Introduction to **Process Optimization** and **Advanced Analytics** with the **PI System**

Presented by **Landry Khounlavong** (Product Marketing Manager, OSIsoft)
Tom Bai (Systems Engineer, OSIsoft)

Where are we in our PI 101 Journey

Landscape

My Operational Data, the PI System and the Greater Technology Landscape

Asset Health

Introduction to Asset Monitoring & CBM with the PI System

Process Optimization

Intro to Process Optimization & Advanced Analytics with the PI System

Visualization

Introduction to Visualizing data with the PI System

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Process optimization is a journey

Issue needs a solution

Opportunity is identified

Heroic levels of optimization

Two questions to be addressed in 30 minutes

How can the process of **process optimization** be optimized?

Is there a *buzz* word that I can use to optimize a process?

Age-old questions in process optimization

How can we:

- ↑ production by X%?
- ↓ production time by Y hours?
- ↓ operating costs by $Z?

Process optimization can be streamlined with the right tool set

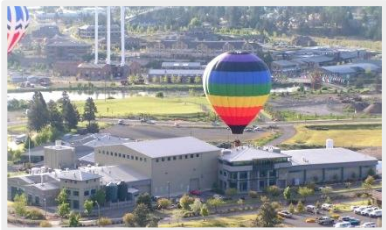
What components are inefficient?	**Why** is it inefficient?	**How** can we improve it?	**Did** the process's efficiency improve?
Challenges Data silos Access overhead Solution ?	Challenges Many "truths" Comparison difficulty Solution ?	Challenges Thermodynamics Fluid mechanics Solution ?	Challenges Data silos Access overhead Solution ?

How can the **PI System** help optimize a process?

Customer Success Story

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

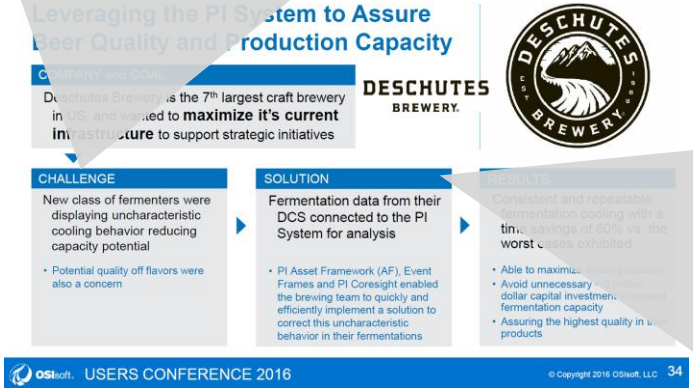
- 2 brewhouses
- 50+ vessels
- Bottling and kegging
- 7th largest US craft brewer

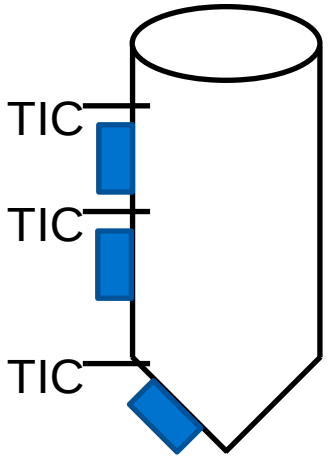


Quick data access enables production increase

Challenge

"…uncharacteristic cooling behavior…"

