PI System and BI, essential tools for productivity in the paper industry

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Agenda

- Introduction
- Business challenges
- Batch Digester performance
- Centerlining on a paper machine
- Sheet break re-thread
- Summary
- Tips from the trenches on design
- Close

International Paper

- World's Largest Pulp and Paper Company
  - Founded 1898
  - 55,000 Employees
  - $21.7 Billion Net Sales (2017)
- OSIsoft Installed Base
  - 37 Facilities (62 PI Servers)
    - US, Brazil, Canada, France, India, Poland, Russia
  - 1.9+ Million PI Tags

Challenge – Solution - Results

International Paper, like many companies in pulp and paper, is facing a workforce turnover. Newer and better tools are required for the younger and less experienced workforce.

CHALLENGE

Inordinate amount of time spent pulling and shaping data instead of acting upon what the data says

- Need to asses performance at a glance
- SME's retiring, new engineers need different tools

SOLUTION

Displays with modern techniques to give more intelligence around larger datasets and real-time performance

- PI AF, PI Event Frames, PI Vision, PI OLEDB Enterprise, PI Integrator for Business Analytics
- BI tools like Power BI and Tableau

RESULTS

Financial impact TBD, but can attack problems that were hard to get to before

- Machine Centerlining
- Digester performance and steam usage
- Sheet break re-thread performance

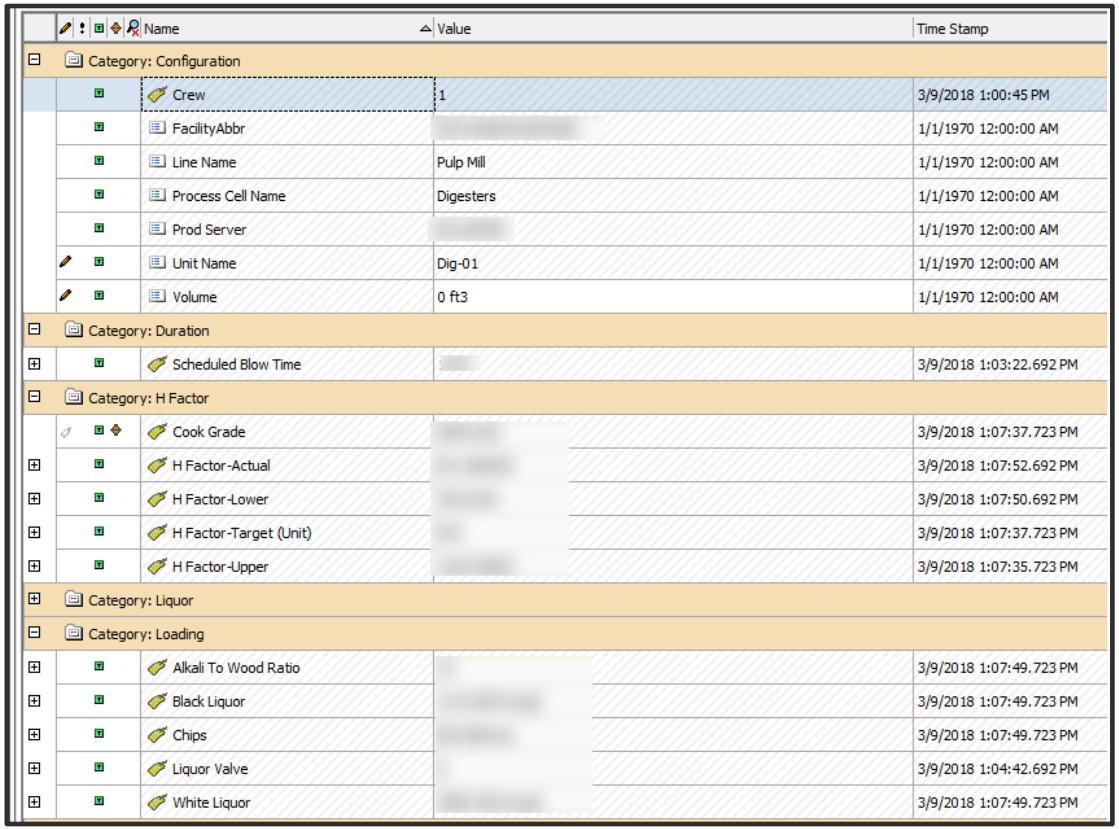
Batch Digester Performance

What is a Batch Digester?

