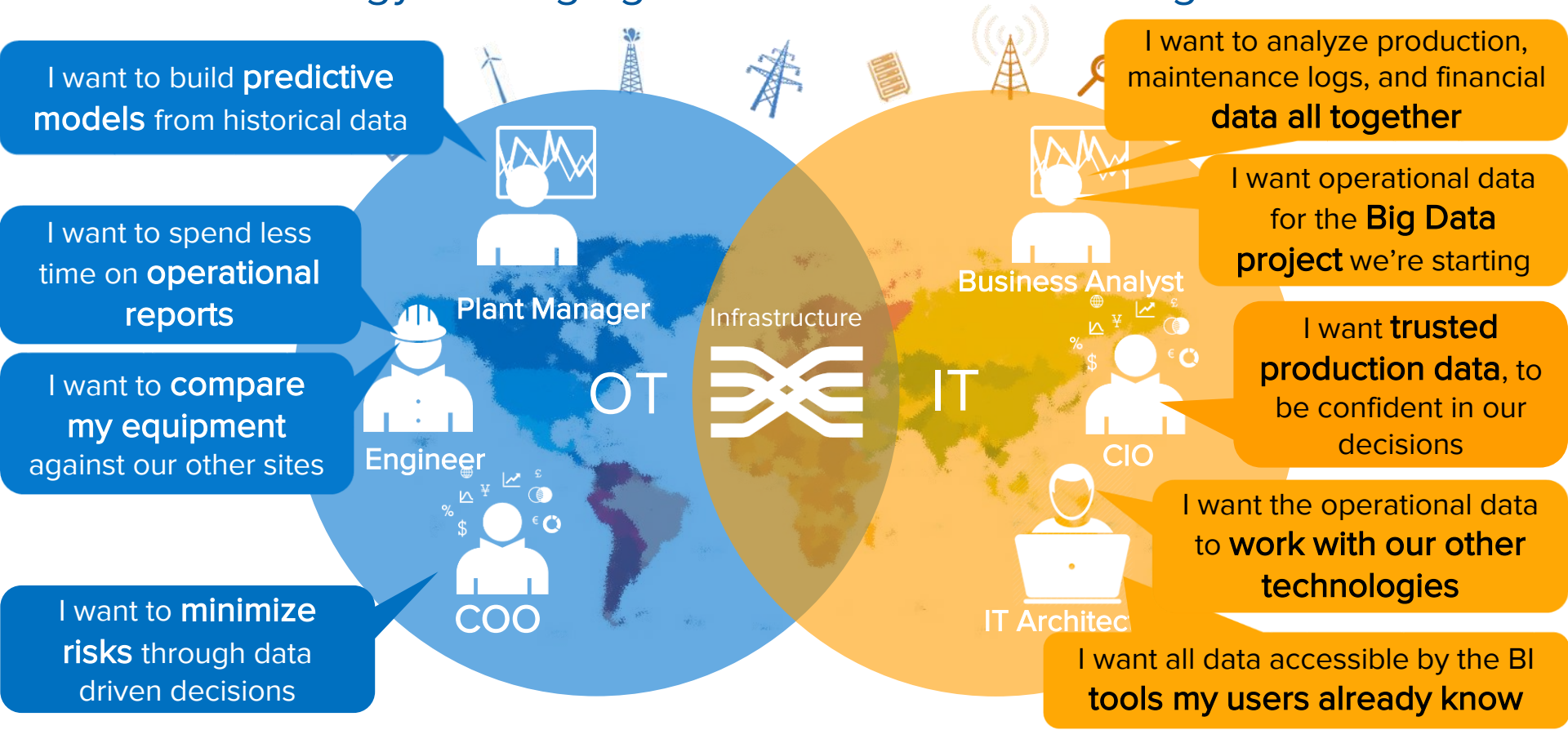
hadoop

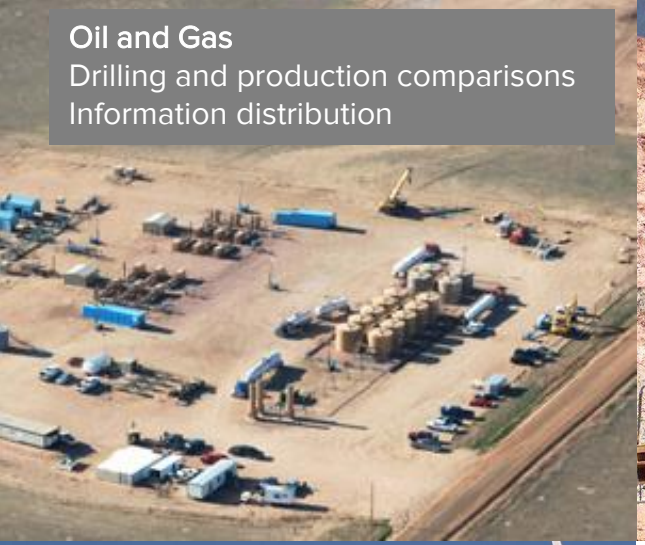
Power BI

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

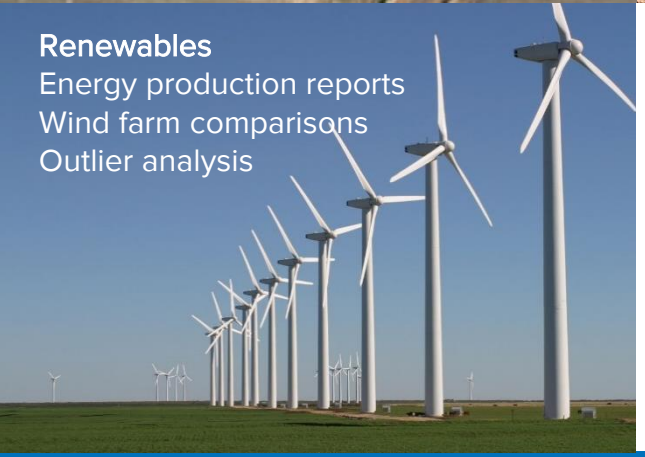




Oil and Gas
Drilling and production comparisons
Information distribution

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

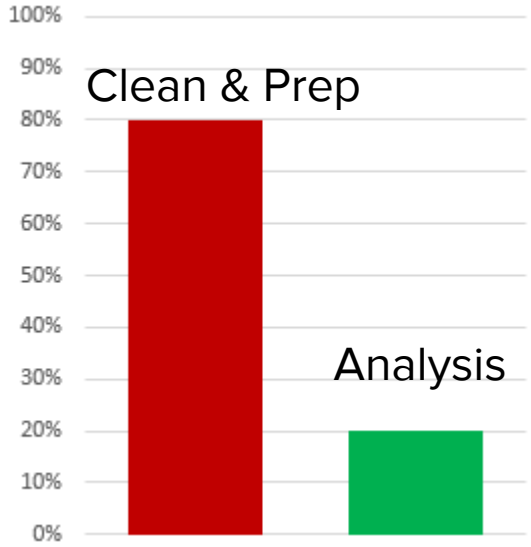
PI Integrator for Business Analytics is in use today!

- ✓ 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

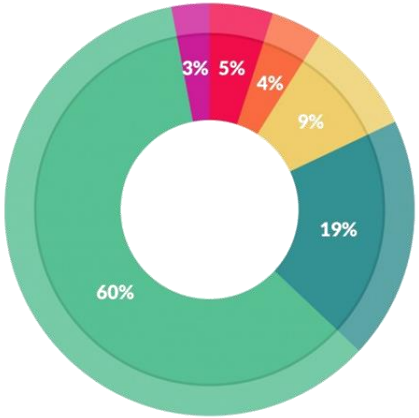
64% of large enterprises plan to implement a big data project.
85% will be unsuccessful.



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

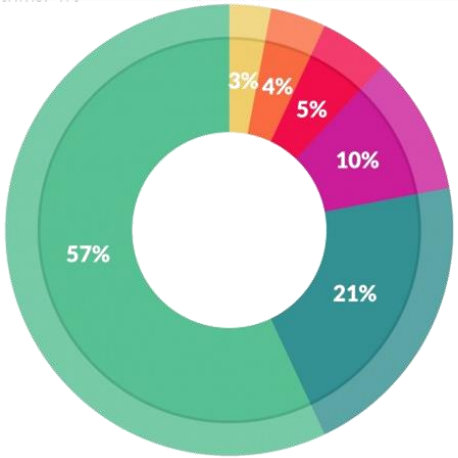
Source: https://hbr.org/2014/04/the-sexiest-job-of-the-21st-century-is-tedious-and-that-needs-to-change/

(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%*

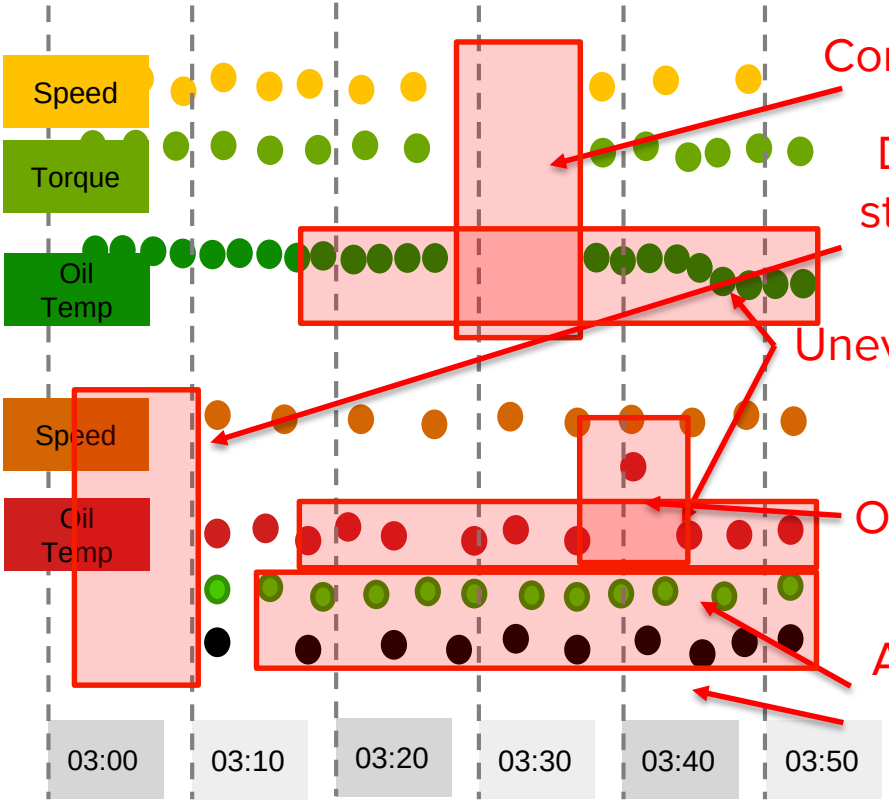


What's the least enjoyable part of data science?

