



PI Integrator for Business Analytics

Big Data Analytics with the PI System

Presented by **Mark Knox, Senior Systems Engineer**
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I need to **minimize risks** through Data Driven Decisions

I want share PI System data to groups **outside of Operations**

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



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

I want to **compare** my equipment with **ALL** of our other sites





We need to be more confident in the decisions we make.
We need trusted data

I want to combine systems of record for our corporate reports

We are starting a Big Data project, and we need operational data



I want to add Operational Data to our existing enterprise data warehouse

I want to get operational data into more of the BI Tools that people use



BIG DATA



" high **volume**, **velocity**, and/or **variety** information assets that demand cost-effective, innovative forms of information processing that enable insight, decision making, and process automation "

---Gartner

The Benefits of Big Data

6% more profitable

83% improved process cycle times

49% had payback in one year or less

54% report ROIs >100%

27% year-over-year increase in revenue

12% less operating expense

5% more productive

Sources: Harvard Business Review, Forbes, IDB



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The Big Data Landscape

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

Apps

Vertical



Data As A Service



Consumer



Ad / Media Apps



Business Intelligence



Operational Intelligence



Analytics And Visualization



Infrastructure

Analytics



Operational



As A Service



Structured DB



Technologies

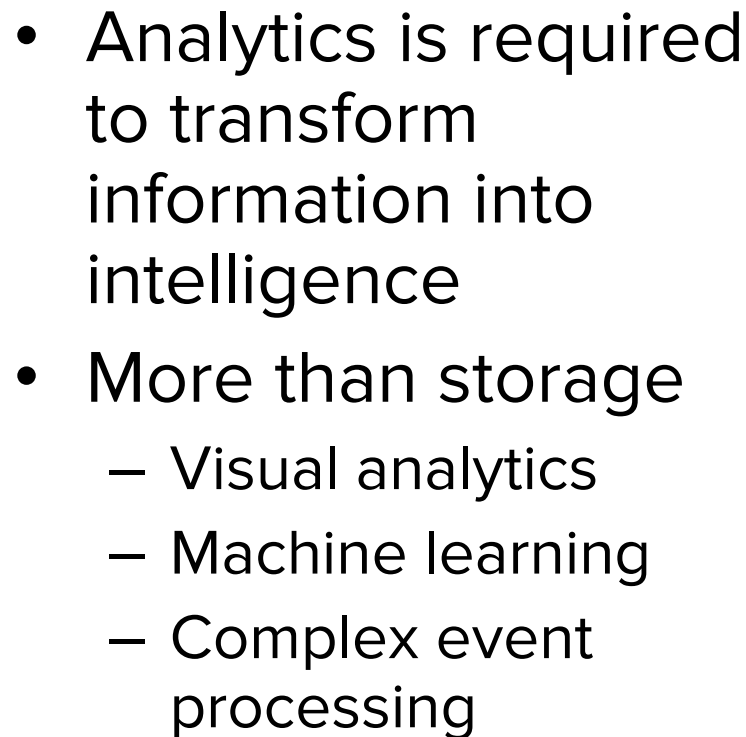


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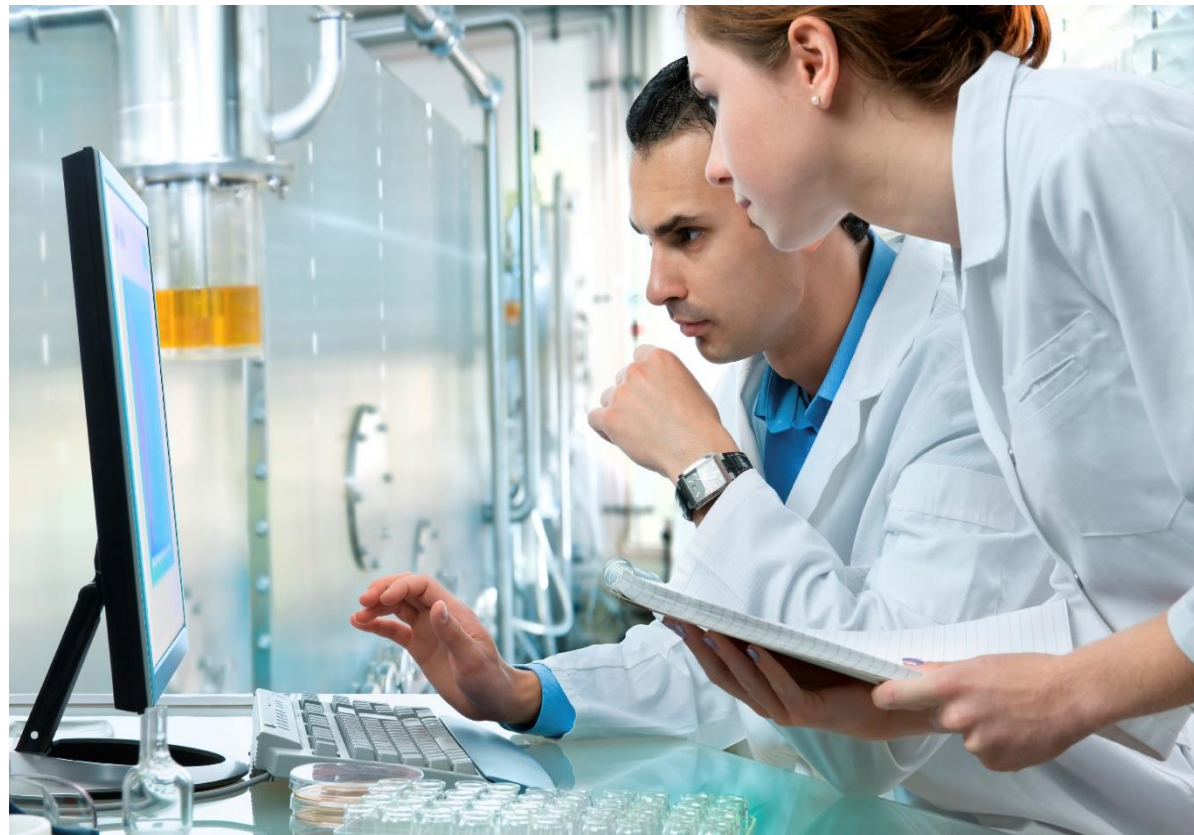
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Big Data Analytics