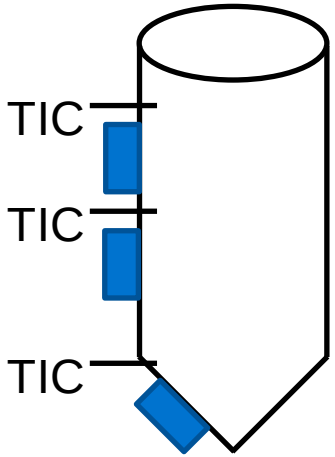


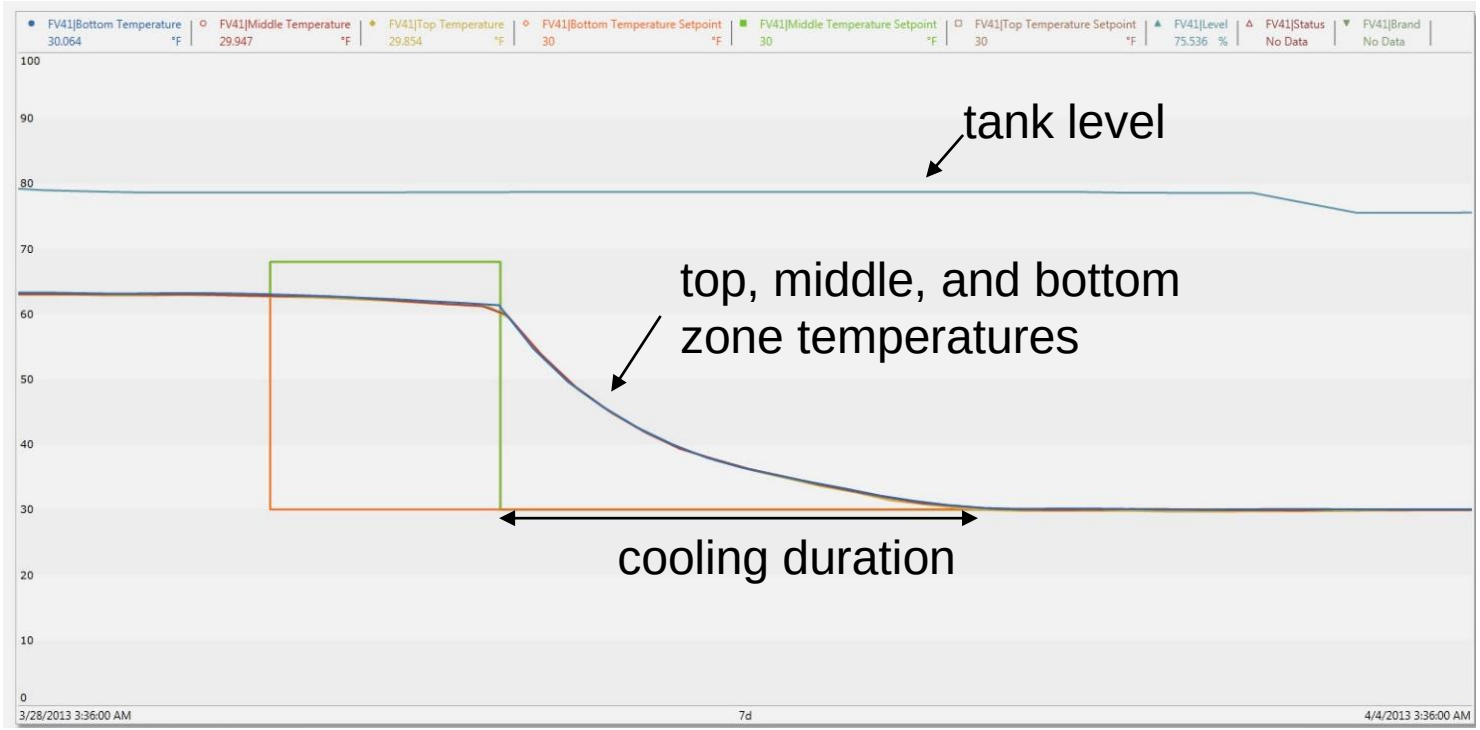


Solution

"…PI System enabled the brewing team to quickly and efficiently implement a solution to correct this uncharacteristic behavior…"

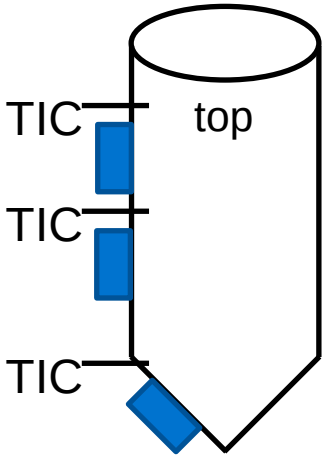
An ideal cooling process for the *entire* tank

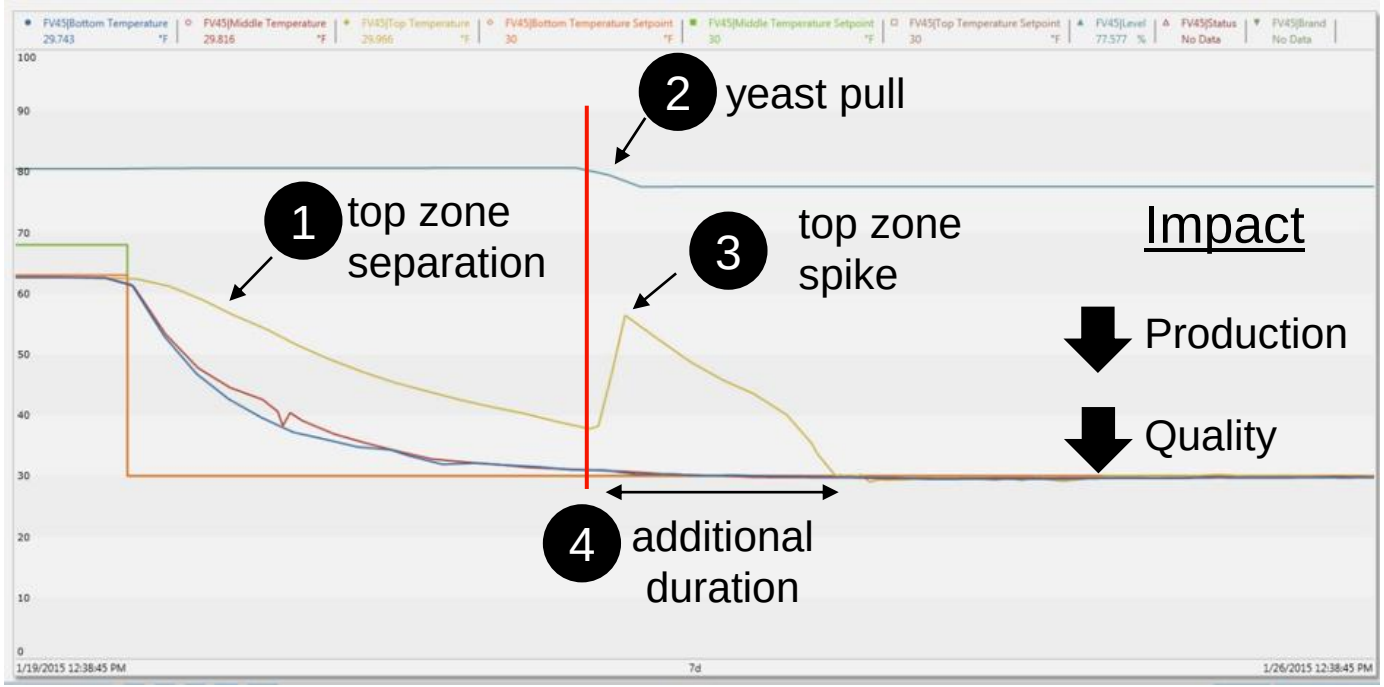




Identify → Analyze → Implement → Validate

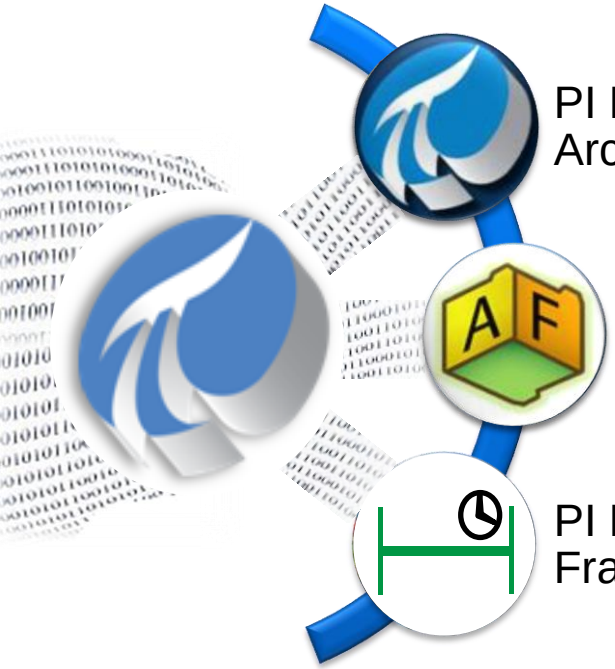
A deviation in cooling causes a delay in production