- *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

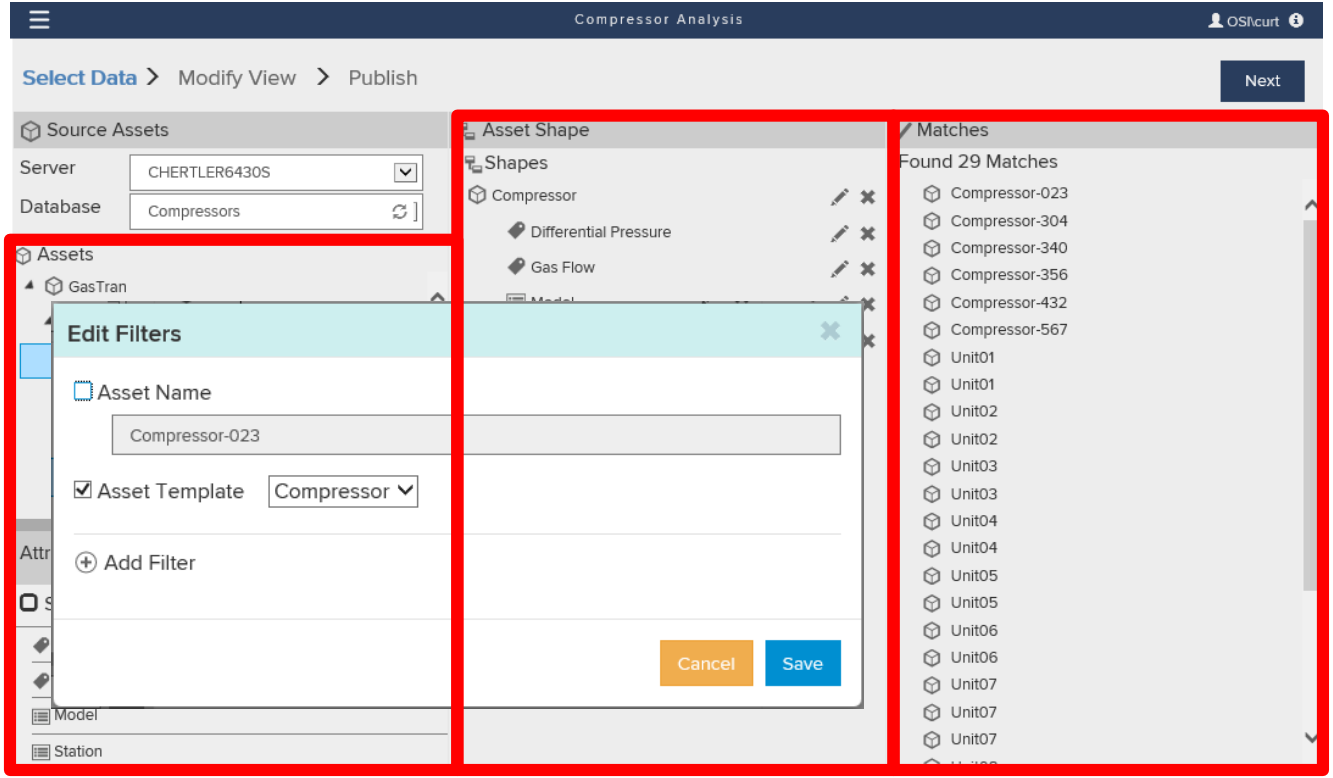
Microsoft SQL Server Reporting Services

hadoop

Analyze

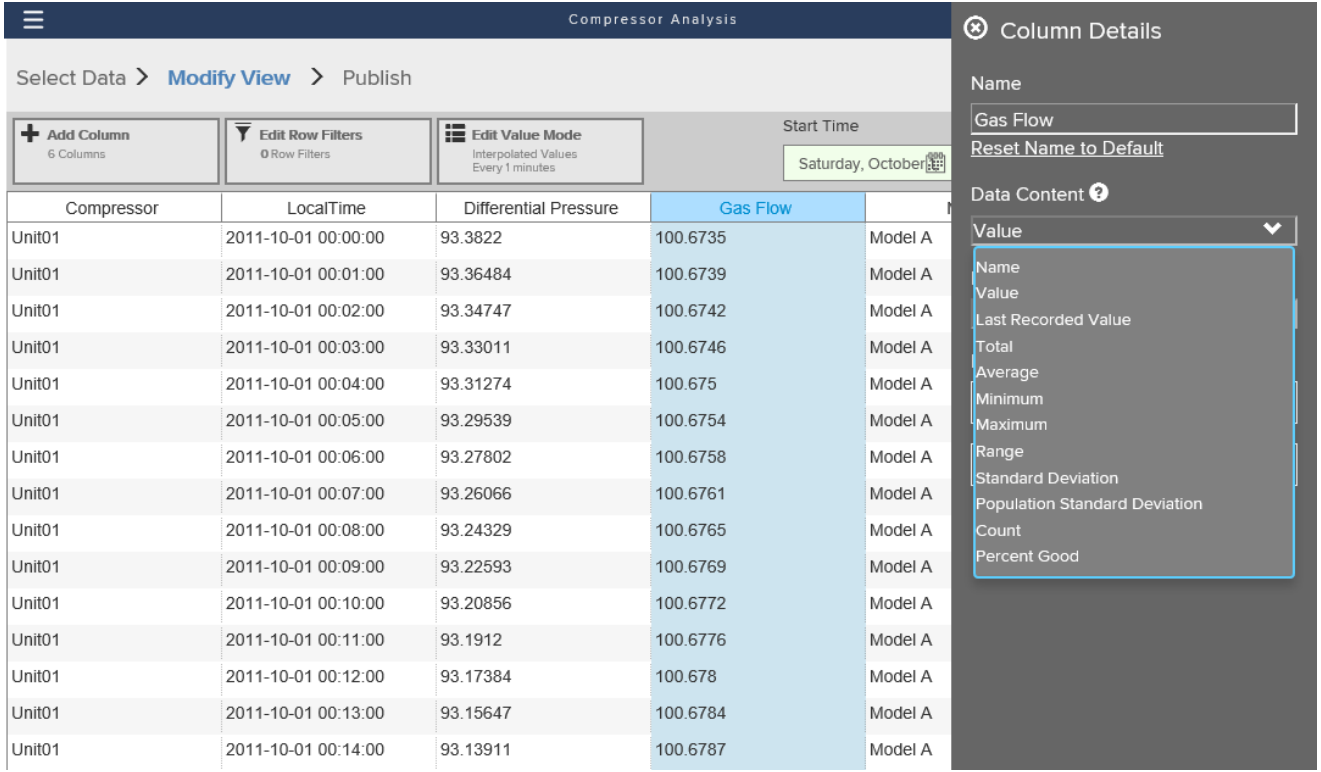
PI Integrator for Business Analytics - “Select Data”

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



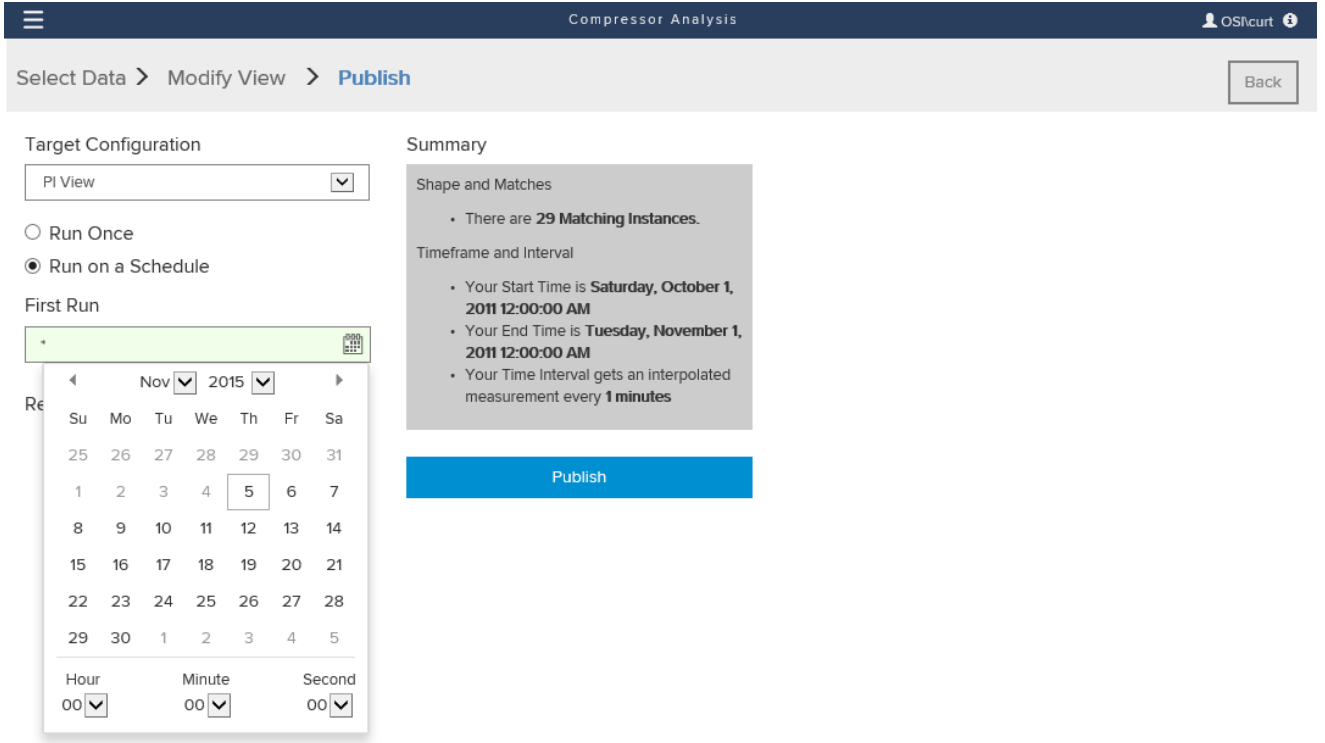
PI Integrator for Business Analytics - “Modify View”