Business Problem

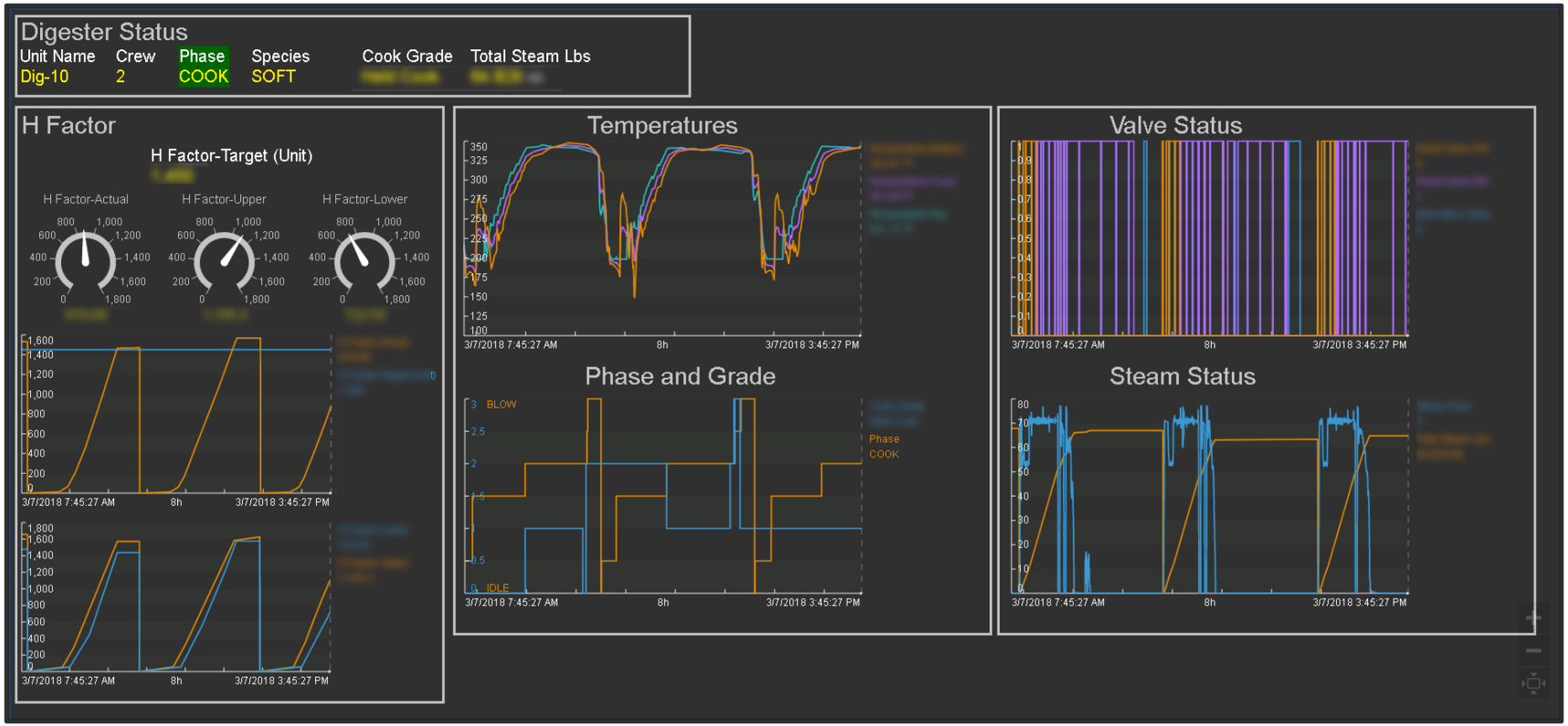
- We were actually looking at paper machine runnability when **we found that steam usage per cook was up and certain digesters were performing worse** – so, go where the data leads you
- Multi-variate analysis picked up changes in digesters could have been affecting paper machine runnability. Still looking at some of these issues
- Found some issues that needed more investigation by mill SME's, including **steam usage in the cooking process (may be using more than in the past)**