Identify → Analyze → Implement → Validate

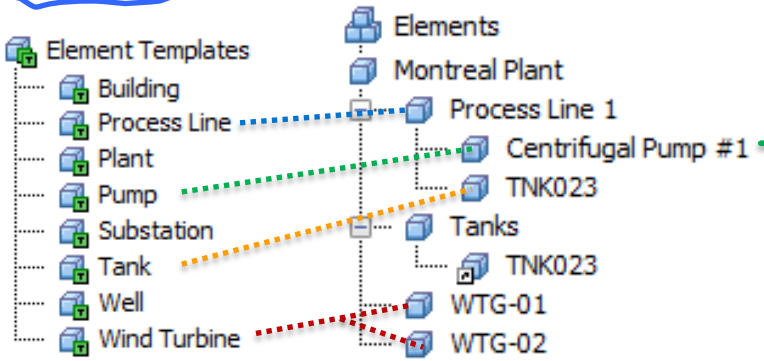
Before we save the beer … what magic happened?



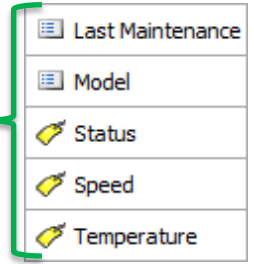
PI Data Archive

PI Asset Framework

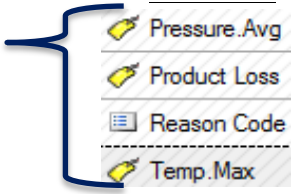
PI Event Frames



Element Attributes



Event Frame Attributes



Process Excursion

Startup

Downtime

Shift

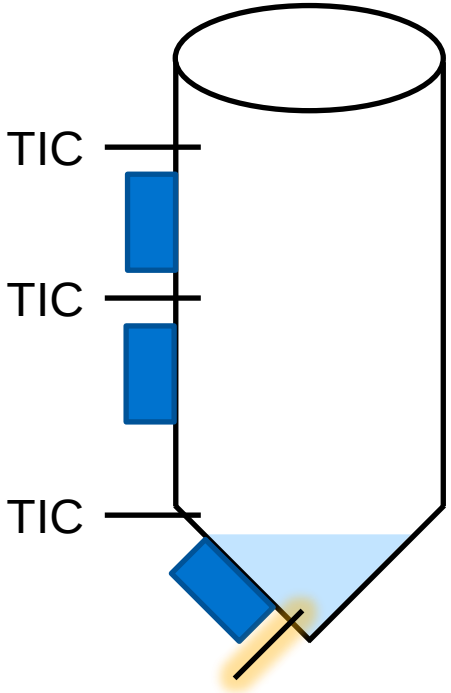
Shutdown

Batch

Environmental Excursion

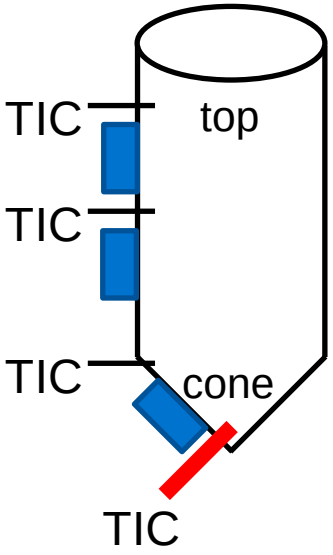
Grade Change

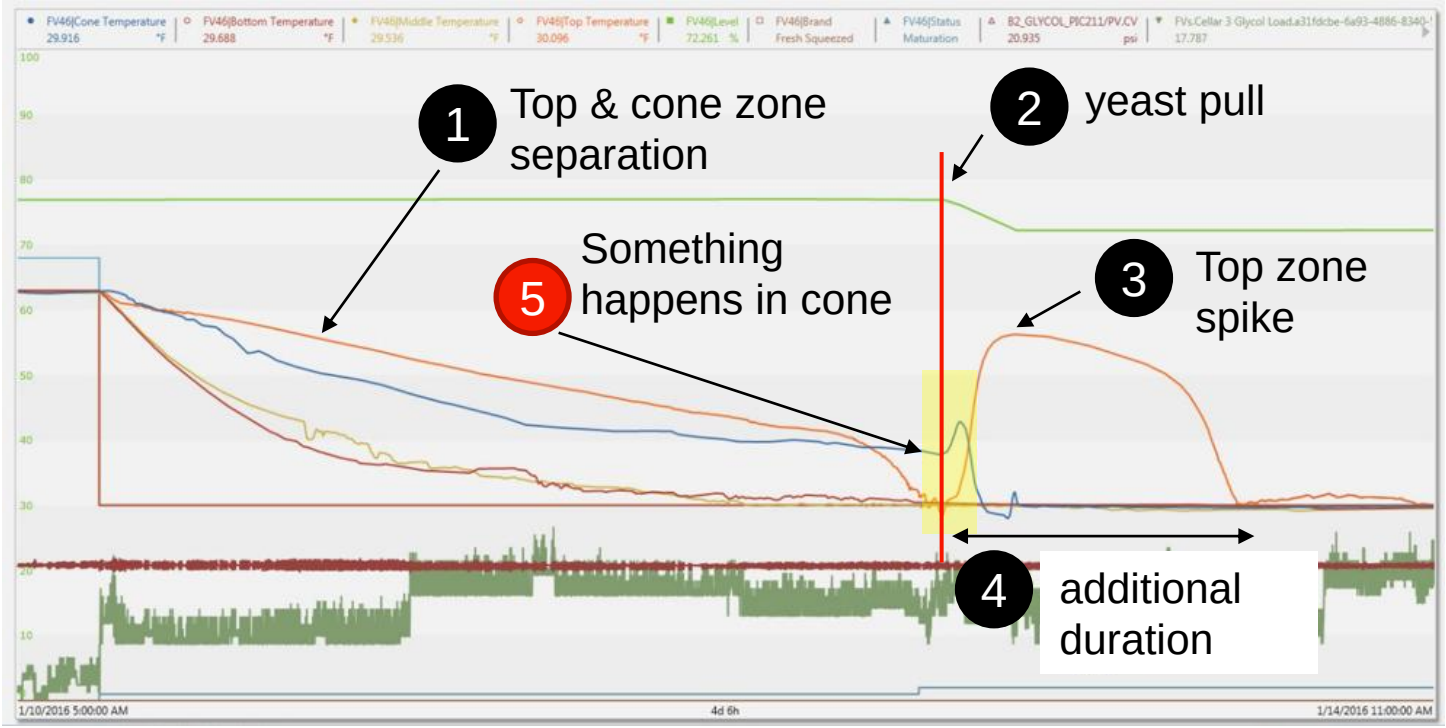
Monitor temperature at the bottom of the vessel