Context in the Physical World

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



Context in the Physical World



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

Context in the Physical World

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



Big Data Analytics and the PI System

Statistical
Analytics



Analytical
Insight



Visual
Analytics

Time Series



Relational



Unstructured



Geospatial

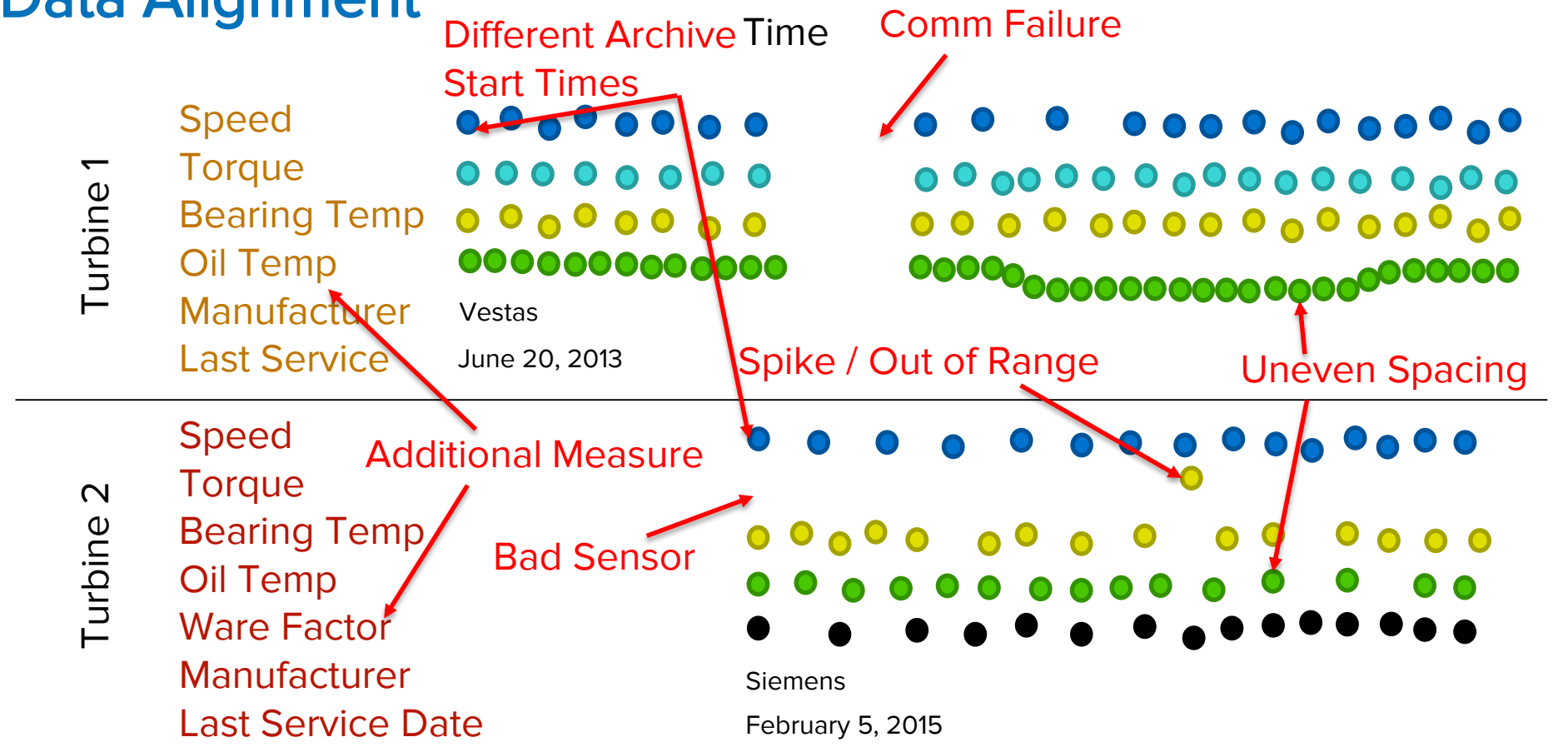


Real-Time Time-Series Data Isn't Perfect

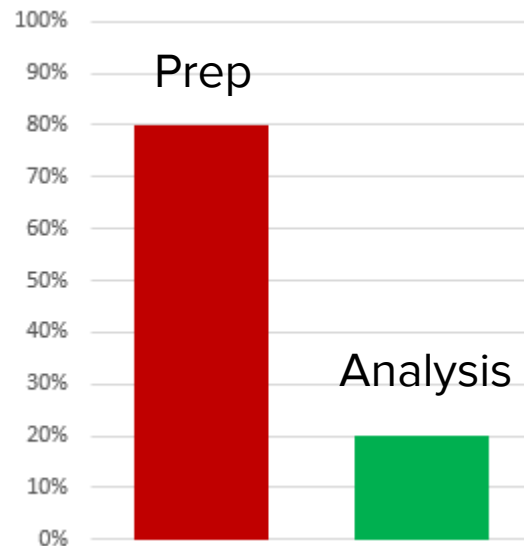


- Naturally incomplete
- Doesn't look like relational data
- Not evenly spaced
- Subject to errors in measurement