First Things First

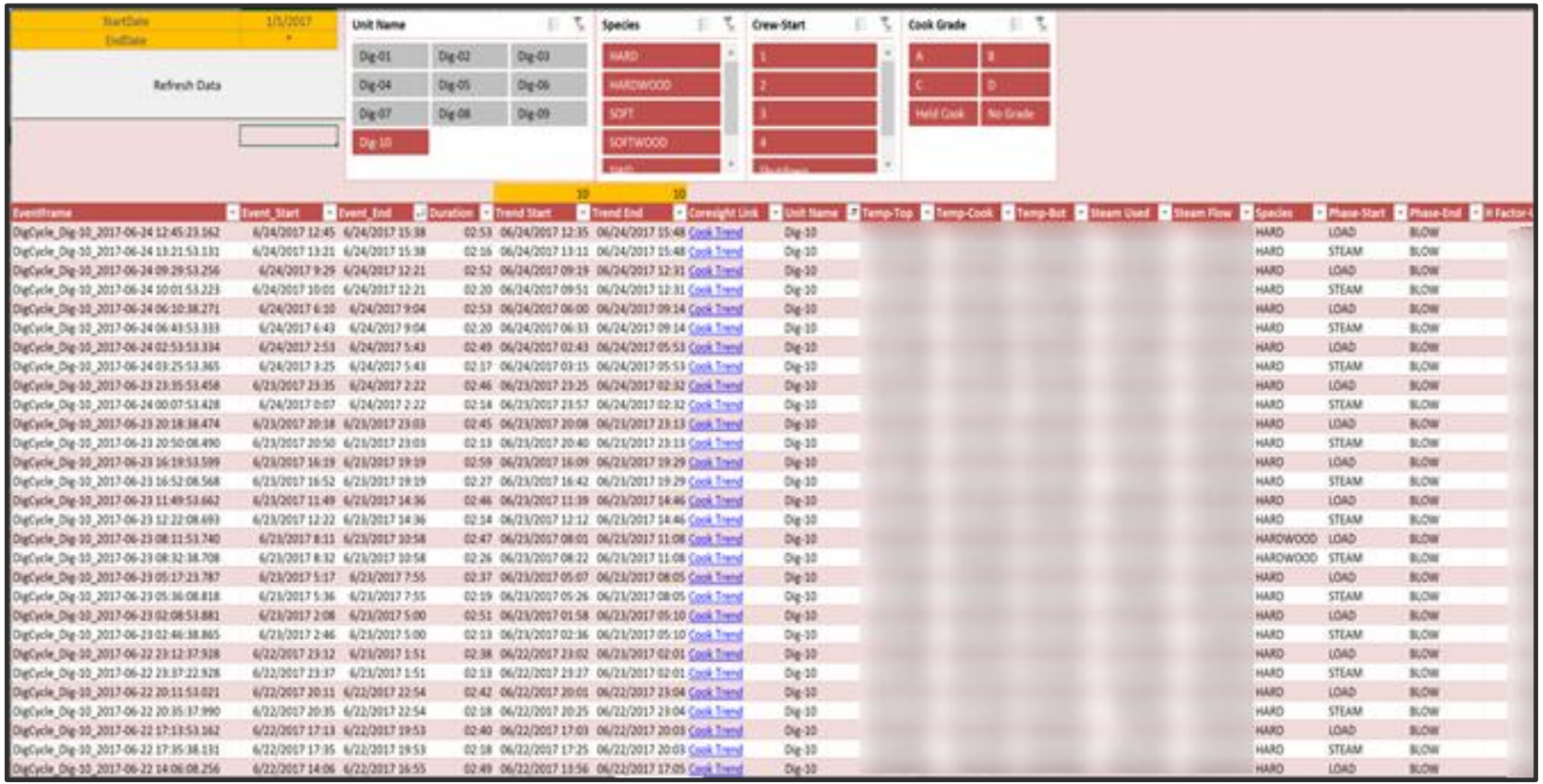


Name	Value	Time Stamp
Category: Configuration		
Crew	1	3/9/2018 1:00:45 PM
FacilityAbbr		1/1/1970 12:00:00 AM
Line Name	Pulp Mill	1/1/1970 12:00:00 AM
Process Cell Name	Digesters	1/1/1970 12:00:00 AM
Prod Server		1/1/1970 12:00:00 AM
Unit Name	Dig-01	1/1/1970 12:00:00 AM
Volume	0 ft3	1/1/1970 12:00:00 AM
Category: Duration		
Scheduled Blow Time		3/9/2018 1:03:22.692 PM
Category: H Factor		
Cook Grade		3/9/2018 1:07:37.723 PM
H Factor-Actual		3/9/2018 1:07:52.692 PM
H Factor-Lower		3/9/2018 1:07:50.692 PM
H Factor-Target (Unit)		3/9/2018 1:07:37.723 PM
H Factor-Upper		3/9/2018 1:07:35.723 PM
Category: Liquor		
Category: Loading		
Alkali To Wood Ratio		3/9/2018 1:07:49.723 PM
Black Liquor		3/9/2018 1:07:49.723 PM
Chips		3/9/2018 1:07:49.723 PM
Liquor Valve		3/9/2018 1:04:42.692 PM
White Liquor		3/9/2018 1:07:49.723 PM