Identify → Analyze → Implement → Validate

Cone region response correlated with top region

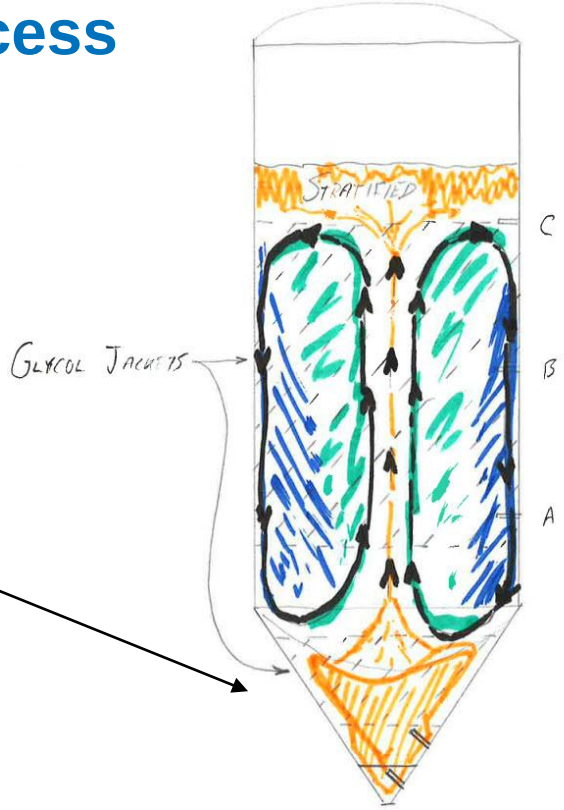




Identify → Analyze → Implement → Validate

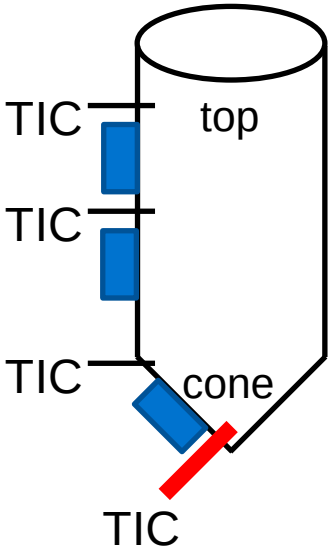
Hypothesis drives change in process

Cool the cone of the vessel as fermentation begins to cease



Identify → Analyze → Implement → Validate

Process change reduces cooling time



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Process optimization can be streamlined with the right tool set

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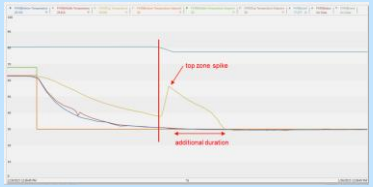
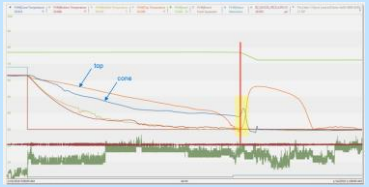
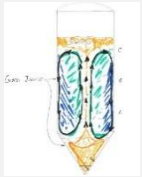
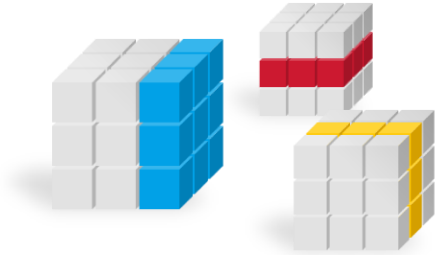
		 Domain expertise required	

Advanced Analytics

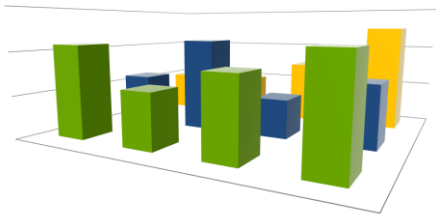
Ways to get value from (big) data with advanced analytics