Data Alignment



Data Wrangling



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

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

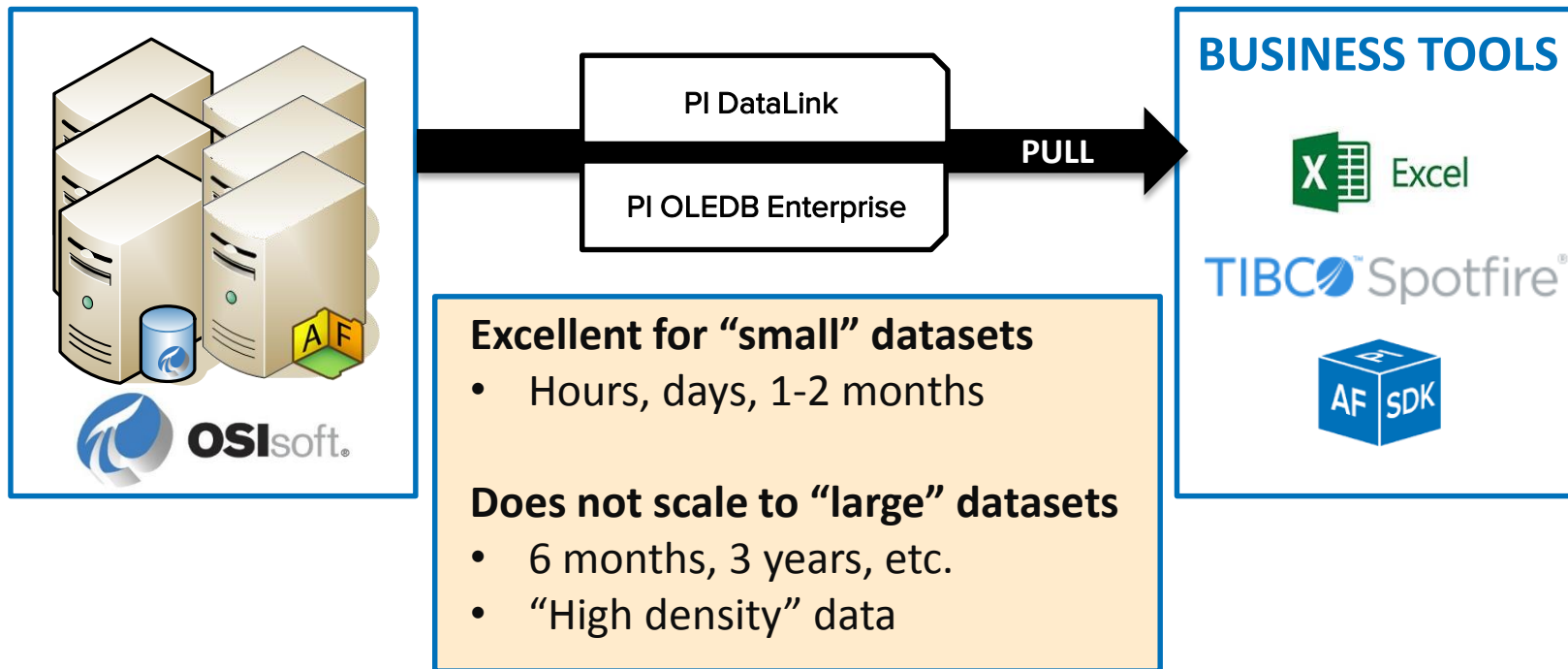


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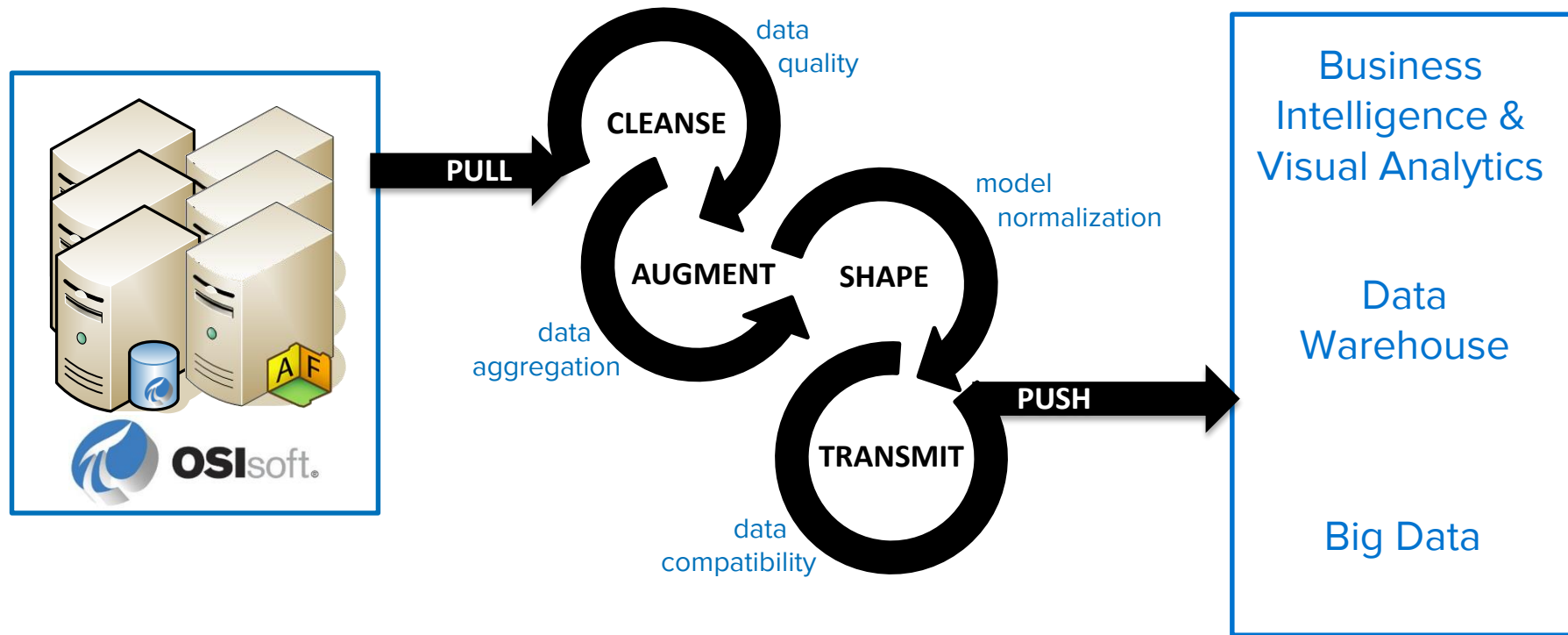
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Traditional Data Delivery



PI Integrator for Business Analytics



Video placeholder

(see <http://osisoft.com> > Resources > View by Event for video replay).