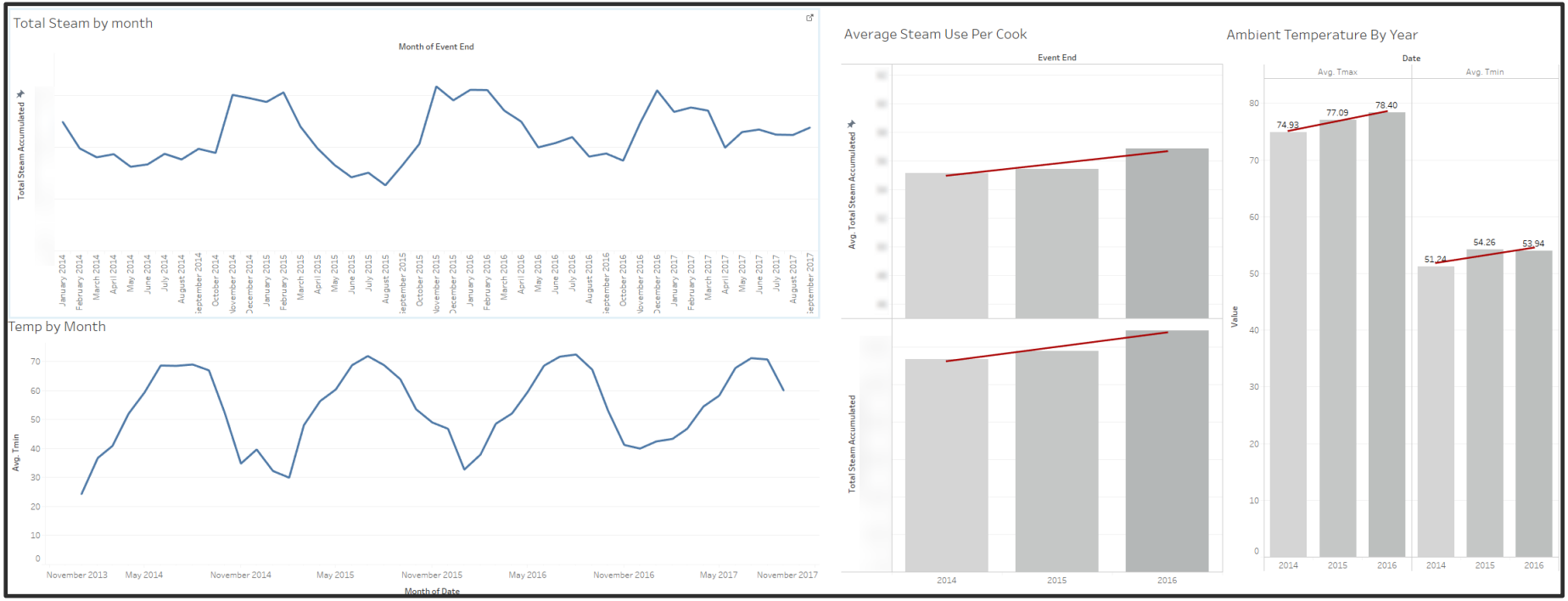
PI Vision



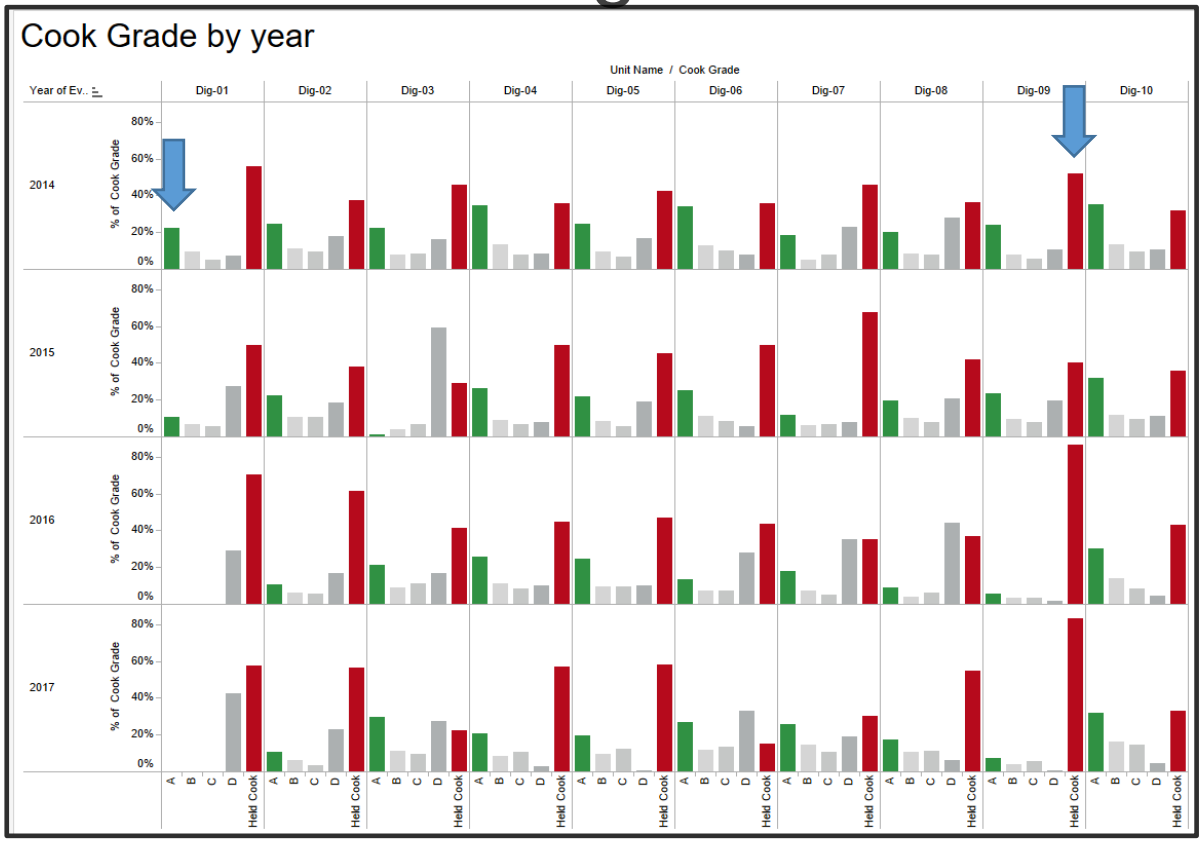
LOTS of Event Frames….



BI Helps With Large and Multiple Datasets



Cook Grading Over 4 Years



Machine Centerlining

Business Problem

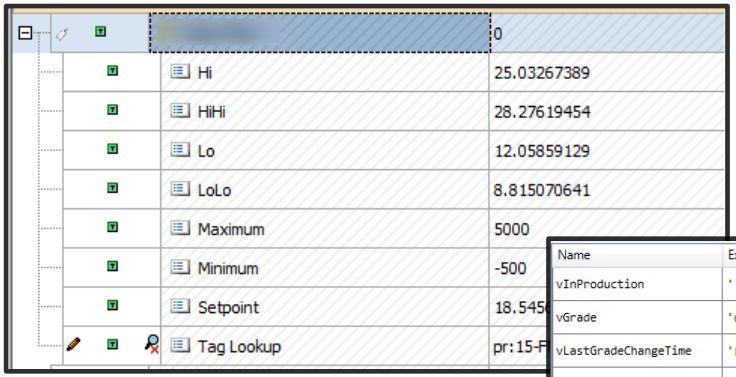
- **Lots of turnover** in the mill leading to poor runnability at a particular mill
- "Old hands" who knew where to run the machine on different grades are gone – **much less experienced operators and supervision**
- How do we keep them **"out of the ditch?"**
- Engineering issues stem around the **time it takes to pull data to calculate targets and limits** and keep them up to date and to help when things aren't running well

What is Centerlining?