Data Warehouses



Centralizing data from **different** business systems

Visual Correlations

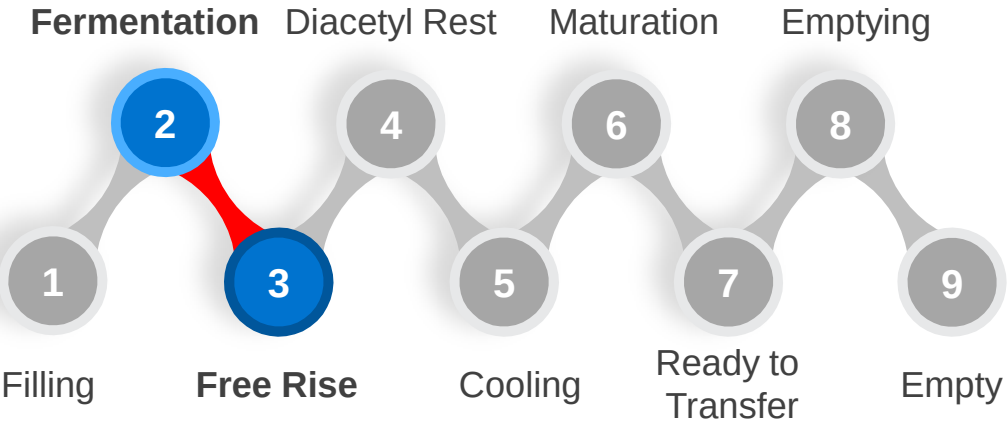


Visualizing data sets across **multiple** variables

Data Science

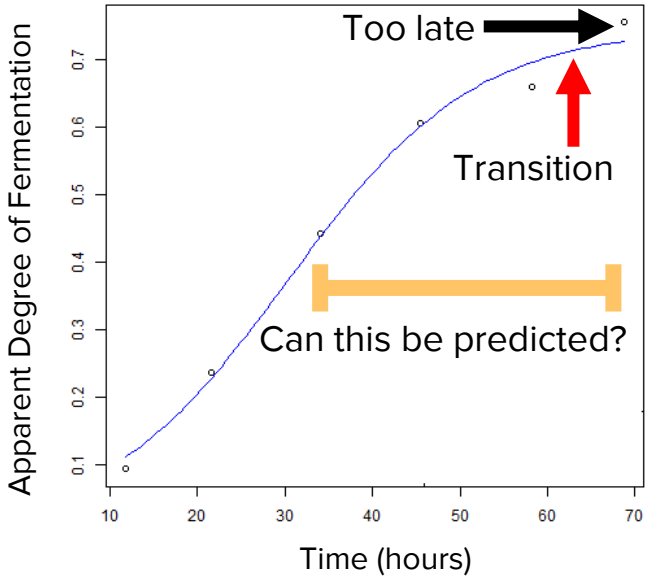
Identifying patterns with statistical approaches

Need to predict transition from fermentation to free rise



Challenge

- Transition occurs between infrequent manual measurements

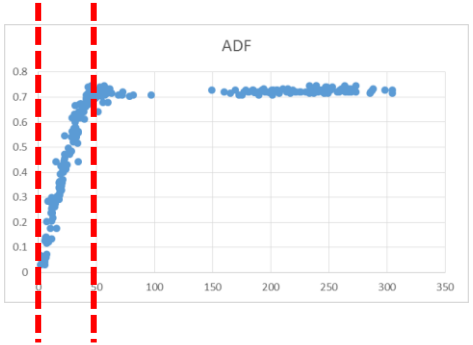


Spreadsheet analytics proves confidence in predictability

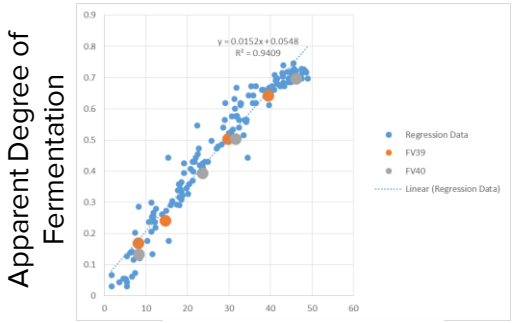
Bring Raw Data In

	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]			0.201844
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					