PI Integrator for Business Analytics

Business Intelligence Edition

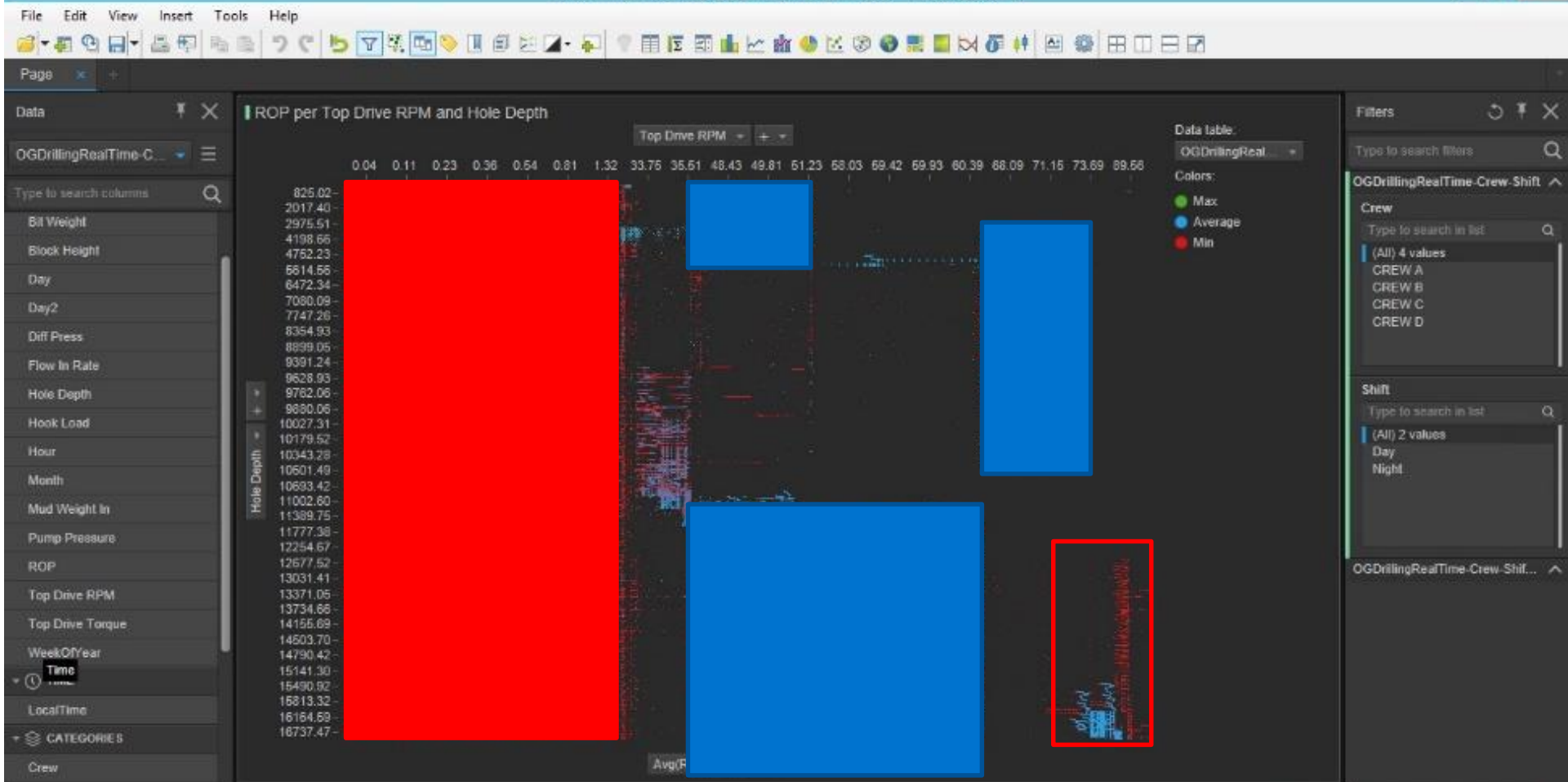


- Create PI Views
- Access decision-ready data via ODBC
- Best solution to provide access to analytics
 - Tibco Spotfire, Tableau, Microsoft Power BI
 - SAS, Cognos, Oracle
 - Most dashboarding tools

Oil Well Drilling - Example



- Optimize Well Drilling Times
- Operate Drill Rigs efficiently (ROP)
- Avoid damaging Stick Slip events and costly maintenance





- Day2
- Diff Press
- Flow In Rate
- Hole Depth
- Hook Load
- Hour
- Month
- Mud Weight In
- Pump Pressure
- ROP
- Top Drive RPM
- Top Drive Torque
- WeekOfYear
- TIME
- LocalTime
- CATEGORIES
- Crew

ROP per Crew and Well ID

Crew

CREW A

CREW B

CREW C

CREW D

Well-23708671

Well-23708672

Well-23708927

Well-23709012

Well-23709014

Well ID

Avg(ROP)

Data table:

OGDrillingReal...

Colors:

- Max
- Average
- Min

Filters

Type to search filters

OGDrillingRealTime-Crew-Shift

Shift

Type to search in list

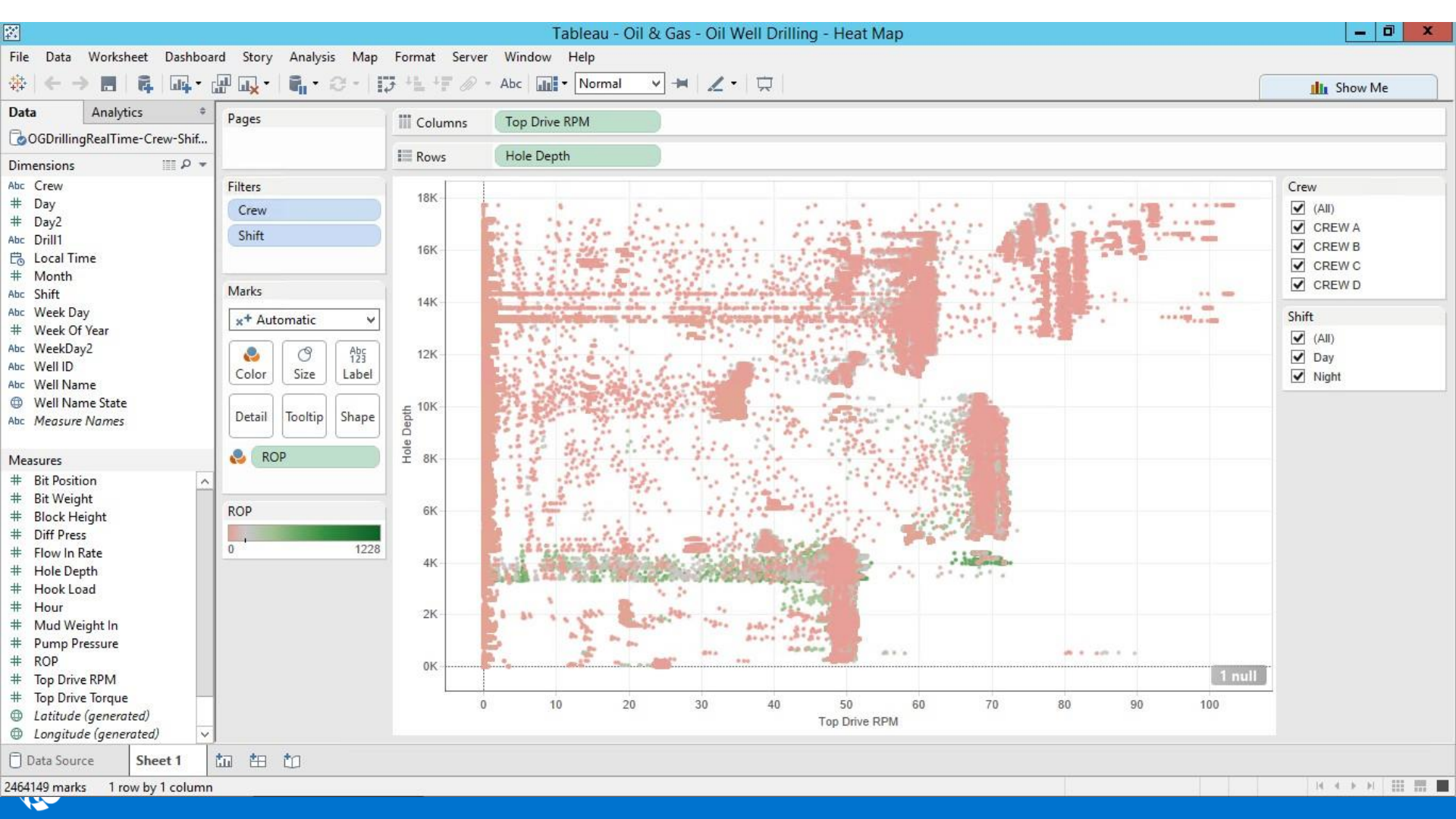
- (All) 2 values
- Day
- Night

Well ID

Type to search in list

- (All) 6 values
- None
- Well-23708671
- Well-23708672
- Well-23708927
- Well-23709012
- Well-23709014

OGDrillingRealTime-Crew-Shift



Workflow of PI Integrator for Business Analytics Business Intelligence Edition

- Define an Asset Shape
- Enhance the Dataset
 - Time slicers
 - Various data & time filters
 - Define overall time range & interval
- Publish to Target Destination