- Centerlining is the process ensuring that a paper machine uses **optimum parameters for all key variables of the machine on every production/grade run**. The steps include:
  - Determine the **variables that affect paper machine performance** (in an ideal world)
  - **Calculating targets and limits** (specification and control limits) by product/grade
  - Ensure that the **targets and limits are used for every production/grade run**

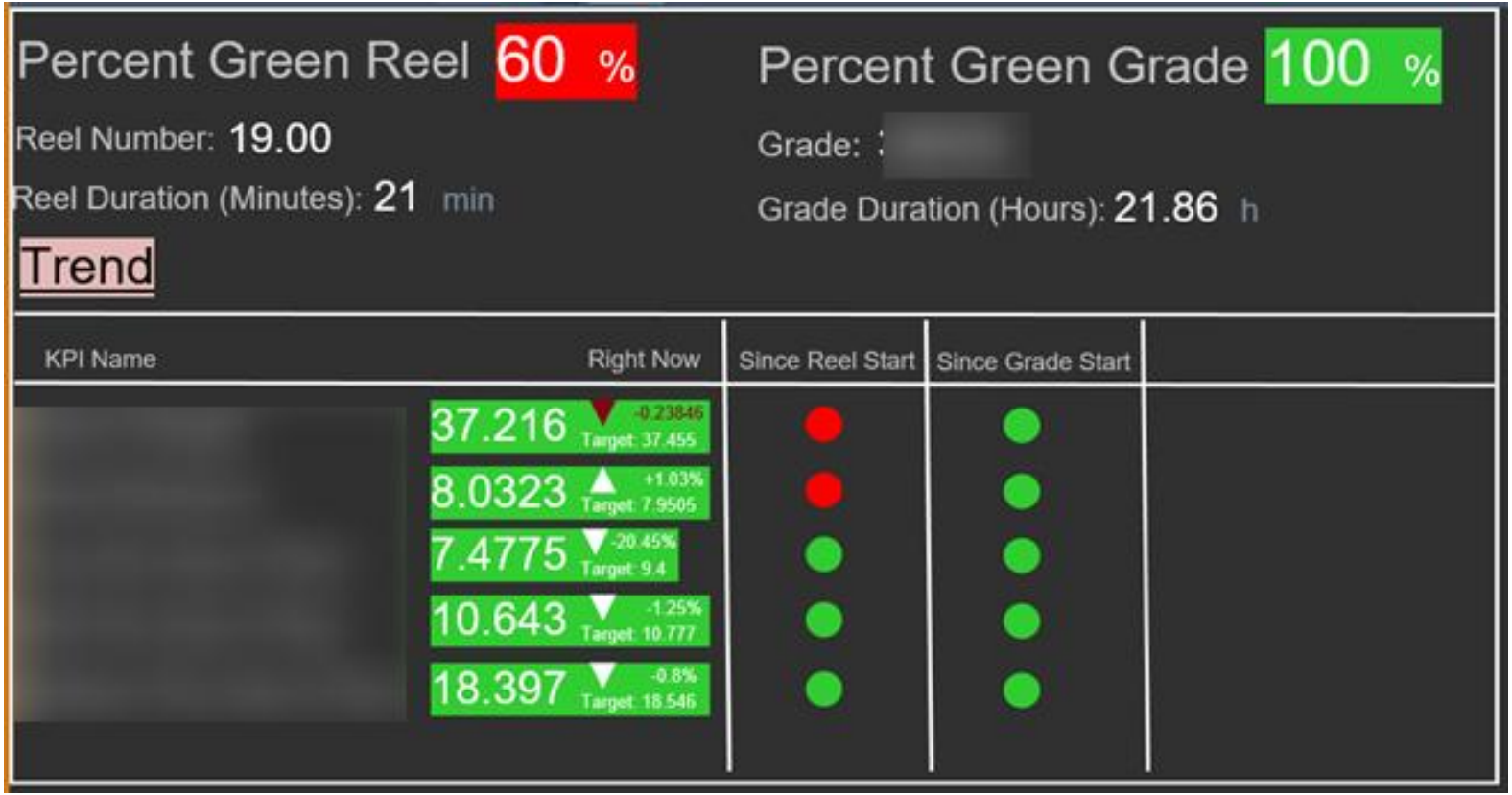
Current State For the Operator

Re-imagining for the Operator Part 1



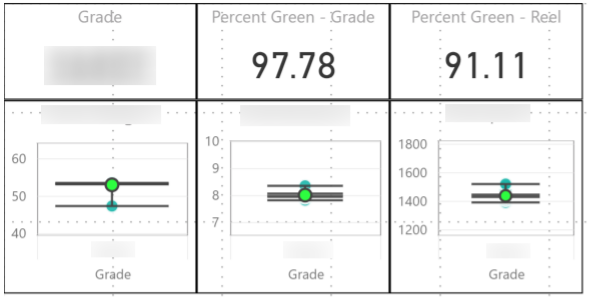
Name	Expression	Value at Evaluation	Value at Last Trigger	Output Attribute
vInProduction	'..|Machine In Production'	Down	Down	Map
vGrade	'Grade'			Map
vLastGradeChangeTime	'Last Grade Change Time'	3/5/2018 5:48:33 PM	3/5/2018 5:48:33 PM	Map
vReelStartTime	'Reel Start Time'	3/7/2018 6:57:00 AM	3/7/2018 6:57:00 AM	Map
v LoLimit	'..| |Lo'	36.934	36.934	Map
v HiLimit	'..| |Hi'	37.976	37.976	Map
v Now	'..| '	37.436	37.436	Map
v Grade	TagAvg('..| ', 'Last Grade Change Time', '*')	37.508	37.508	Map
v Reel	TagAvg('..| ','Reel Start Time','*')	37.436	37.436	Map
v InTolGrade	if '..|Machine In Production' = "In Production" and v Grade > '..| |Lo' and v Grade < '..| |Hi' then 1 else 0	0	0	In Tol - Grade
v InTolReel	if '..|Machine In Production' = "In Production" and v Reel > '..| |Lo' and v Reel < '..| |Hi' then 1 else 0	0	0	In Tol - Reel