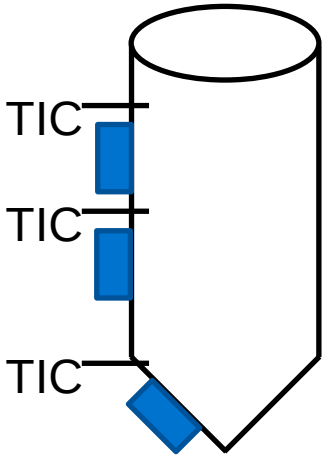
Clean it Up



Fit to a Line

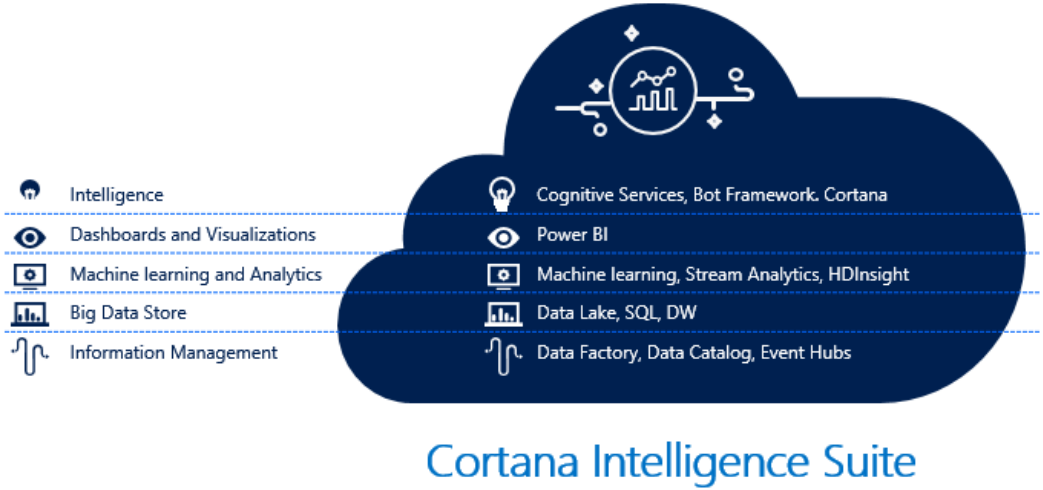


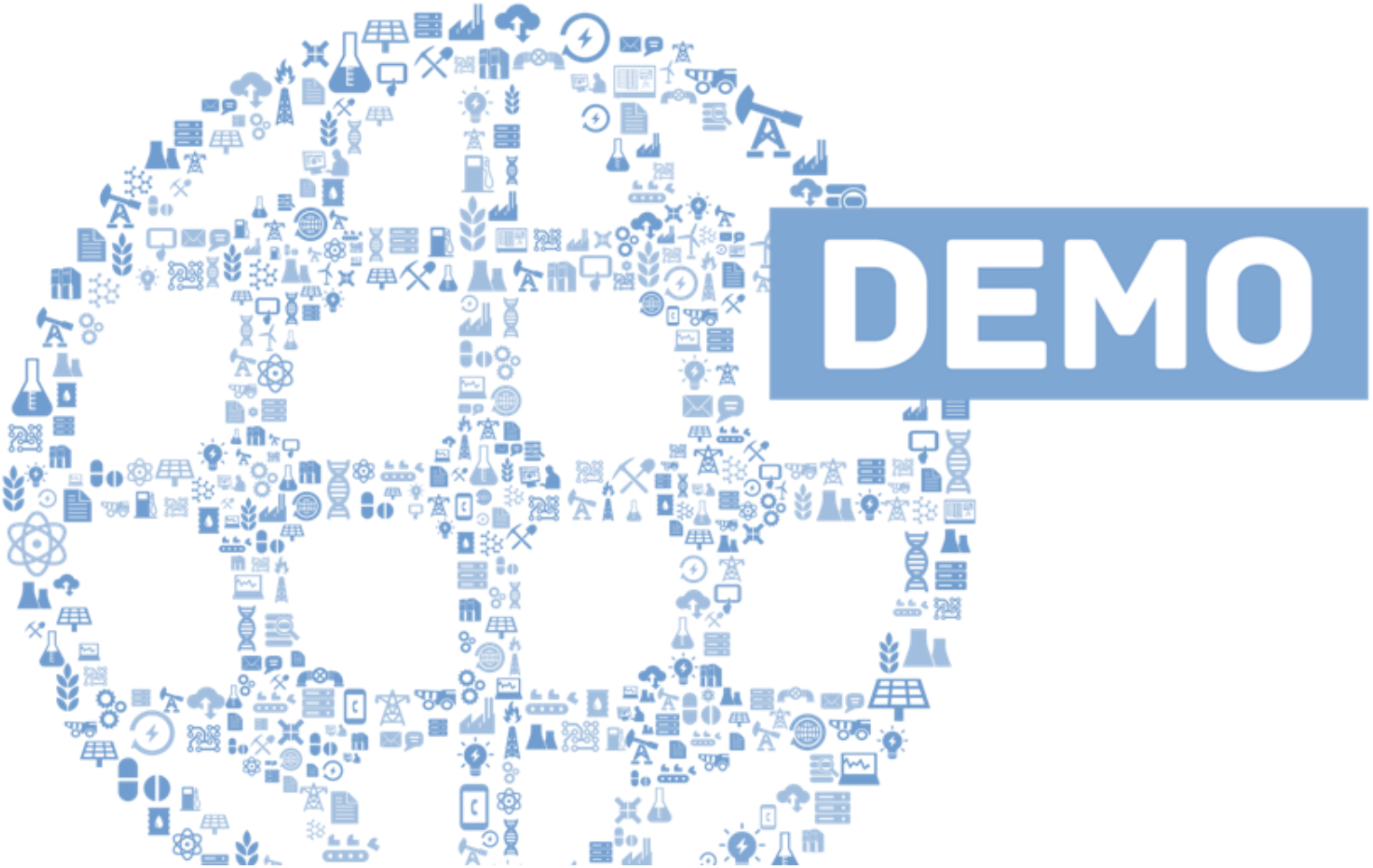
How to operationalize data preparation and predictions



PI System

?





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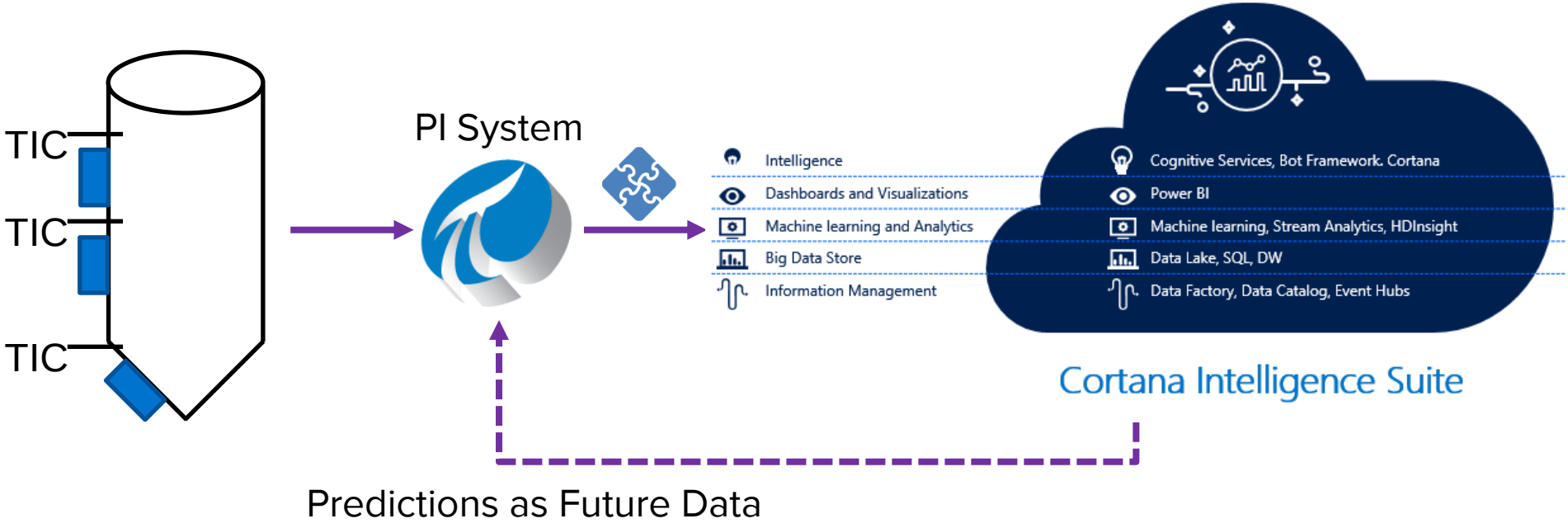
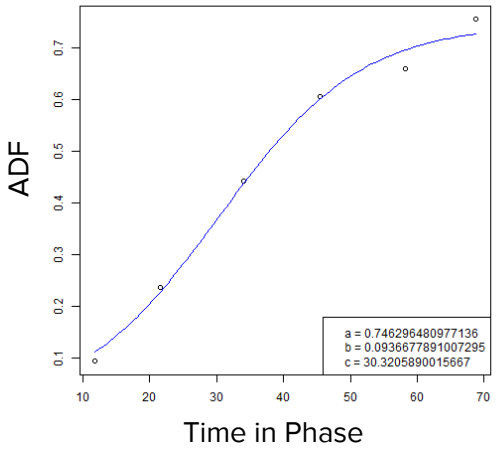