Workflow of PI Integrator for Business Analytics Business Intelligence Edition

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Source Assets

ServerDFPIAFDatabasePetroLux

Assets

- Conventional Gas
- Conventional Oil
- Drilling Operations
 - Drill1

Attributesfilter

Deselect All

- Bit Position
- Bit Weight
- Block Height
- Crew
- Diff Press
- Drill Time
- Flow In Rate
- Hole Depth
- Hook Load
- Mud Weight In
- Pump Pressure
- ROP
- Shift
- Top Drive RPM
- Top Drive Torque
- Well ID

Asset Shape

Shapes

- Drill1
 - Bit Position
 - Bit Weight
 - Block Height
 - Crew
 - Diff Press
 - Drill Time
 - Flow In Rate
 - Hole Depth
 - Hook Load
 - Mud Weight In
 - Pump Pressure
 - ROP
 - Shift
 - Top Drive RPM
 - Top Drive Torque
 - Well ID
 - Well Name
 - Well Name State

Matches

Found 1 Match

- Drill1



Edit Filters

☐ Asset Name

Drill1

☒ Asset Template

Rig

☐ Asset Category

Drilling Rigs

+

Add Filter

Cancel

Save



Source Assets

Server

DFPIAF

Database

PetroLux

Assets

Asset Lists

Key Performance Indicators

PetroLux Corporation

Attributes

filter

x

⌵

Select All

Bit Position

Bit Weight

Block Height

Crew

Diff Press

Drill Time

Flow In Rate

Hole Depth

Hook Load

Mud Weight In

Pump Pressure

Asset Shape

Shapes

Rig

Bit Position

Bit Weight

Block Height

Crew

Diff Press

Drill Time

Flow In Rate

Hole Depth

Hook Load

Mud Weight In

Pump Pressure

ROP

Shift

Top Drive RPM

Top Drive Torque

Well ID

Well Name

Well Name State

✎

✕

Matches

Found 12 Matches

Drill1

Drill10

Drill11

Drill12

Drill2

Drill3

Drill4

Drill5

Drill6

Drill7

Drill8

Drill9

Workflow of PI Integrator for Business Analytics Business Intelligence Edition

- Define an Asset Shape
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23708671
Well- Well1 Drilling

Add Column

Data Column

Time Column

Select Time Column Options

Minute (17)

Second (40)

Milliseconds (359)

UTC Milliseconds (359)

UTC Seconds (40)

Ticks (635817430603590000)

Time Zone Offset (420)

TimeStamp

Year

Month

Day

Day of the Week

Hour

Week of the Year

☒ Local

☐ GMT

Cancel

Display 7 time columns



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Select Data > **Modify View** > Publish

Back

Next

+ Add Column
25 ColumnsEdit Row Filters
0 Row FiltersEdit Value Mode
Interpolated Values
Every 1 minutes

Start Time

*-8d

End Time

*

Apply

Rig	LocalTime	Year	Day	WeekDay	Hour	WeekOfYear	Bit Position	Bit
Drill1	2015-10-20 14:10:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:11:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:12:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:13:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:14:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:15:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:16:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:17:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:18:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:19:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:20:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:21:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:22:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:23:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:24:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:25:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:26:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:27:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:28:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:29:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:30:32	2015	20	Tuesday	14	43	null	null
Drill1	2015-10-20 14:31:32	2015	20	Tuesday	14	43	null	null



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Row Filters



Add New Row Filter

Numeric

Include rows based on whether the contents of a column contain certain numeric values.

String

Include rows based on whether the contents of a column match a string pattern.

Digital

Include rows based on whether the contents of a column contain certain digital values.

Event Frame

Include rows where certain Event Frames are active.

Null Values

Include rows where the contents of a column contain a value.

Close



Row Filters

Add New Row Filter

Numeric

String

Digital

Event Frame

Null Values

Include rows based on whether the contents of a column contain certain numeric values.

Include rows based on whether the contents of a column match a string pattern.

Include rows based on whether the contents of a column contain certain digital values.

Include rows where certain Event Frames are active.

Include rows where the contents of a column contain a value.

Close

Add Numeric Row Filter

Include Rows where

all

 of the following conditions are true

Bit Position

greater than or equal to

0

ROP

greater than or equal to

0

Hole Depth

greater than or equal to

0

Top Drive RPM

greater than or equal to

0

+ Add Another Filter Criteria

Cancel

Save Numeric Row Filter



Row Filters



Add New Row Filter

Numeric

Include rows based on whether the contents of a column contain certain numeric values.

String

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Null Values

Include rows where the contents of a column contain a value.

Close



Row Filters 

Add New Row Filter

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Include rows based on whether the contents of a column contain certain numeric values.

String

Include rows based on whether the contents of a column match a string pattern.

Digital

Include rows based on whether the contents of a column contain certain digital values.


Event Frame

Include rows where certain Event Frames are active.

Null Values

Include rows where the contents of a column contain a value.

Close

Add String Row Filter 

Include Rows where


all

 of the following conditions are true

Well Name State

not equal to

Done

 Add Another Filter Criteria

Cancel

Save String Row Filter



Row Filters



Add New Row Filter

Numeric

Include rows based on whether the contents of a column contain certain numeric values.

String

Include rows based on whether the contents of a column match a string pattern.

Digital

Include rows based on whether the contents of a column contain certain digital values.

Event Frame

Include rows where certain Event Frames are active.

Null Values

Include rows where the contents of a column contain a value.

Close



Row Filters ✕

Add New Row Filter

Numeric

Include rows based on whether the contents of a column contain certain numeric values.

String

Include rows based on whether the contents of a column match a string pattern.

Digital

Include rows based on whether the contents of a column contain certain digital values.

Event Frame

Include rows where certain Event Frames are active.

Null Values

Include rows where the contents of a column contain a value.

Close

Add Null Value Row Filter ✕

Include Rows where all ▾ of the following conditions are true

Bit Position ▾

is not Null ▾

+ Add Another Filter Criteria

Cancel

Save Null Value Row Filter



Numeric Filter 1



Include rows where all of the following are true

Bit Position is ≥ 0

ROP is ≥ 0

Hole Depth is ≥ 0

Top Drive RPM is ≥ 0

String Filter 1



Include rows where all of the following are true

Well Name State is \neq Done

Null Value Filter 1



Include rows where all of the following are true

Add New Row Filter

Numeric

Include rows based on whether the contents of a column contain certain numeric values.

String

Include rows based on whether the contents of a column match a string pattern.

Digital

Include rows based on whether the contents of a column contain certain digital values.

Event Frame

Include rows where certain Event Frames are active.

Null Values

Include rows where the contents of a column contain a value.

Close

Workflow of PI Integrator for Business Analytics Business Intelligence Edition

- Define an Asset Shape
- Enhance the Dataset
 - Time slicers
 - Various data & time filters
 - Define overall time range & interval
- **Publish** to Target Destination



Select Data > Modify View > **Publish**

Target Configuration

PI View ▼

- ☒ Run Once
- ☐ Run on a Schedule

Summary

Shape and Matches

- There are **12 Matching Instances**.