Re-imagining For the Operator Part 2

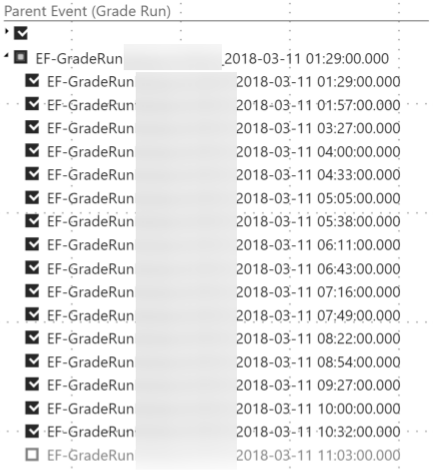


Now, For the Engineers

Now, For the Engineers



EventFrame		Average of Percent Green Grade	Average of Percent Green Reel
EF-GradeRunI	2018-02-28 22:56:00.000	100.00	60.00
EF-GradeRunI	2018-03-11 01:29:00.000	100.00	80.00
EF-GradeRunI	2018-03-11 01:57:00.000	80.00	80.00
EF-GradeRunI	2018-03-11 03:27:00.000	80.00	100.00
EF-GradeRunI	2018-03-11 04:00:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 04:33:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 05:05:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 05:38:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 06:11:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 06:43:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 07:16:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 07:49:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 08:22:00.000	100.00	80.00
EF-GradeRunI	2018-03-11 08:54:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 09:27:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 10:00:00.000	100.00	100.00
EF-GradeRunI	2018-03-11 10:32:00.000	100.00	60.00
Total		**97.78**	**91.11**



Sheet Break Re-Thread

Business Problem

- Mill wanted to understand **how long the re-thread process took after a sheet break** (downtime event). **Time = $$**
  - By crew
  - By grade
- Engineer who wanted to solve this **pulled lots of data** and wrote logic to capture events in Excel/Minitab
- **Not a scalable solution** for ongoing performance and analysis
  - **Engineer transferred to a new role** after the initial analysis

Lots of Analytics – Real Time and Post Process

Name	Expression	Value at Evaluatio	Value at Last Trigg	Output Attribute
vSheetBreakFirstOut	'Break First Out'	NO BREAK	NO BREAK	Map
vBreakStartTime	if PrevVal('Break First Out','*') = "NO BREAK" and TagVal('Break First Out','*') <> "NO BREAK" then '*' else NoOutput()	-	-	Break Start Time
vBreakEndTime	if PrevVal('Break First Out','*') <> "NO BREAK" and TagVal('Break First Out','*') = "NO BREAK" then '*' else NoOutput()	-	-	Break End Time
vWetEndWashUp	('Break First Out' = "Break 1" or 'Break First Out' = "Break 2" or 'Break First Out' = "Break 3" or 'Break First Out' = "Break 4" or 'Break First Out' = "Break 5" or 'Break First Out' = "Break 6" or 'Break First Out' = "Break 7") and '< 50 and '< 50 and ' < 500			
vThreadingPressesAndMain	> 500 and not ((TagVal('4th Press Speed','*- and 'Break First Out' <> "No Break" and < 0.5			
vThreadingSizePressAndAfter	//It was noticed that sometimes this c 'Break First Out' = "Break 6" and > 0.5			
vThreadingCalStackAndReel	'Break First Out' = "Break 9" and > 250 and > 250			
vWetEndWashUpTimeMins	if ('Break First Out' <> "NO BREAK" or and PrevVal('Break First Out','*') <> then TimeEq('Wet End Wash Up', 'Break			

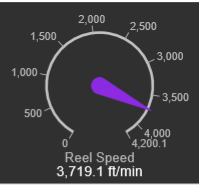
Name	Expression	Value at Evaluatio	Value at Last Trigg	Output Attribute
vBreakSignal	'Break First Out'	NO BREAK	NO BREAK	Map
vLastBreakEndTime	PrevVal('Break End Time',Prevevent('Break End Time','*'))	3/6/2018 10:31:05	3/6/2018 10:31:05	Last Break Break End Time
vBreakDuration	if BadVal('Break Duration') then NoOutput() else if 'Break First Out' = "NO BREAK" and PrevVal('Break First Out',' then TagVal('Break Duration') else NoOutput()	-	-	Break Duration For Analytics
vWetEndWashUpTime	if BadVal('Wet End Wash Up Time') then NoOutput() else if 'Wet End Wash Up Time' > 0 and 'Break First Out' = "NO BREAK" and PrevVal('Break First Out', then TagVal('Wet End Wash Up Time') else NoOutput()	-	-	Wet End Wash Up Time For Analytics
vThreadPressMainSectTime	if BadVal('Threading Presses and Main Section Time') then NoOutpu if 'Threading Presses and Main Section Time' > 0 and 'Break First Out' = "NO BREAK" and PrevVal('Break First Out', then TagVal('Threading Presses and Main Section Time') else NoOutput()	-	-	Threading Presses and Main Section Time For Analytics
vThreadSizePressAfterTime	if BadVal('Threading Size Press and After Section Time') then NoO if 'Threading Size Press and After Section Time' > 0 and 'Break First Out' = "NO BREAK" and PrevVal('Break First Out', then TagVal('Threading Size Press and After Section Time') else NoOutput()	-	-	Threading Size Press and After Section Time For Analytics
vThreadCalStackReelTime	if BadVal('Threading Calender Stack and Reel Time') then NoOutput if 'Threading Calender Stack and Reel Time' > 0 and 'Break First Out' = "NO BREAK" and PrevVal('Break First Out', then TagVal('Threading Calender Stack and Reel Time') else NoOutput()	-	-	Threading Calender Stack and Reel Time For Analytics
vYTDAvgWetEndWashUp	if not HasChanged('Wet End Wash Up Time For Analytics','1-1') then 0 else TagMean('Wet End Wash Up Time For Analytics','1-1','*')	35.201	35.201	YTD Average - Wet End Wash Up Time
vYTDAvgThreadPressAndMain	//the not Haschanged() expression covers the start of a new year if not HasChanged('Threading Presses and Main Section Time For An	27.943	27.943	YTD Average - Threading Presses and Main Section Time