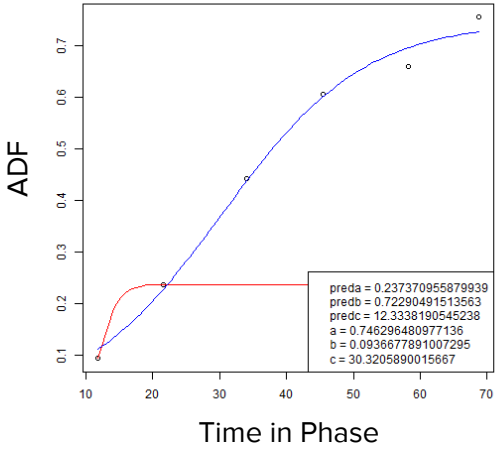
Refining a predictive model take iterations and expertise

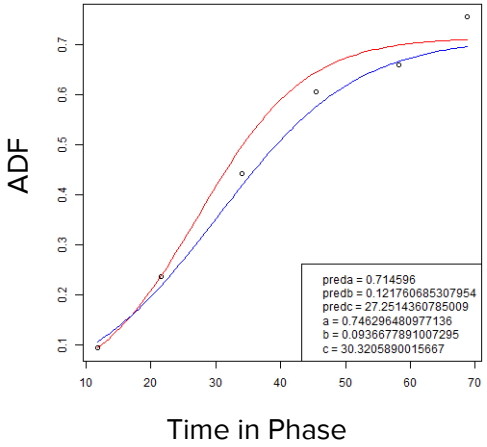
Benchmark: Measure accuracy against a standard (based on historical data)

Predict: Use 2 early densities to estimate transition time

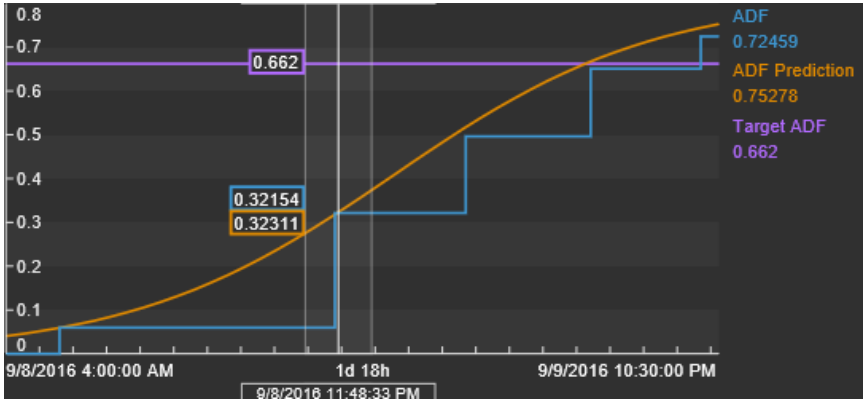
Refine: base predictions on brand for greater accuracy

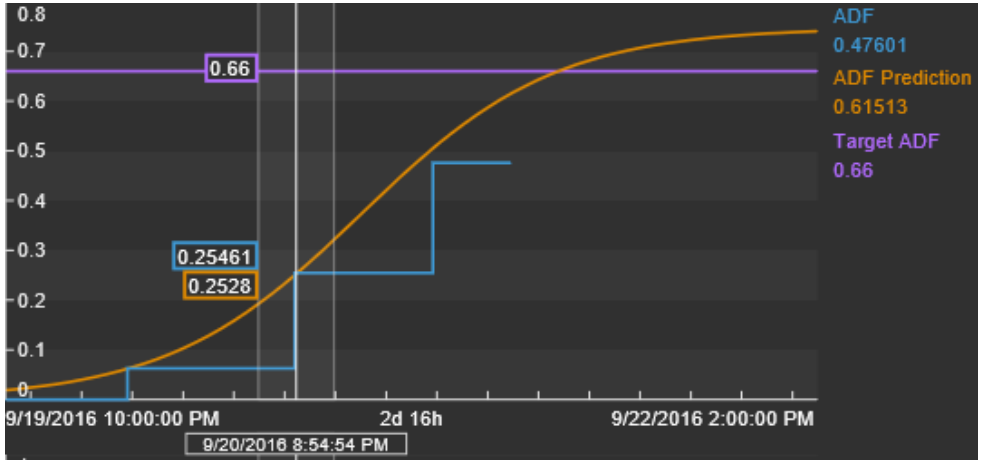






Operationalizing predictions on when the transition occurs … for all brands and vessels





In summary

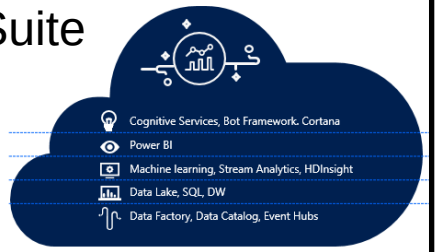
Is there a *buzz* word that I can use to optimize a process?