Timeframe and Interval

- Your Start Time is **3/18/2013, 12:00:00 AM**
- Your End Time is **7/4/2014, 12:00:00 AM**
- Your Time Interval gets an interpolated measurement every **1 seconds**

Publish



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Select Data > Modify View > **Publish**

Target Configuration

PI View ▼

- ☐ Run Once
- ☒ Run on a Schedule

First Run

•



Recur every

5 ▼

minutes ▼

Summary

Shape and Matches

- There are **12 Matching Instances**.

Timeframe and Interval

- Your Start Time is **3/18/2013, 12:00:00 AM**
- Your End Time is **7/4/2014, 12:00:00 AM**
- Your Time Interval gets an interpolated measurement every **1 seconds**

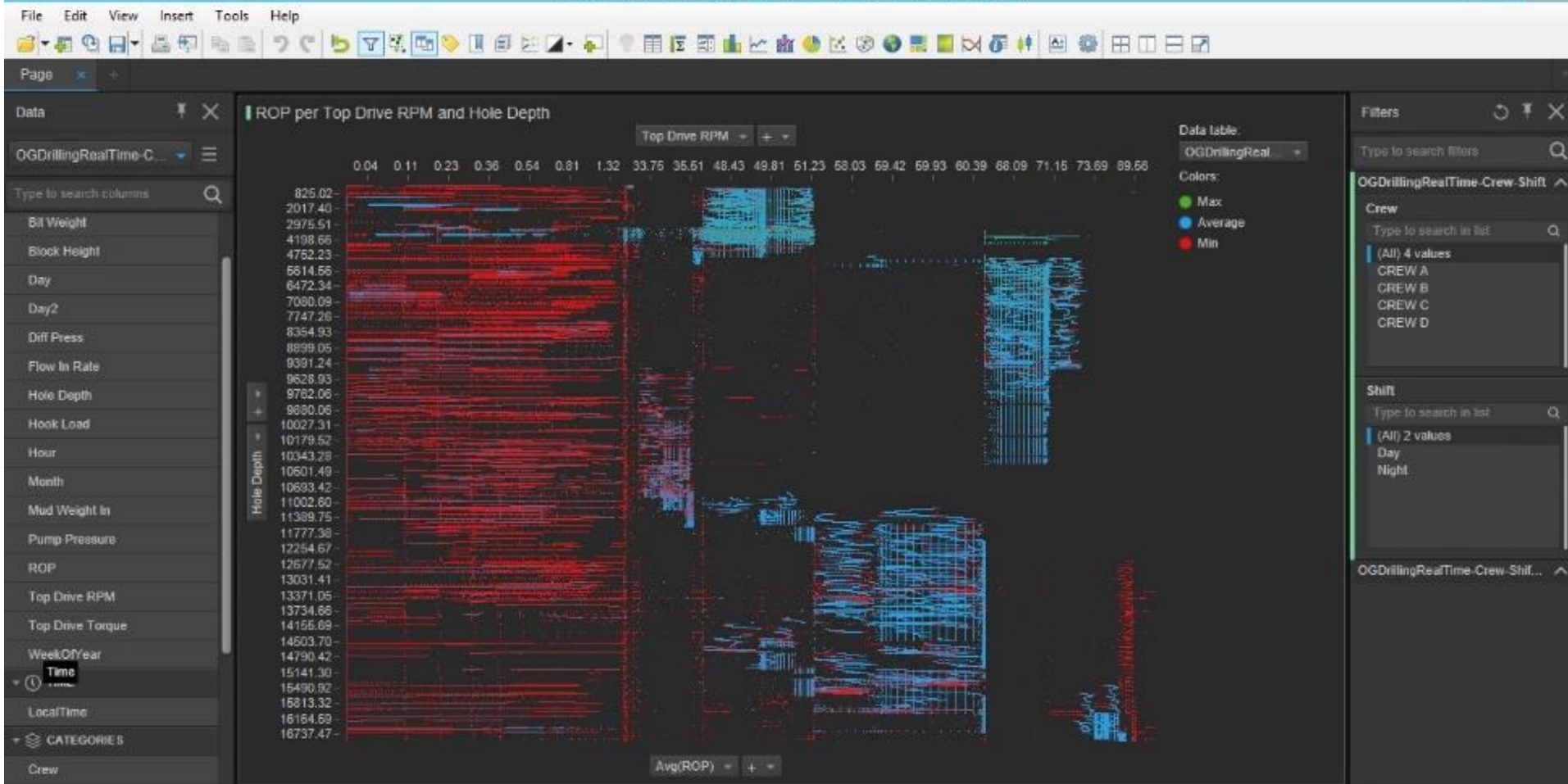
Publish



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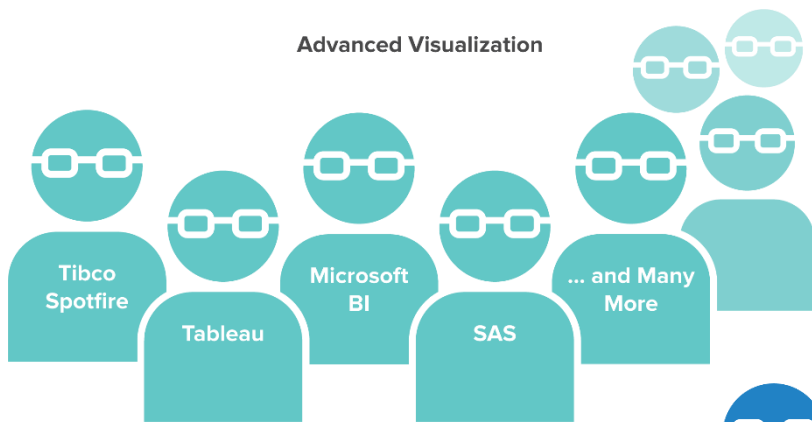
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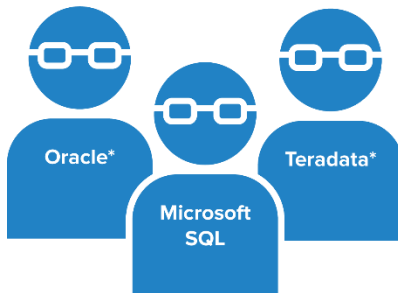


What Systems Are Supported?