PI Vision – For Real-Time Analysis

Machine Information

Unit Name	Crew	Grade Downtime Minutes	Grade
[redacted]	4	0	[redacted]

Break First Out	Wet End Wash Up	Threading Presses and Main Section	Threading Size Press and After Section	Threading Calender Stack and Reel
NO BREAK	False	False	False	False



Current/Most Recent Break Status

		Target	
Break Duration	35	45	-22.19%
Wet End Wash Up Time	0	15	-100%
Threading Presses and Main Section Time	0	15	-100%
Threading Size Press and After Section Time	11	10	+9.86%
Threading Calender Stack and Reel Time	3.24	5	-35.15%

Break Start Time
3/9/2018 6:33:49.083008 PM

Break End Time
3/9/2018 7:08:49.85701 PM

Previous Break Status

		Target	
Last Break - Break Duration	37.7	45	-16.11%
Last Break - Wet End Wash Up Time	10.3	15	-31.13%
Last Break - Threading Presses and Main Section Time	9.33	15	-37.78%
Last Break - Threading Size Press and After Section Time	5.98	10	-40.24%
Last Break - Threading Calender Stack and Reel Time	2.17	5	-56.63%

Last Break Break Start Time
3/9/2018 1:56:34.332001 PM

Last Break Break End Time
3/9/2018 2:34:19.228012 PM

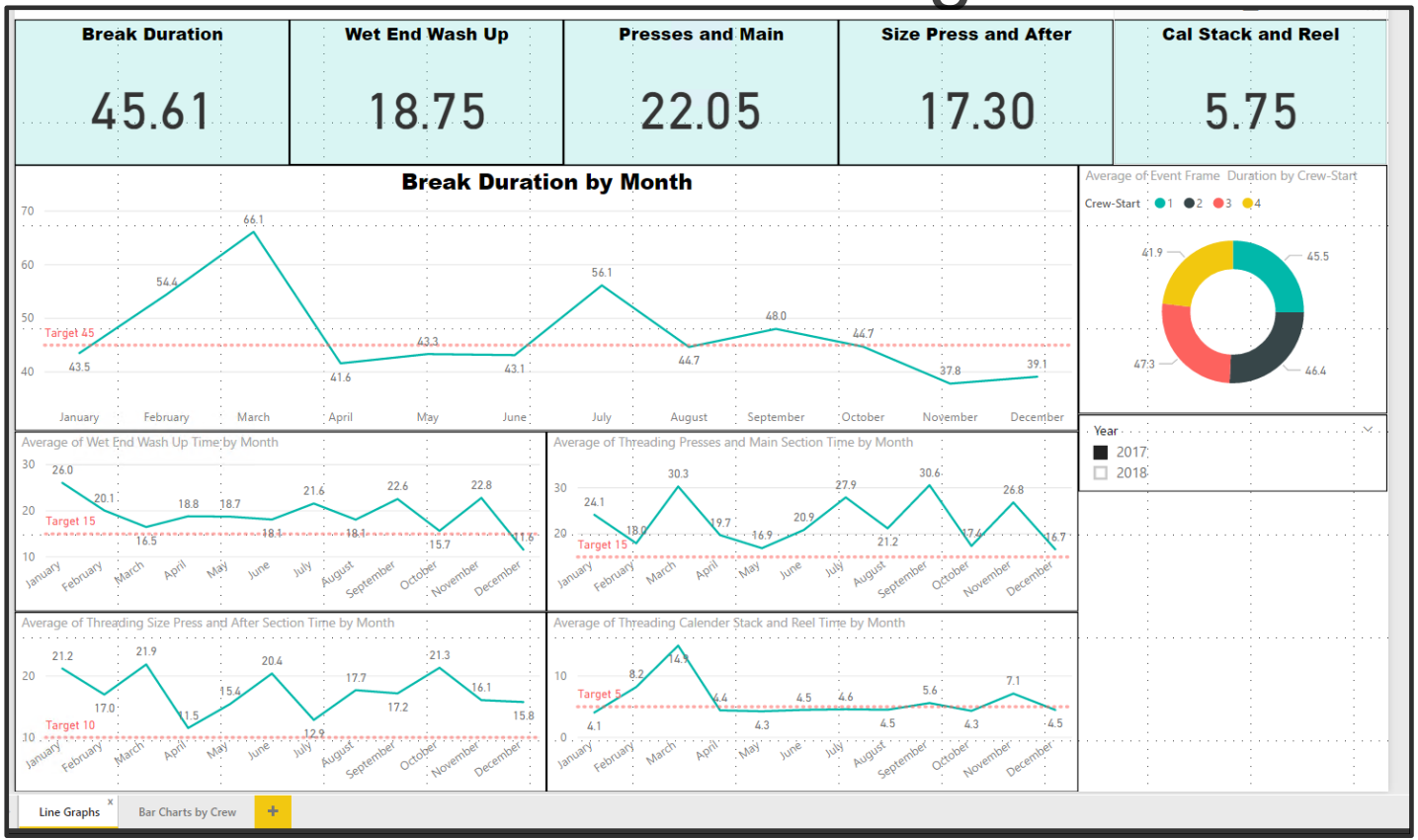
Month to Date Stats

		Target	
MTD Average - Break Duration	43.3	45	-3.85%
MTD Average - Wet End Wash Up Time	11.9	15	-20.49%
MTD Average - Threading Presses and Main Section Time	18.4	15	+22.78%
MTD Average - Threading Size Press and After Section Time	13.1	10	+31.18%
MTD Average - Threading Calender Stack and Reel Time	3.2	5	-36.06%