PI Integrators

Automated data preparation for advanced analytics

Cortana Intelligence Suite

Apply advanced analytics to data to gain insight



Cortana Intelligence Suite

How can the process of **process optimization** be optimized?

PI System

- Quick data access
- One version of truth
- Asset and event organization

감사합니다

谢谢

Danke

Gracias

Merci

Thank You

ありがとう

Спасибо

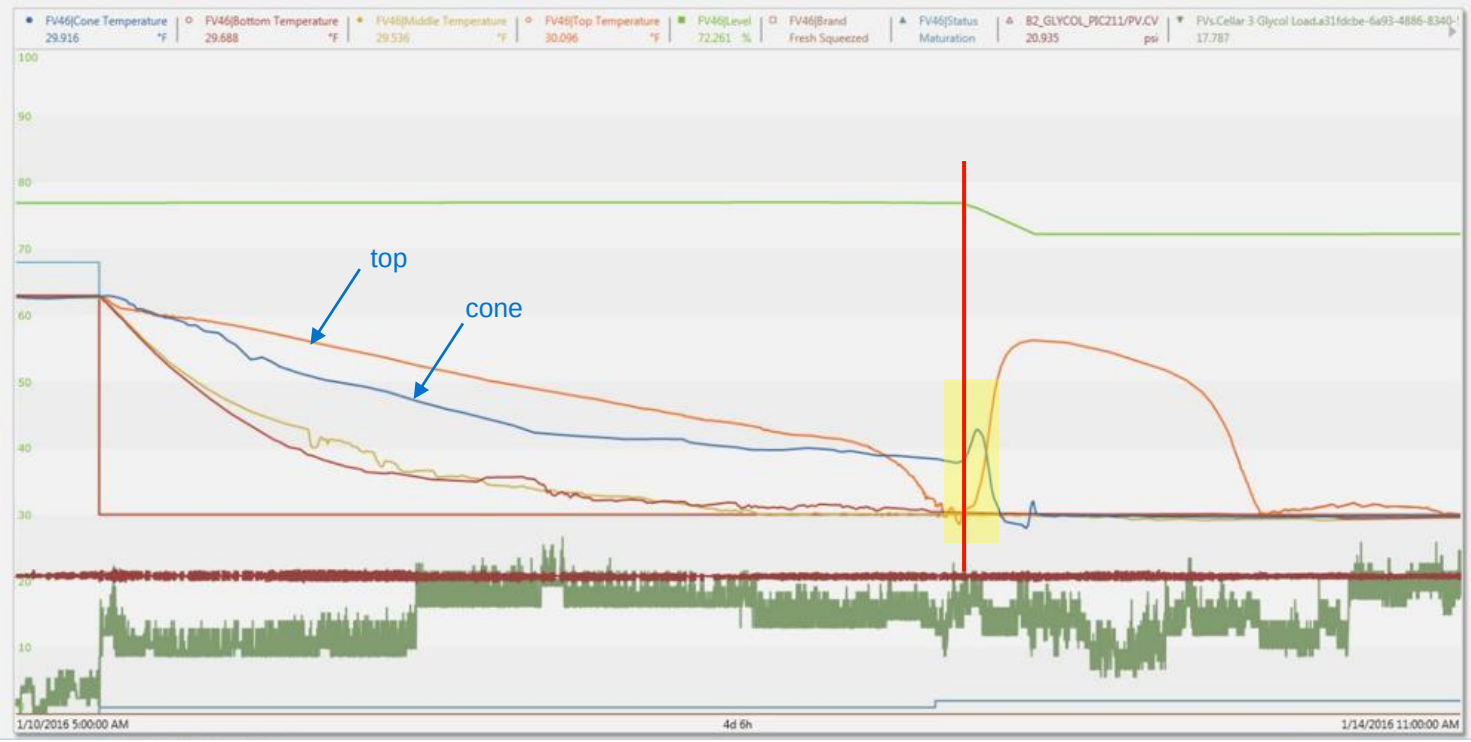
Obrigado

Contact Information

Landry Khounlavong
Product Marketing Manager
OSIsoft – San Leandro, CA
lkhounlavong@osisoft.com

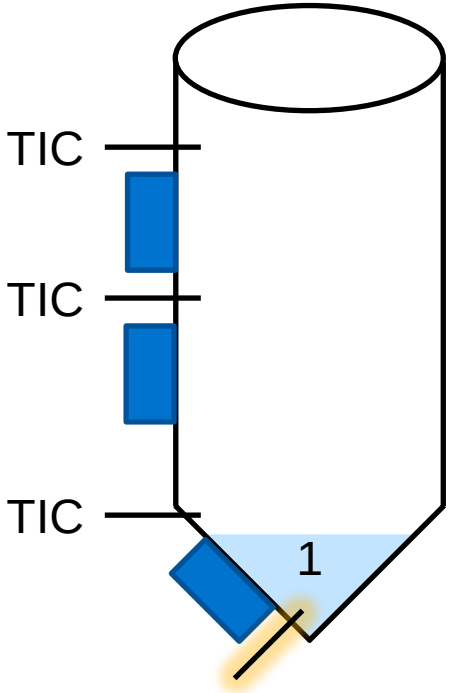
Tom Bai
Systems Engineer
OSIsoft - San Leandro, CA
tbai@osisoft.com

Cone region response correlated with top region



Identify → Analyze → Implement → Validate

Monitor temperature at the bottom of the vessel



Identify → Analyze → Implement → Validate

In summary

- Is there *actually* a buzz word that I can use to optimize a process?
  - Easy-to-use tools exist to automate data preparation
  - Data science can be tackled with out-of-the-box tools
- How can the process of **process optimization** be optimized?
  - Don’t let data silos prohibit quick data access
  - Have a single version of the truth
  - Organize data around common language and events

Insert Cortana logo