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



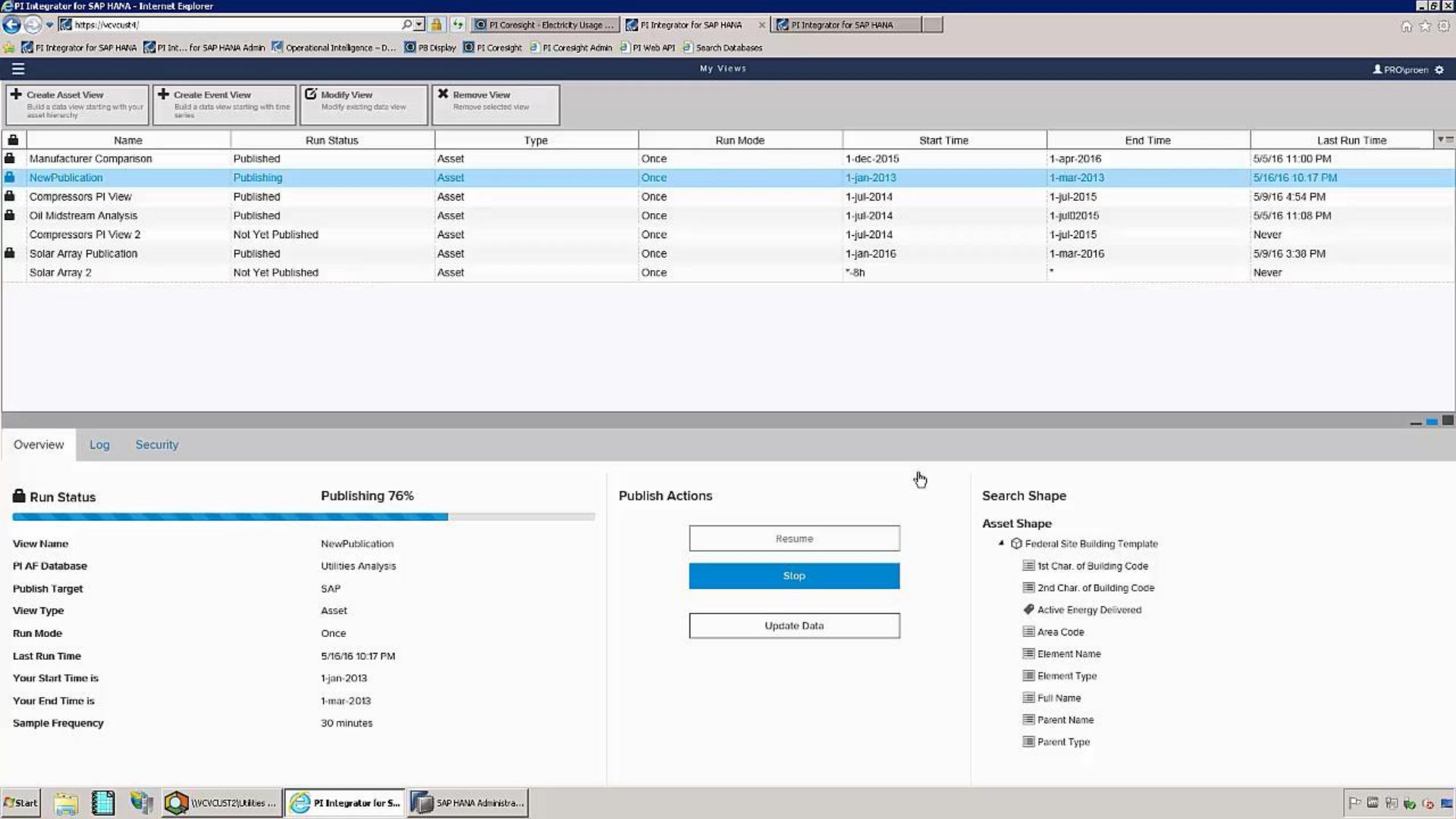
PI Integrator for Business Analytics - “Publish”

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

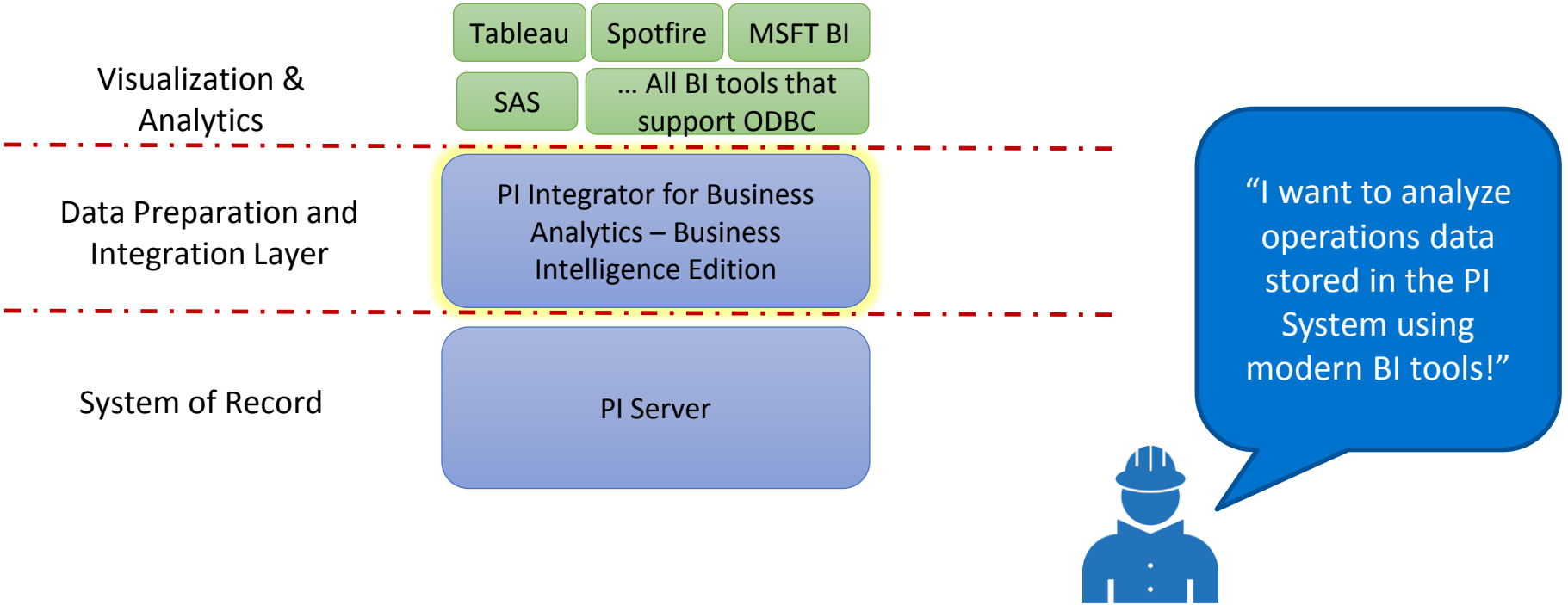


Let's See This in Action!

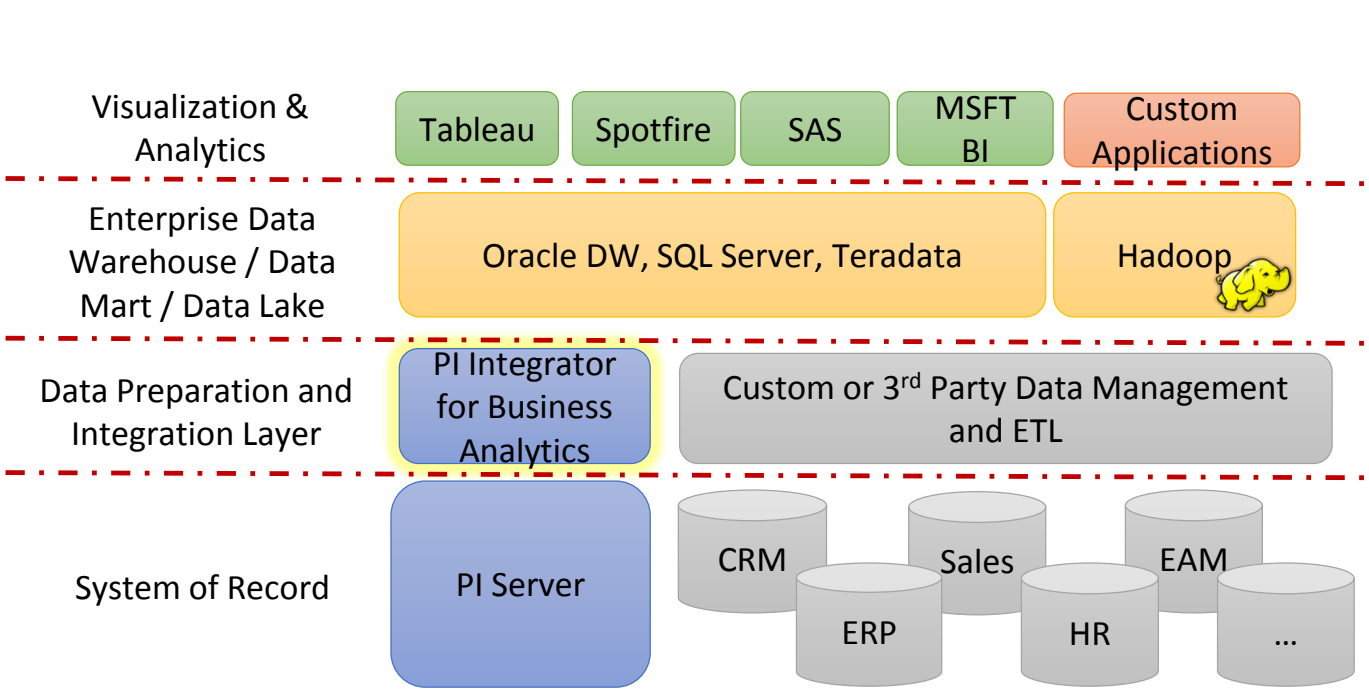
Publishing Building Energy Consumption for 67 Buildings to SAP HANA


PI Integrator for SAP HANA - Internet Explorer
My Views
Create Asset View
Build a data view starting with your asset hierarchy
Create Event View
Build a data view starting with time series
Modify View
Modify existing data view
Remove View
Remove selected view
Name
Run Status
Type
Run Mode
Start Time
End Time
Last Run Time
Manufacturer Comparison
Published
Asset
Once
1-dec-2015
1-apr-2016
5/5/16 11:00 PM
NewPublication
Publishing
Asset
Once
1-jan-2013
1-mar-2013
5/16/16 10:17 PM
Compressors PI View
Published
Asset
Once
1-jul-2014
1-jul-2015
5/9/16 4:54 PM
Oil Midstream Analysis
Published
Asset
Once
1-jul-2014
1-jul2015
5/5/16 11:08 PM
Compressors PI View 2
Not Yet Published
Asset
Once
1-jul-2014
1-jul-2015
Never
Solar Array Publication
Published
Asset
Once
1-jan-2016
1-mar-2016
5/9/16 3:38 PM
Solar Array 2
Not Yet Published
Asset
Once
*-8h
*
Never
Overview
Log
Security
Run Status
Publishing 76%
View Name
NewPublication
PI AF Database
Utilities Analysis
Publish Target
SAP
View Type
Asset
Run Mode
Once
Last Run Time
5/16/16 10:17 PM
Your Start Time is
1-jan-2013
Your End Time is
1-mar-2013
Sample Frequency
30 minutes
Publish Actions
Resume
Stop
Update Data
Search Shape
Asset Shape
Federal Site Building Template
1st Char. of Building Code
2nd Char. of Building Code
Active Energy Delivered
Area Code
Element Name
Element Type
Full Name
Parent Name
Parent Type