Year to Date Stats

		Target	
YTD Average - Break Duration	53.8	45	+19.6%
YTD Average - Wet End Wash Up Time	33	15	+119.87%
YTD Average - Threading Presses and Main Section Time	26.9	15	+79.31%
YTD Average - Threading Size Press and After Section Time	20	10	+100.19%
YTD Average - Threading Calender Stack and Reel Time	5.33	5	+6.55%

Power BI and the PI Integrator for BA



Summary

- New additions to the workforce requiring **different tools and faster analysis**
- **Need more context** around limits **(Red/Yellow/Green)**
- **Interactive displays** in PI Vision and BI tools – top level **should be simple and should tell a story**. **Draw the audience's eye** to what you need them to see. Drill down into detail as needed
- **AF, Analytics, and Event Frames** give us **context** we need
- **PI Integrator for Business Analytics great tool to replace large data pulls** and to refresh BI reports is invaluable

Design Tips

- **Be cognizant of your audience(s)** – could be 3-4 "customers" of your solution. Build the **right tool for the right audience**
- Strategic use of color and empty space in visuals – draw attention to the story you are trying to tell – start at the top left of the page – our eye is naturally drawn there
- **Boxes around groupings** in displays as appropriate
- **Use limits (AF attribute traits)**
- Understand **Analytics best practices** (triggering, error checking, use of variables, etc.)
- Work with SME's to **validate everything** you do

Co-Presenters

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- Industrial Insight
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- Process Information Manager
- International Paper

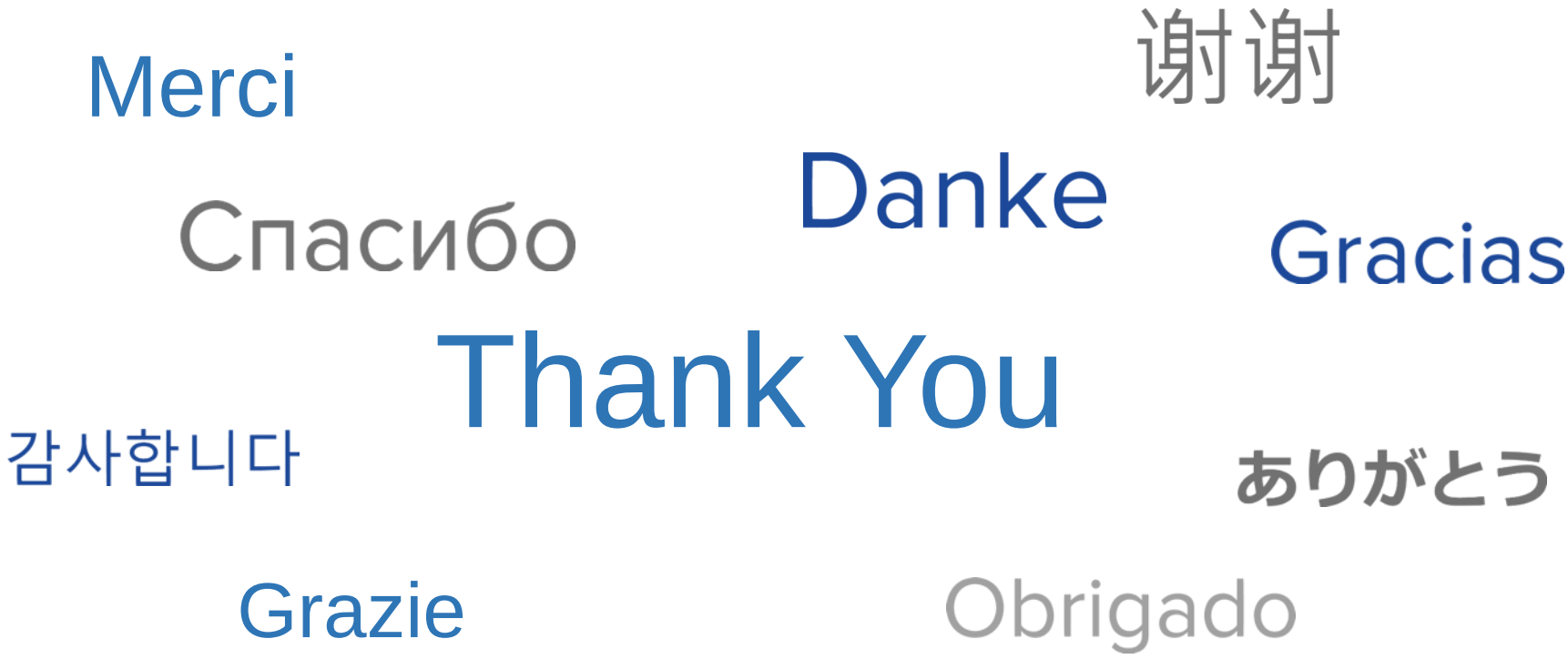
Questions

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

State your **name & company**

Please remember to…

Complete the Online Survey for this session



Challenge: **How much time are your people spending pulling and shaping data? Isn't there a better use of their time?**