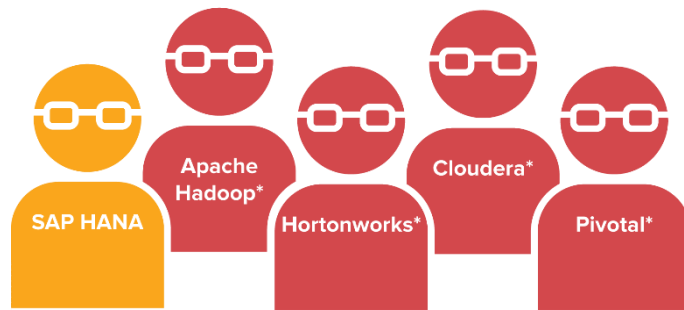
Advanced Visualization



Data Warehouse



Big Data*

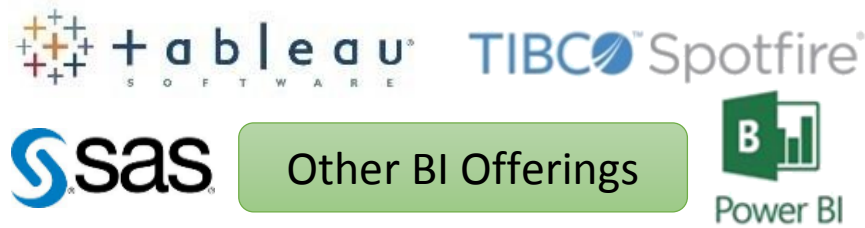


*Coming Soon, Stay Tuned!

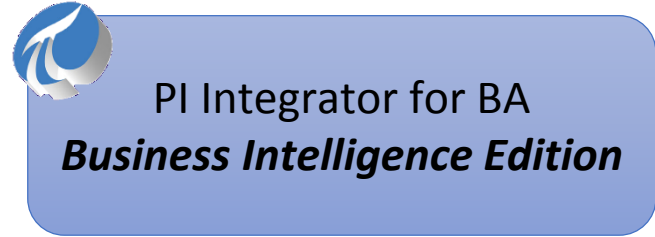


Business Intelligence Edition Architecture

Visualization
& Analytics



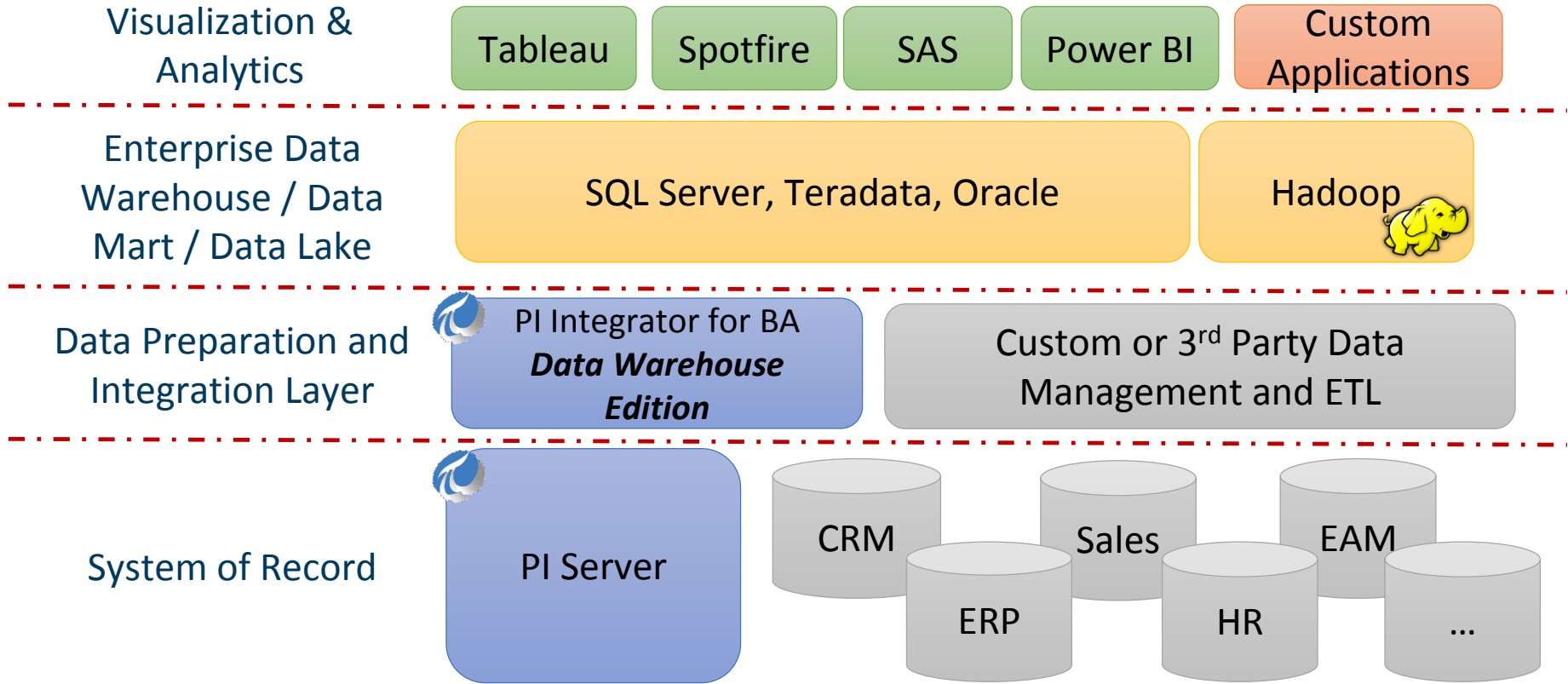
Data Preparation and
Integration Layer



System of Record



Data Warehouse Edition Architecture



PI Integrator for SAP HANA

- Native Integration with HANA Smart Data Access (SDA)
- Data is brought into memory on demand
- Focus on BI, reporting, and predictive analytics
- A.k.a. SAP IoT Adapter by OSIsoft