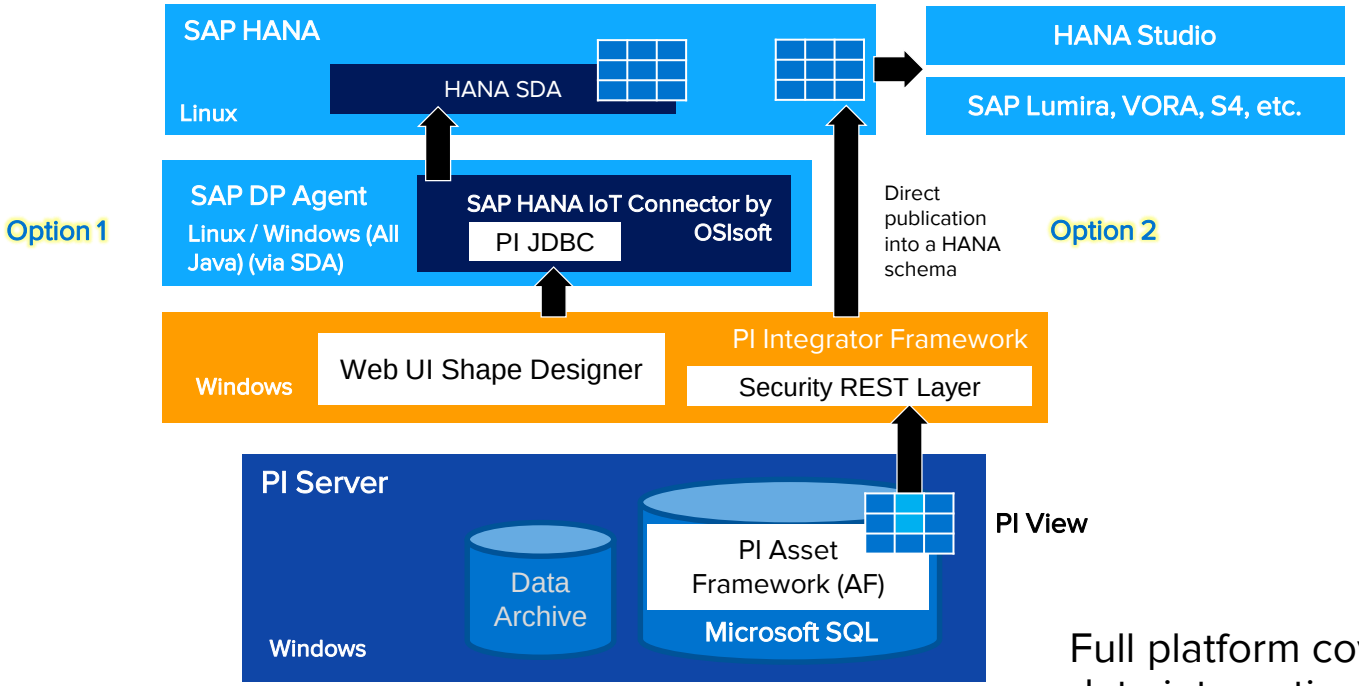
Operational Reporting & Analysis Architecture



Enterprise Data Warehouse Architecture

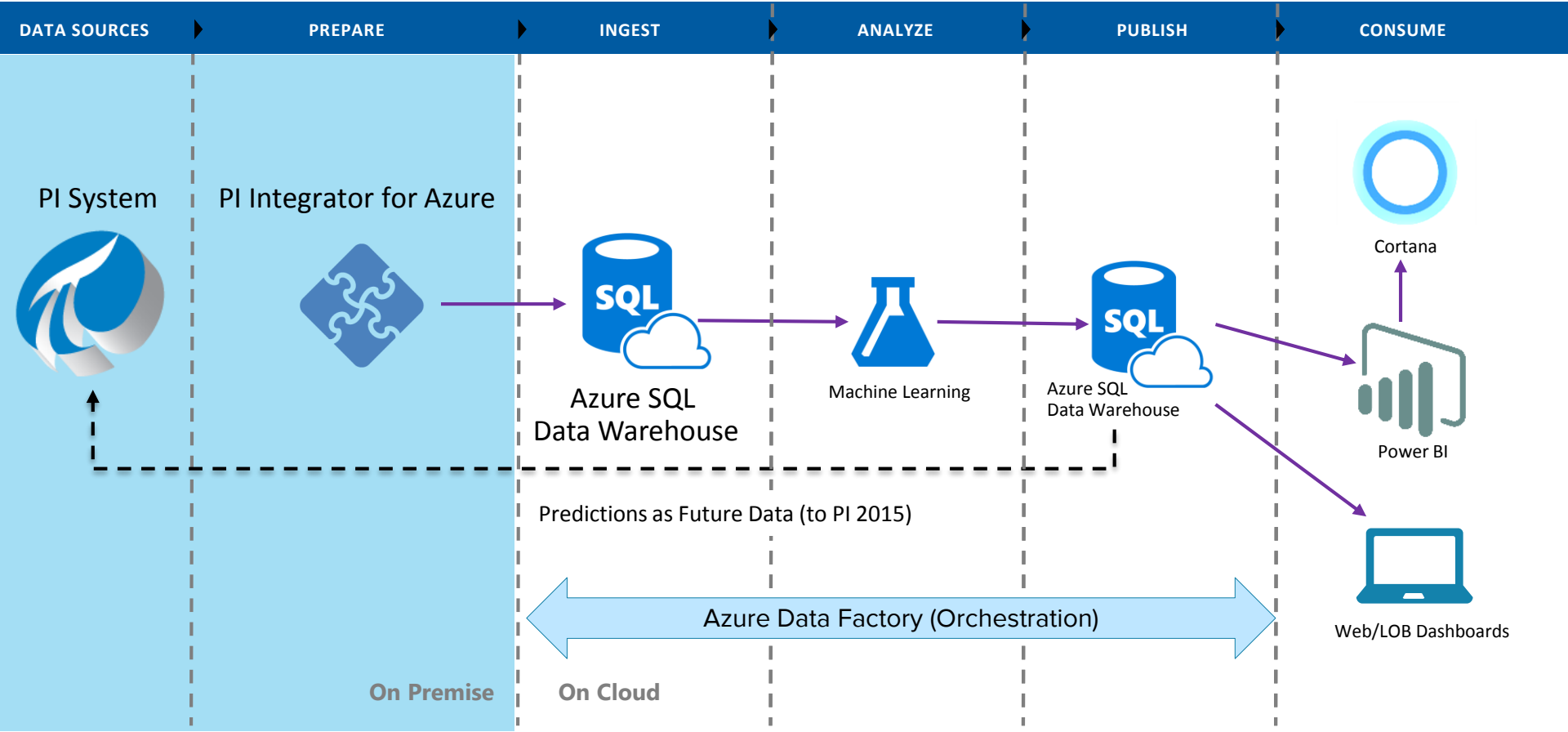


PI Integrator for SAP HANA Architecture



Full platform coverage for all data integration scenarios!

Soon… PI Integrator for Azure SQL Datawarehouse



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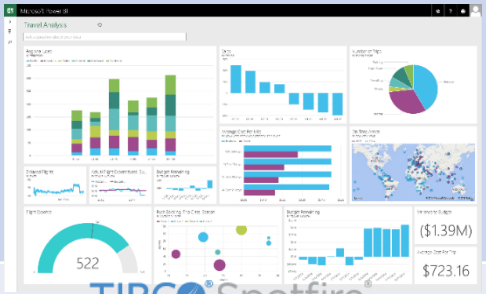
Multivariate, other statistics & machine learning resources One time answers or Running models	Drill drown, rollup Anywhere anytime	The right way to bring operational data to I.T.'s Big Data party…



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

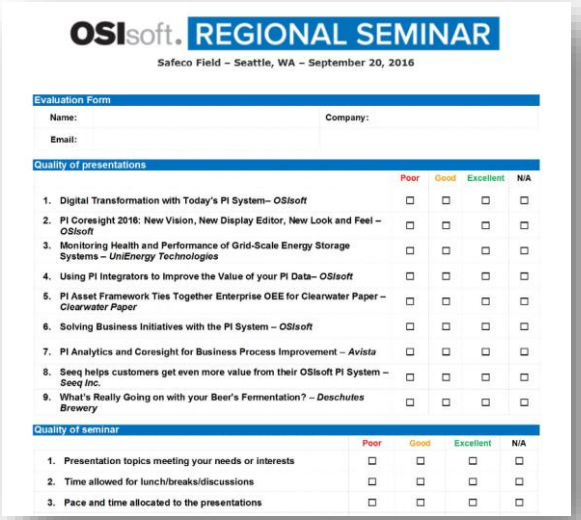
Questions

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

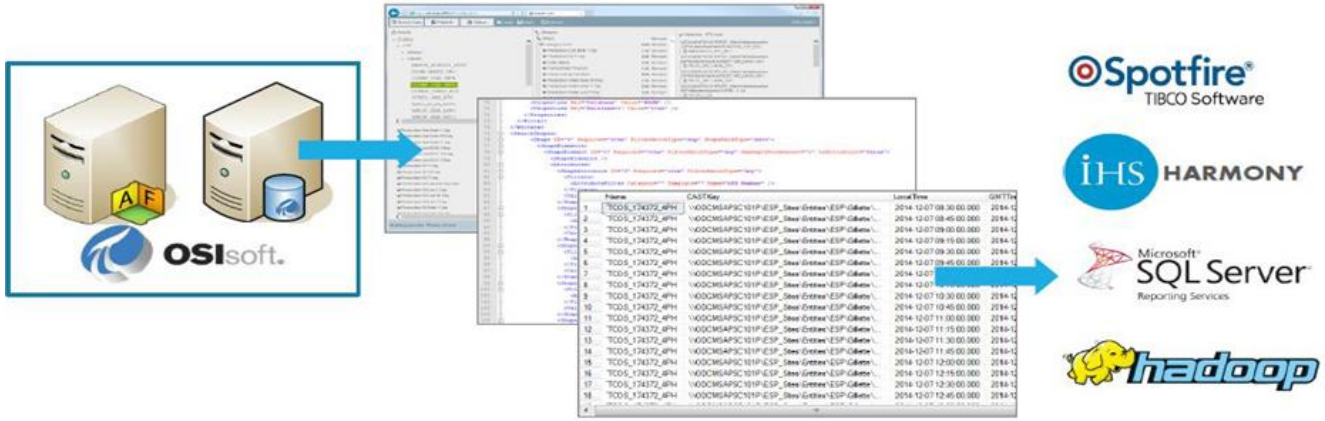
	Poor	Good	Excellent	N/A
1. Digital Transformation with Today's PI System– *OSIsoft*	☐	☐	☐	☐
2. PI Coresight 2016: New Vision, New Display Editor, New Look and Feel – *OSIsoft*	☐	☐	☐	☐
3. Monitoring Health and Performance of Grid-Scale Energy Storage Systems – *UniEnergy Technologies*	☐	☐	☐	☐
4. Using 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

PI Integrator for Business Analytics



The PI Integrator for Business Analytics fully realizes the PI infrastructure goal by providing peerless real-time & deep historical PI process data to enterprise “big data” dash-boarding, integration, analysis and data scientist tools with easy configuration and performance.

PI Integrator For Business Analytics

- **No programming or queries** - browser based configuration
  - Integrated to PI AF - uses templates as schemas
- **Rest Model Accessed with ODBC driver**
  - New fast PI ODBC Driver & PI Data Access Server
- **Windows Integrated security** with delegation (Kerberos)
- **Updates for new data on a schedule**

PI Integrator For Business Analytics

Integrator Targets:

- Microsoft SQLServer
- Hadoop
- Oracle
- Ascii files/CSVs
- SAP Hana (from SAP)
- Microsoft SQL Datawarehouse for Azure (cloud based)

PI Integrator For Business Analytics

- Supports PI Event Frames
- Time Sampling analogous to PI Datalink
- Data cleansing (nulls/errors), row filtering (by value, etc..), data typing (string/numeric) for each column
- Aggregations supported – calculate averages, totals for intervals.

PI Integrator For Business Analytics

Compared to previous OSIsoft data access technologies:

- **Much easier to learn** (2 hrs instead of 1 day - configured not coded)

  no coding – no code generators

- **Much higher performing** (many millions of rows instead of <100K)

  ~ 25K outbound events per second

- **Integrates to key 21st century technologies**

  endorsed by major tech players and many large companies

  More secure

What's new?

Is this merely a new product built by OSIsoft?
or does it fit into a larger perspective?

Relational database technology is changing

Technology is changing – new opportunities from "Big Data" and internet of things

Relational database technology is changing

SQL – the end of an era

- Tablular. Not object oriented
- File oriented. Not scalable
- Security Challenges

SQL and relational / tabular technologies are not adequate to today's data.

Relational database technology is changing

Web Services – not adequate for big data

- Too slow for big data
- Transmission and query – but no storage
- Programming – but no client tools
- Security Challenges

Relational database technology is changing

Best of both worlds technologies required:

REST (representational state transfer) technologies

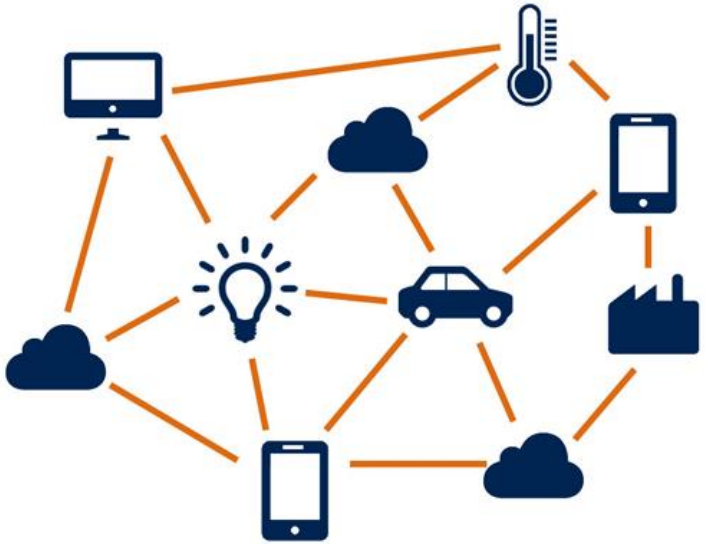
- Web interface and transport – designed for the internet
- Performance – designed for memory resident scalability
- Standard data formats including binary formats
- Object oriented
- Secure in the current cross platform environment

Impact of Social Media

Google, Facebook, and other social media sites have generated massive amounts of data..
This may not seem immediately relevant to industrial applications,
But it has driven new search engine and database technologies..
And it has resulted in self-service clients to do analysis

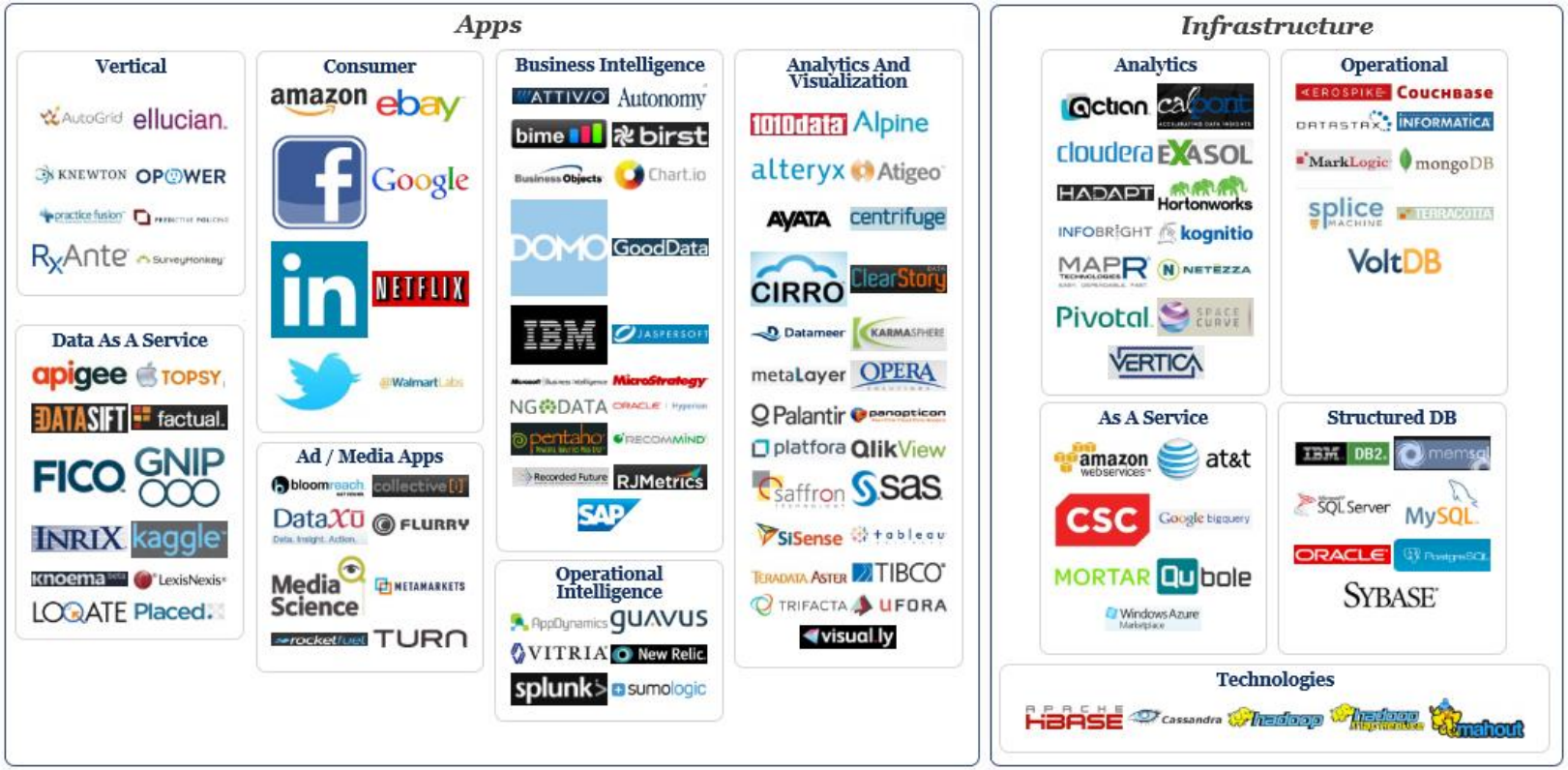
Impact of Internet of Things

As computing becomes less expensive…
Every “thing” gets a computer – refrigerators, fitness wristbands, cars, drones, mobile devices,
and new industrial devices too
These devices are not organized and concentrated pyramidaly
and that is demanding and providing new secure data communications and database technology.



The Big Data Landscape

From: http://www.bigdatalandscape.com/



Why? Big data … 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…

- How are renewables impacting the grid?
- What kind of grid components are associated with voltage violations?
- What is the impact of changing weather?

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

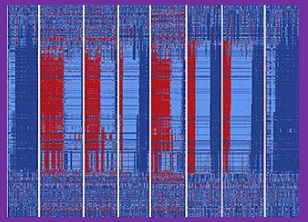
Benchmarking

Fleet-wide performance comparisons

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

System Optimization

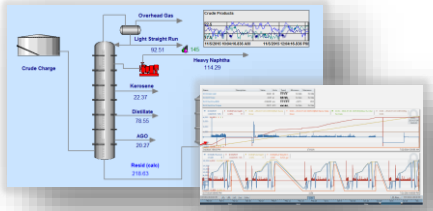
Large scale multi-variate analysis



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

Enabling Analytics for Operational Intelligence

Real-Time Decision Analysis



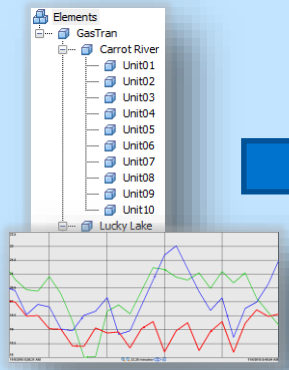
Time and Event
Trending & Awareness

Specialized Models
Simulation & Optimization

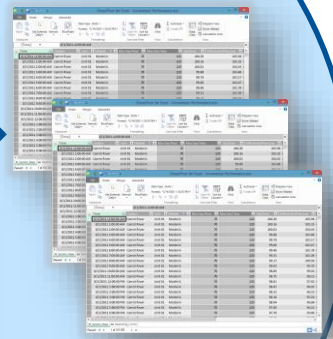
$$Q = \frac{\Delta P_{DD} * kh}{141.2 \mu B_0 \left\{ ln \frac{r_e}{r_w} - \frac{3}{4} + S \right\}}$$

Descriptive
Condition & Performance

PI Integrator for Business Analytics



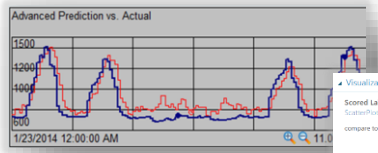
Time, Event and Asset Context

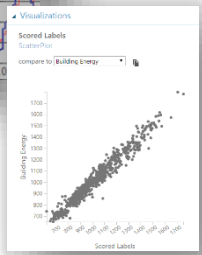


Tabular Context

Retrospective & Predictive Analysis

Multidimensional
Business Intelligence & Dashboards





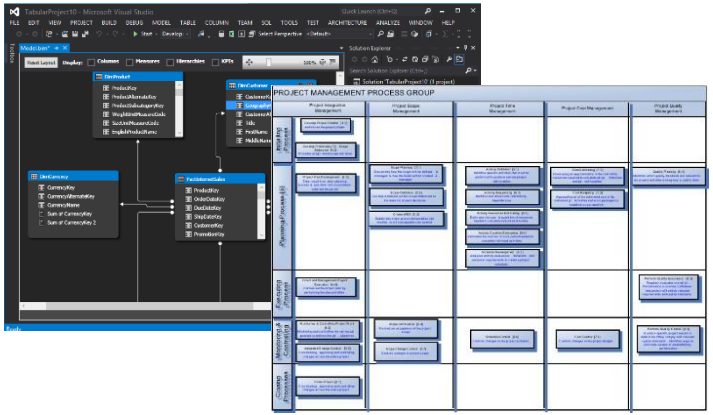
Predictive
Statistical Modelling & Machine Learning

Why? I.T. Integration projects

Data Warehousing

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

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.



hadoop

Power BI

SAP

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

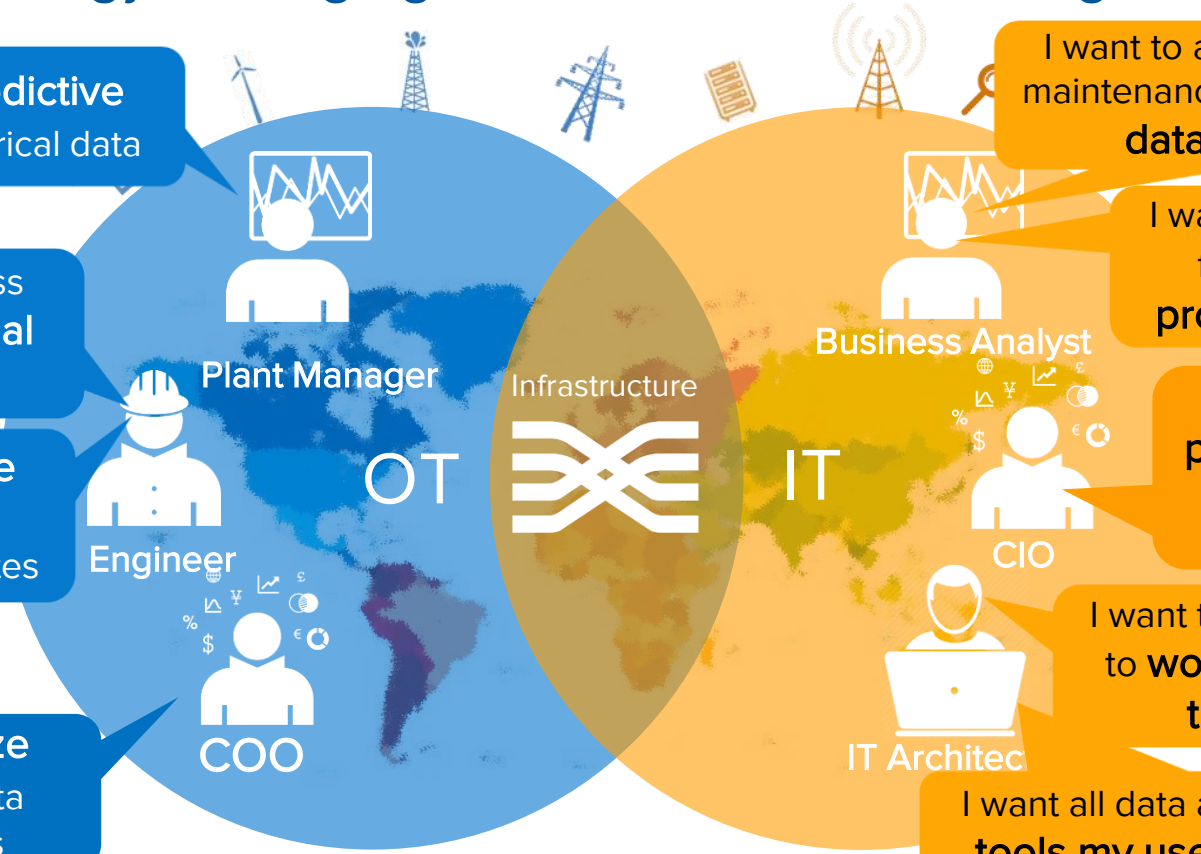
New Technology is bringing the IT and OT Worlds Together

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**

No single purpose data pools – data lakes that are:

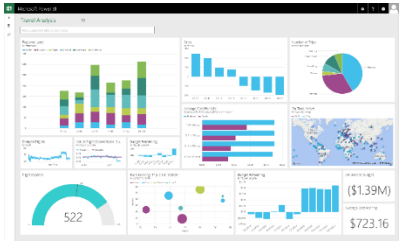
- Reusable & Flexible
- Vetted & Maintained
- Secure
- Integrated with data from other sources

Why? Dashboarding

Visual Analytics

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

Industrial companies are replacing periodic row and column reports (day, shift, etc..) with dynamic web-based dashboards – and they are exploring them from their phones and mobile devices. They are combining the near real time operational data with financial and administrative data for the comprehensive view of the immediate road ahead.

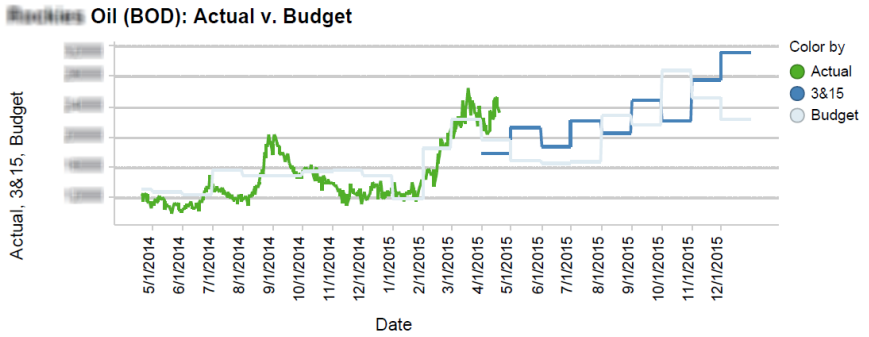


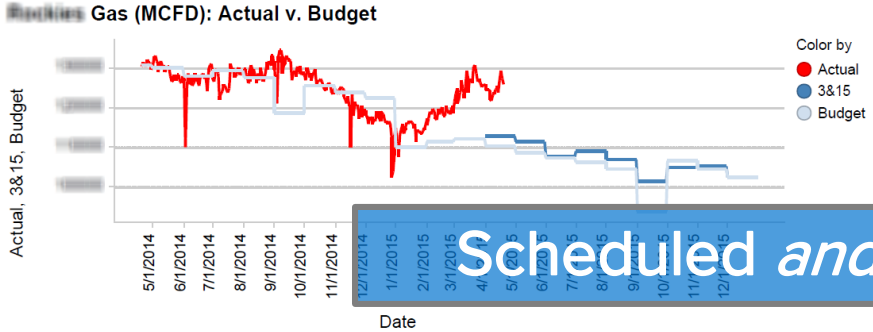
Don't wait for tomorrow to explore performance today

your operational data is a click or swipe away.

Even from your mobile devices

Use Case: Management Summaries



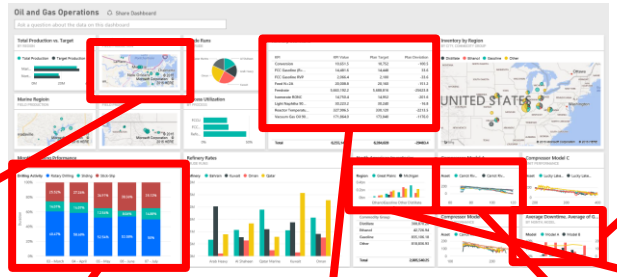


- Automated daily reports
- Multiple data source views
- Management overviews
- KPIs and metrics
- Rollups by business unit
- Future Data (forecast)

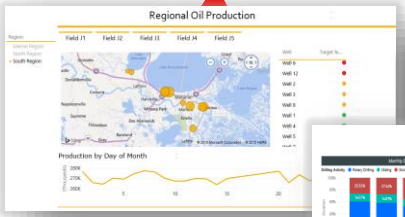
Scheduled *and* Ad-Hoc Reporting

Result: Improved, Detailed Reporting and Analytics

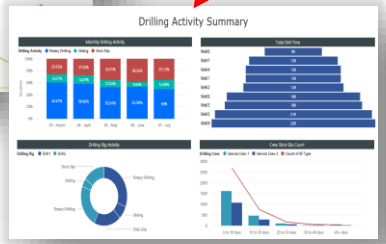
Dashboard drilldowns to detailed reports



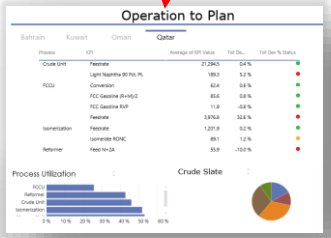
PI Coresight Displays



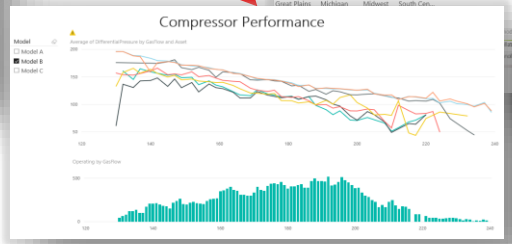
Production Summaries



Drilling Activity Reports



Refinery KPI Scorecards



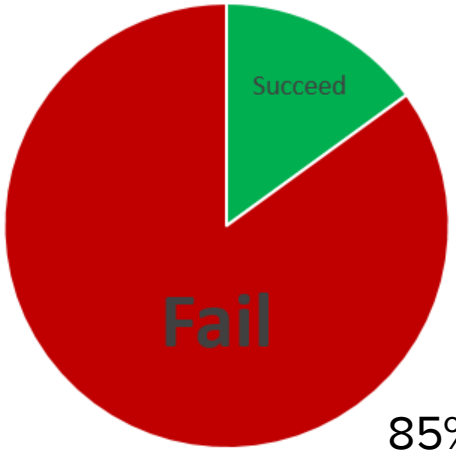
Asset Performance Displays

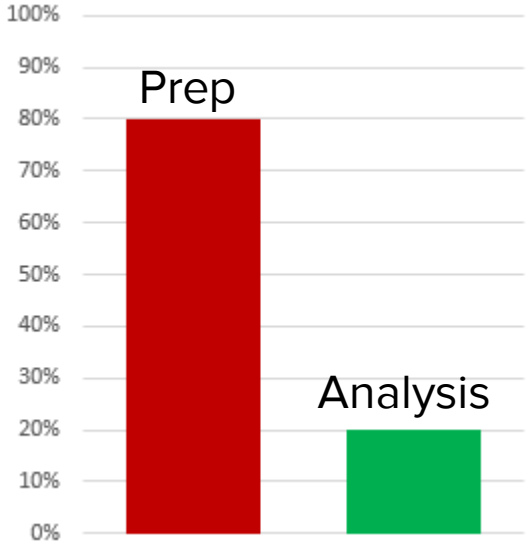
Regional Product Inventories

Big Data Projects Sound Easy… But there are Complications!

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

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

OSIsoft has Listened to Your Needs

Summary of Needs:

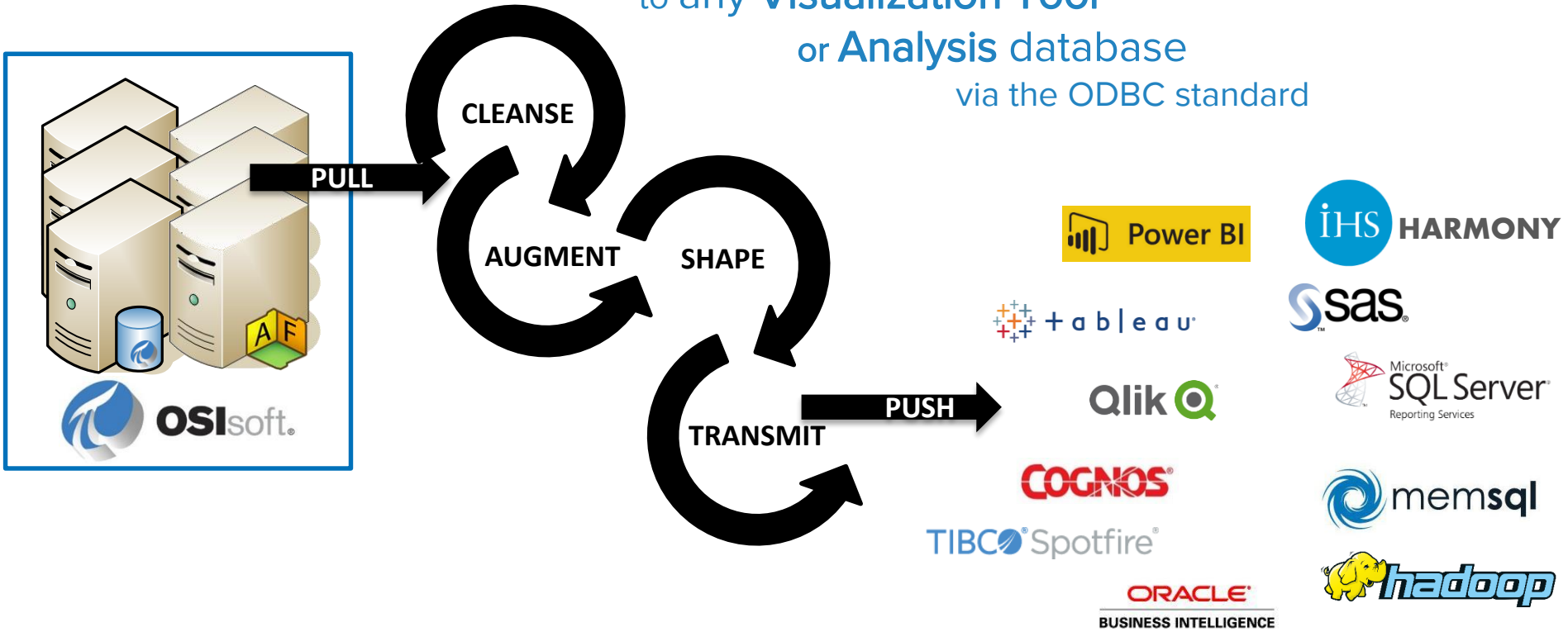
Familiar tools

Scalability without code

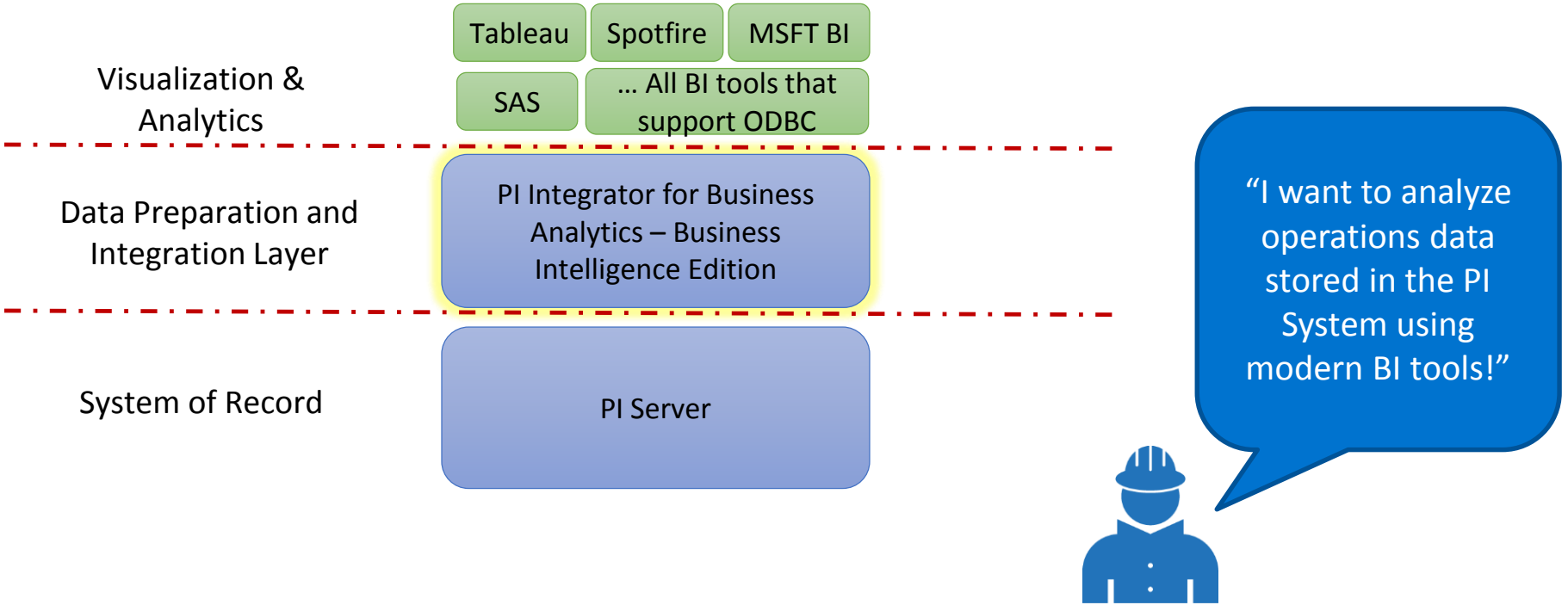
Flexibility and trust

OSIsoft's Solution Lets You Prepare and Deliver Process Data

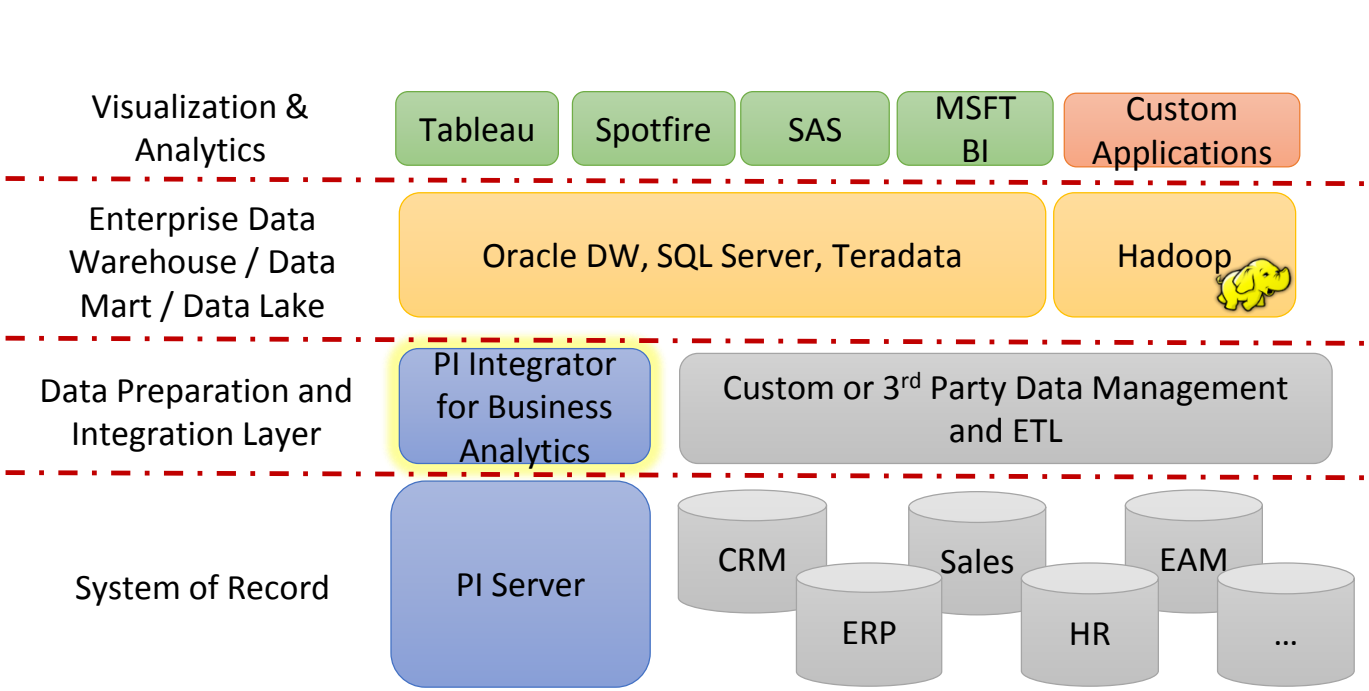
to any **Visualization Tool**
or **Analysis** database
via the ODBC standard



Operational Reporting & Analysis Architecture

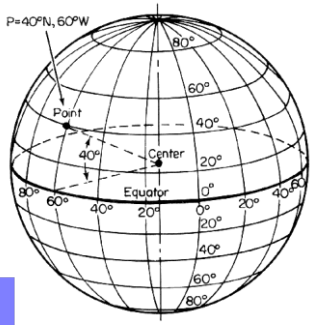


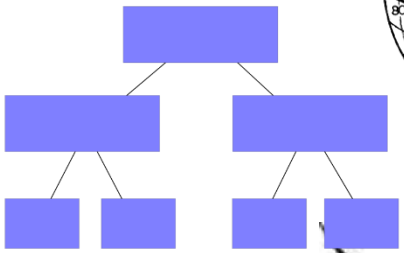
Enterprise Data Warehouse Architecture



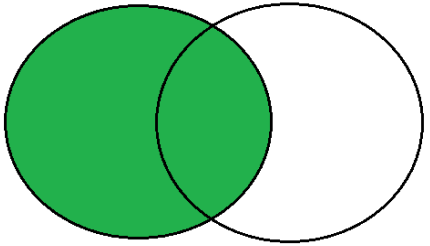
Tips - Meta Data & Hierarchy

- You can't roll up and you can't drill down without hierarchy
- And Meta-data (installation date, mode, long/lat) is where the slicers for great BI comes from





Tips - Joins



Using this technolody – Joins are done in the client

We had pretty clear naming of our elements –
f you are having problems with joining to unique objects – two hints

One to many joins – it's easier to join if one database has only one record per unique item (one per turbine or transformer or substation – you can use this as an index and join other tables to it and they'll transfer those relationships through it.

If your naming is not very unique – you can insert the ElementID in as an attribute and join on that. We did that in this example even though we didn't need to.

Tips - Categories

If you have multiple tables coming from the same element – you can predefine what you want to put in each table by marking them with categories…
Sort by category in the integrator and pull the whole group into your attribute / column selection.

Tips - Aggregates

The default method for getting data into a column for the integrator is interpolation
The fastest method is “last recorded value”
But often the best is an average ..

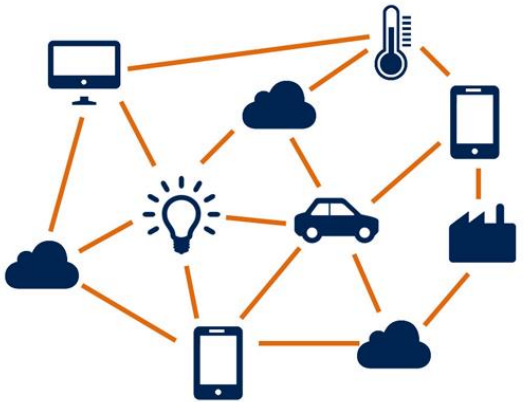
Don’t be shy about the average

Takeaways

As always – developments in the larger technology world (Big Data, the Internet of Things) are producing innovations in database and communications technology

At OSIsoft – we are not just aware of this – we are embracing it…

With technologies that use new standards and methods but are consistent with your decades of history…



Takeaways

PI Integrator For Business Analytics

- **No programming or queries** (based on PI AF)
- **Writes to appropriate Big Data databases** (Hadoop, SAP)
- **Cleanse, Filter, Shape your data – and it will update**
- **Secure**

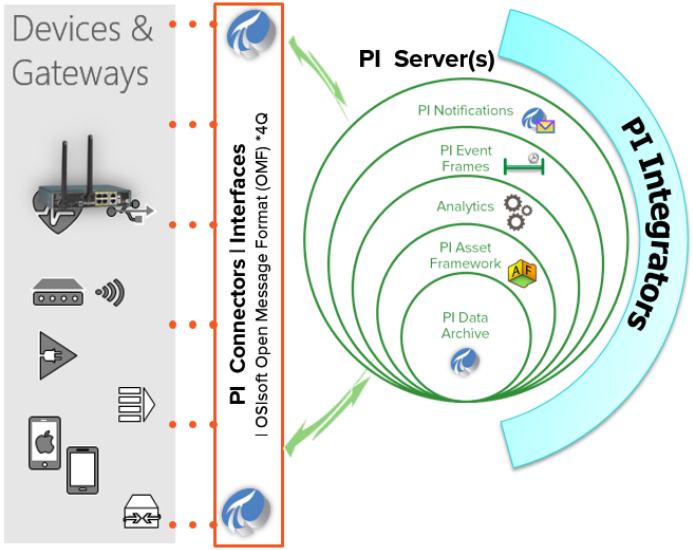
Compared to previous OSIsoft data access technologies:

- **Much easier to learn and use**
- **Much higher performing**

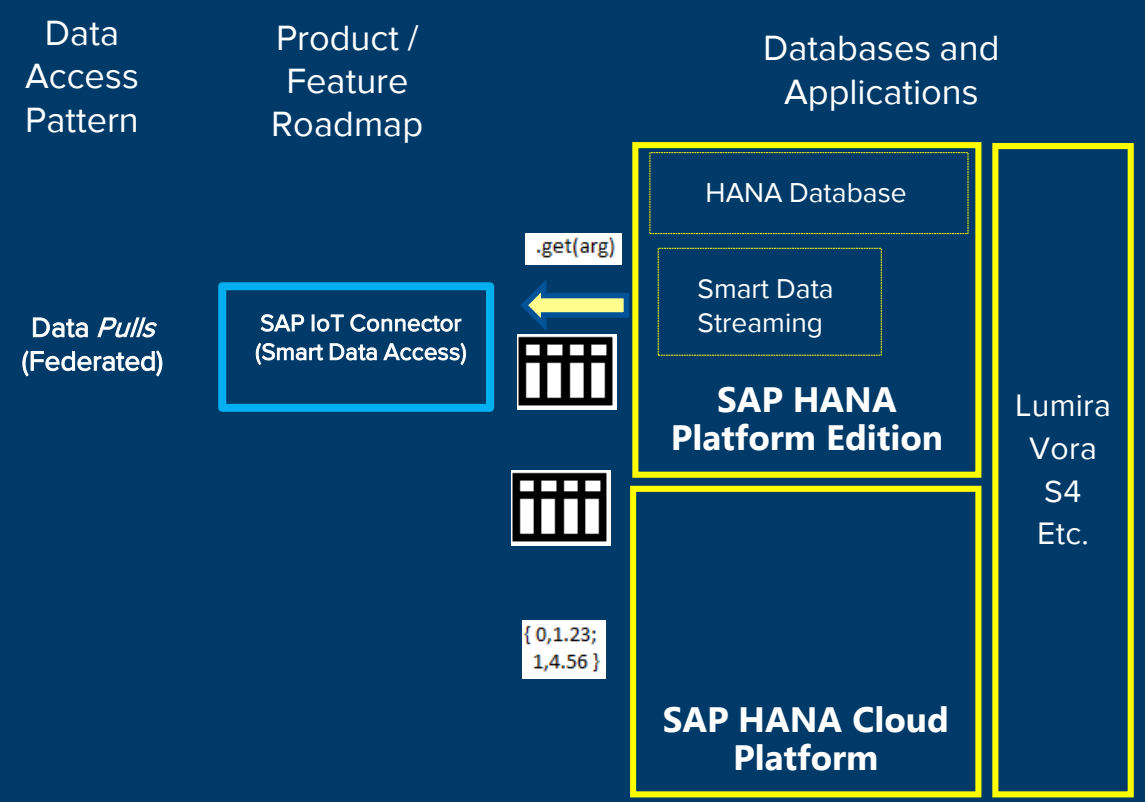
Use Cases

- Production Reporting
  - More detailed view into energy, oil, metals
- Alerting and Customer Intimacy
  - Integrate detailed production data with CRM data to alert on outages and meet customized SLA requirements
- Regulatory Compliance
  - Keep product genealogy data on hand for products to deal with regulatory requests
- Root Cause Analysis
  - Discover patterns related to equipment failure or low quality product

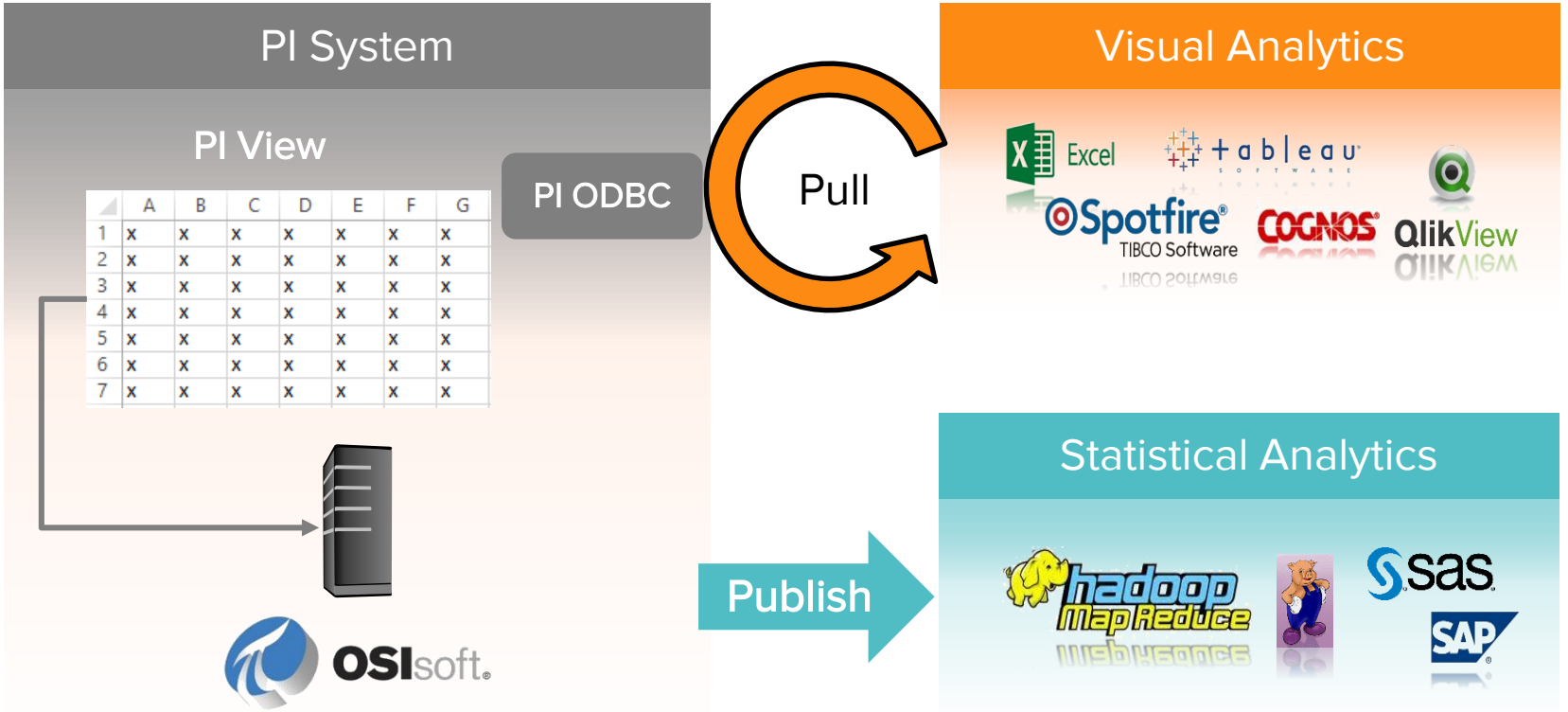
PI Integrator for SAP HANA



Full platform coverage for all data integration scenarios

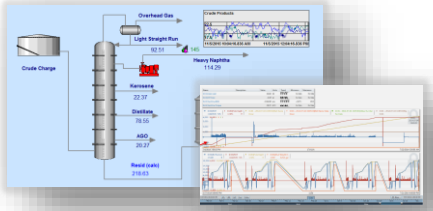


Released: PI Integrator for Business Analytics & SAP Hana



Enabling Analytics for Operational Intelligence

Real-Time Decision Analysis



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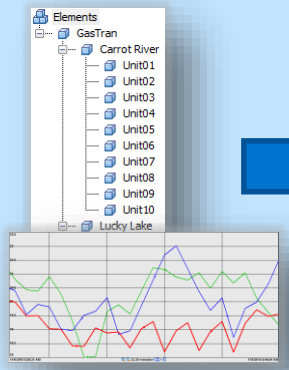

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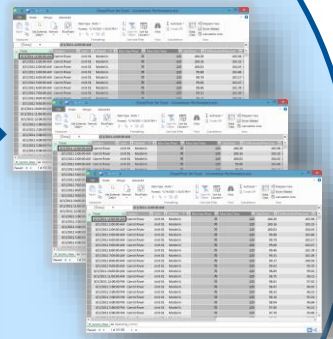

Tabular Context

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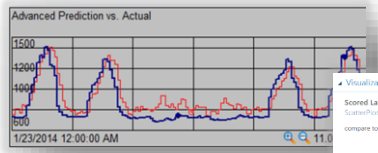
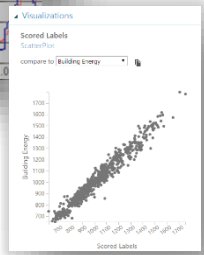
Business Intelligence & Dashboards





Predictive
Statistical Modelling & Machine Learning

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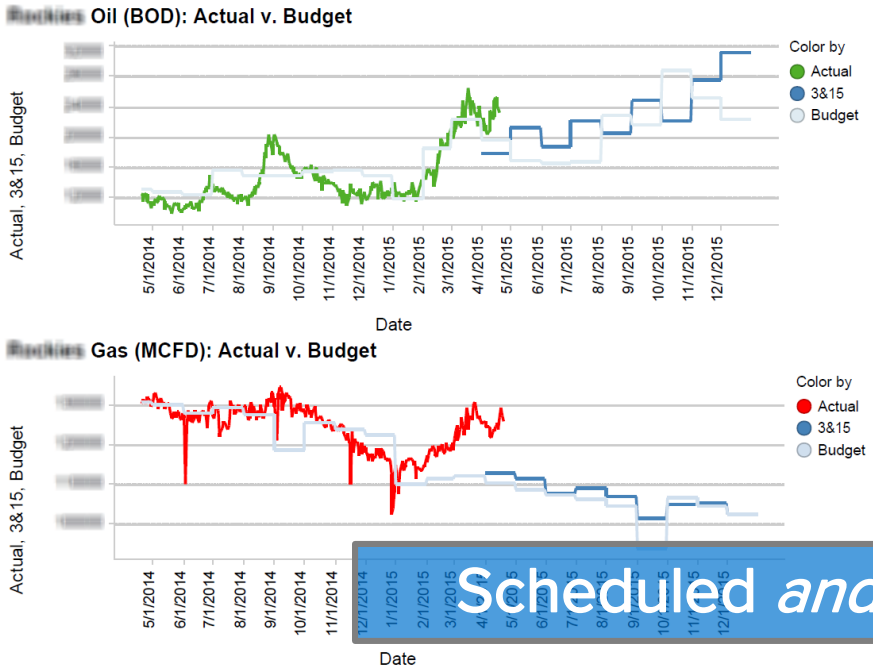

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