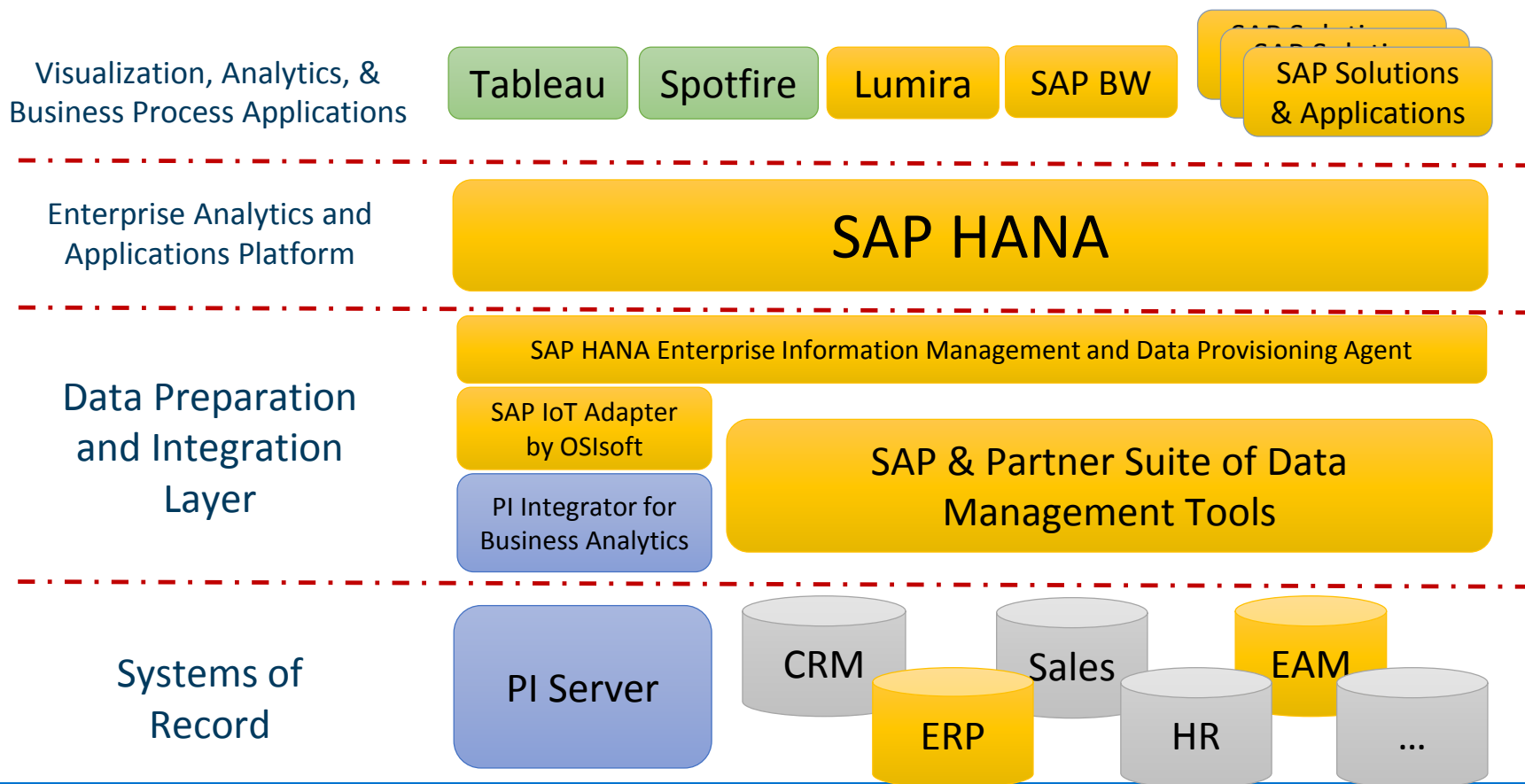
BUSINESS PROCESSES



INDUSTRIAL PROCESSES



SAP HANA Edition Architecture



The PI System Complements Big Data Solutions

Problem	PI System	Big Data	Why?
Collect and store data from a variety of real-time and operational sources	✓		The PI System contextualizes your data, collects natively from a variety of sources and efficiently stores data at less than 10% of the size of big data
Ask questions about a few to hundreds of data points	✓		The PI System is highly tuned for instantaneous answers about your data vs. waiting for minutes or hours for your answer to come from a big cluster
Ask questions about the entire PI archive		✓	Big data is excellent for asking questions about large data sets and finding hidden patterns. Requires writing code and doing analysis in batches vs real-time
Operationalizing and capturing knowledge from analyses	✓		The PI System is the best place to capture knowledge from big data and visual analytics and apply it in real time across all your assets and operations
Deriving correlations and insights from the entire PI archive and external data		✓	Big data is essential for large inspection queries that require complex descriptive analytics, pattern searching, and joining non-PI data



Key Takeaways

- Ask internally, at your company, if there is a Big Data Initiatives and which tools are already in used
 - Leverage existing infrastructure
- Organizing the data is key
 - Proper PI Asset Framework structure
 - Link to metadata

Proven Technology – Early Adopter Program



Merck
Regeneron



EDF-RE



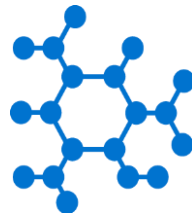
CEMEX
Alcoa GRP



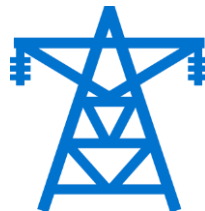
Freeport-McMoRan



Devon Energy
Noble Energy
NOV



BASF



China Southern Grid
SDG&E

Freeport McMoRan Copper and Gold



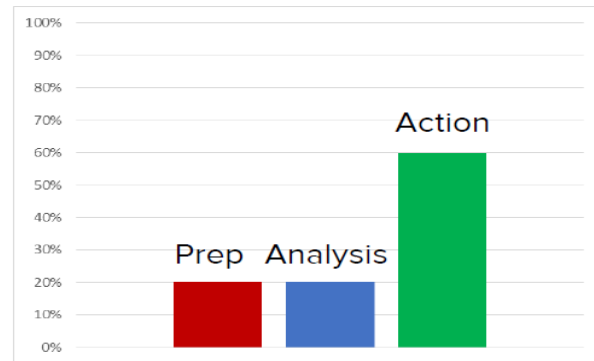
- CIO wanted Big Data Project
- Fuel Savings – Route Optimization (\$14M potential), Idle Times (\$4M)
- Need Granular Data - 1s and 5s data, 300+ Trucks

Freeport McMoRan – What they did

- Collect Truck Data at high fidelity
- Used Established AF Model for Trucks
- Use PI Integrator for Business Analytics
- Established Big Data Lake (Hortonworks)
- Hired Integrator (WWT) to learn Data Science
- Identified Target Use Cases

Freeport McMoRan - Results

- Initial Project started October 2014
- \$4M in Fuel Savings (out of \$14M possible) on Truck Route Optimization
- \$1M in Fuel Savings (out of \$4M possible) on Idle Time
- Paid for all costs associated with establishing big data practice
 - Including 5 data scientists



PI Integrator for Business Analytics Editions

	Business Intelligence Edition	Data Warehouse Edition	SAP HANA Edition
PI Views (client-side ODBC)	Released!	Released!	
Native Connections			
- Microsoft SQL Server		Released!	
- Flat file		Released!	
- SAP HANA			Q4 2015
- Oracle RDBMS 11 & 12		Q2 2016	
- Hadoop HDFS & HIVE		Q2 2016	



Contact Information

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OSIsoft



Questions

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



State your
name & company

Please remember to...

Complete the Survey
for this session



The **Power of Data**
DECISION READY IN REAL-TIME

Evaluation Form (Seminar Location - Date)

Name: _____

Company: _____

Email: _____

Quality and content of the presentations

Poor Good Excellent N/A

Welcome	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The Journey To Real-Time Operational Intelligence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The Power of Connection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tank Level Management System	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using the PI System to Aid in Troubleshooting Operational Aspects of Oil and Gas Well Drilling and Completion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unleash your Infrastructure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information on the Spot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wrap-up/Seminar Conclusion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Quality and organization of the seminar

Choice of date	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Time allowed for lunch/breaks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Choice of presentations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Break and time allowed for the presentation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



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감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado

