

AVEVA PI WORLD

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# Tracking Downtime and Slowbacks

The Good, The New and the Not Ugly

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**AVEVA**

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# International Paper

- World's Largest Pulp and Paper Company
  - Founded 1898
  - \$20.6 Billion Net Sales (2020)
  - Sylvamo Spin-Off (Oct. 2021)

# Tracking Downtime and Slowbacks



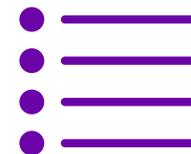
## Challenge

- Enhance Reliability Tracking System (RTS) to Provide Improved Capability and Enterprise Reporting While Replacing Obsolete Technologies



## Solution

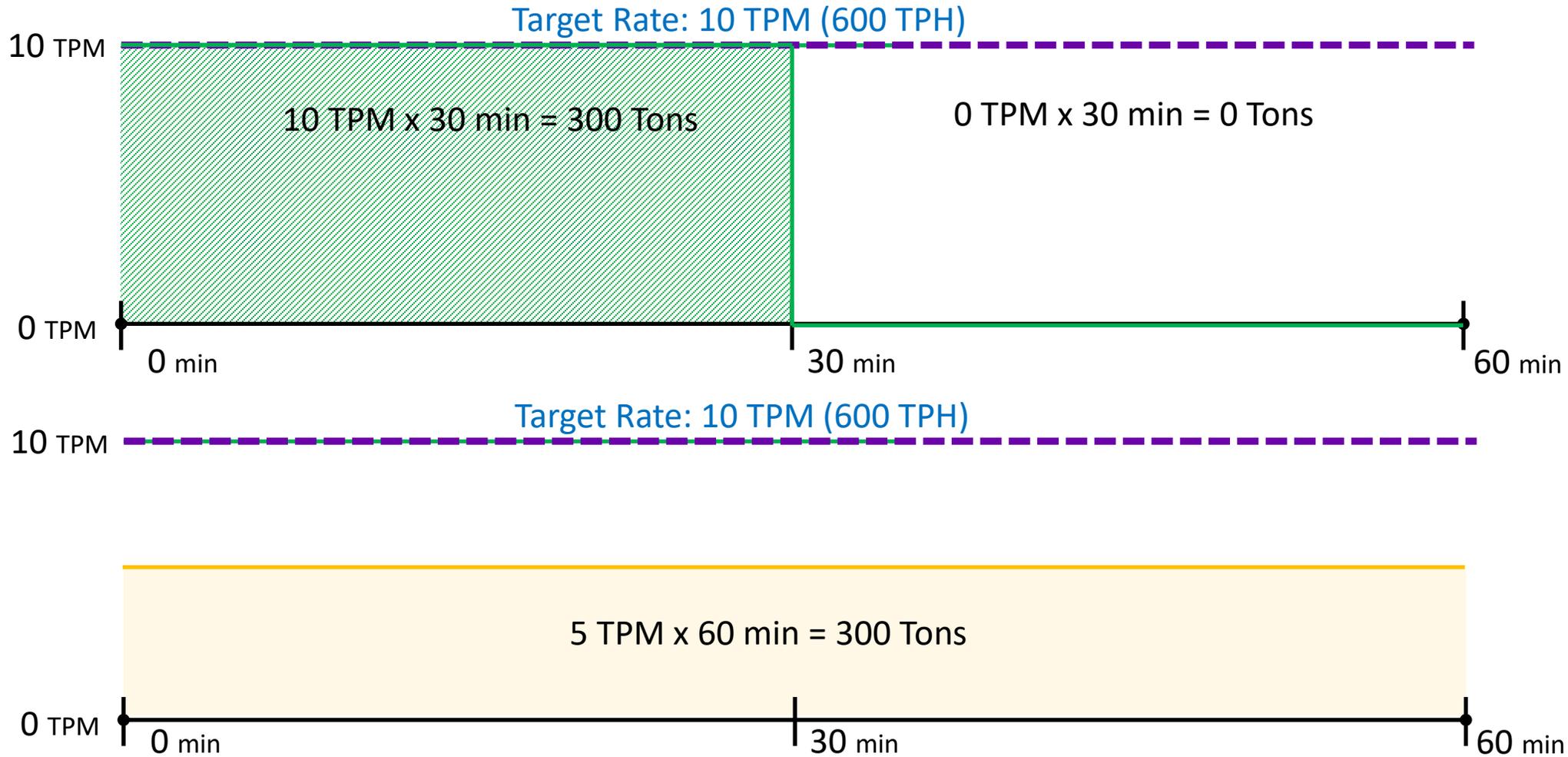
- Deployed the latest AVEVA PI System technology including PI AF, PI Vision and PI Integrator for Business Analytics to Improve Reliability Tracking.



## Benefits

- Enterprise Reporting Based Using PI Integrator Based on Distributed PI AF Templates
- Simplified Troubleshooting
- Sustainable Solution
- Team Deployment Model Instead of Single Person Support

# What is Equivalent Downtime (EQDT)?



# The Beginning of a Journey...

## Building the Case for PI AF in IP (2015)

- Build the Business Case
  - Incorporate Many Facets/Customers
  - Avoid “Shiny Rock” Syndrome
- Single Version of the Truth
  - Standardize Structure and Calculation Methodology
- Simplify Solutions (Reliability Tracking System -> PI AF)
- Reduce Work (“Jeff Reese” Excel Spreadsheet)

<https://www.osisoft.com/presentations/building-the-case-for-asset-framework-at-international-paper/>

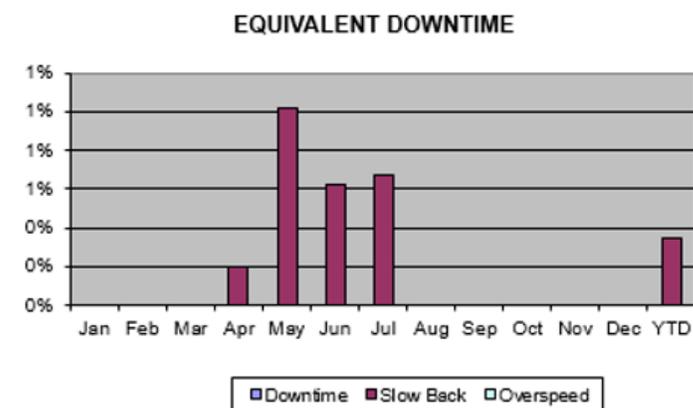
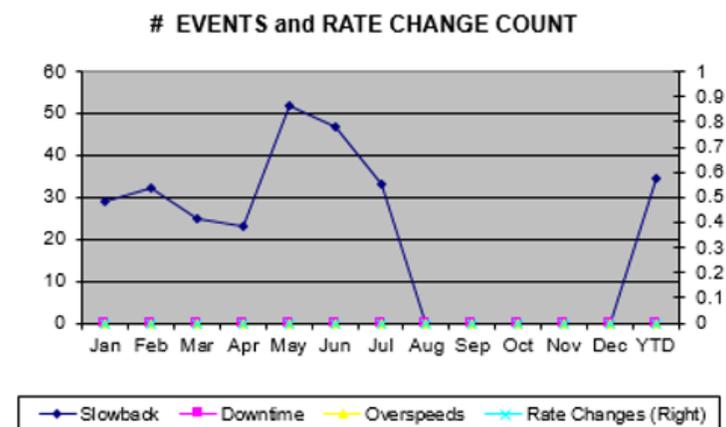


2015

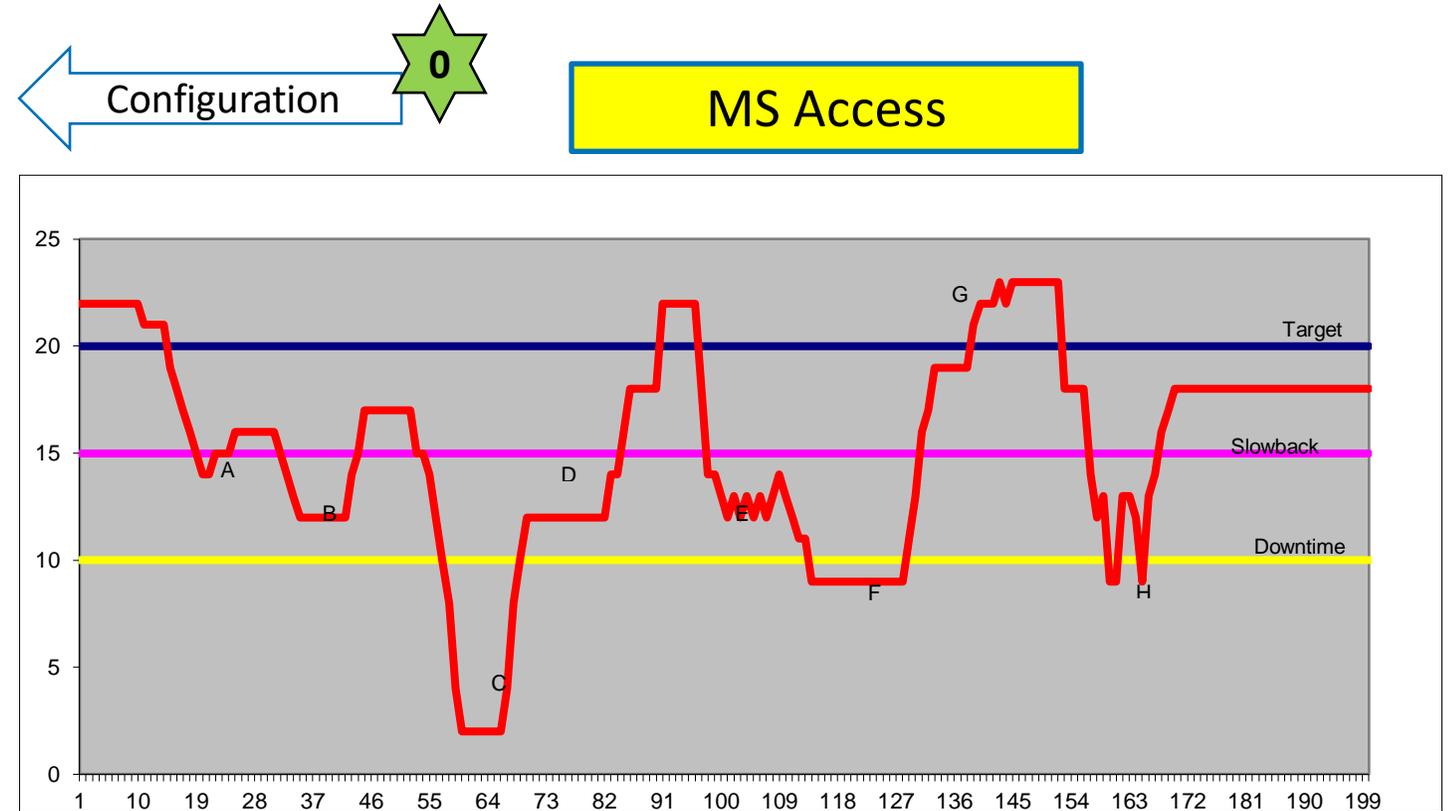
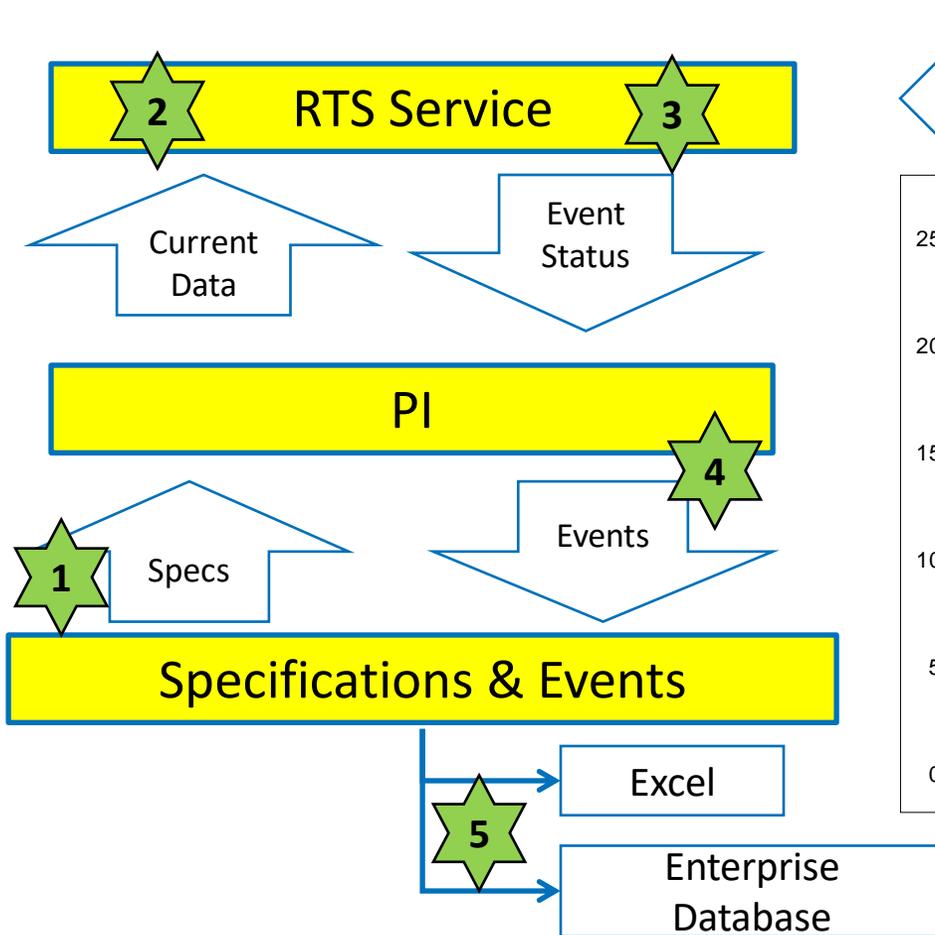
# Reliability Tracking System: A Brief History

- Program **created in 2002** to track downtime and slowback
- Written in **VB6** – ouch!
- Nightly MS Excel Reporting
  - 1 file per unit

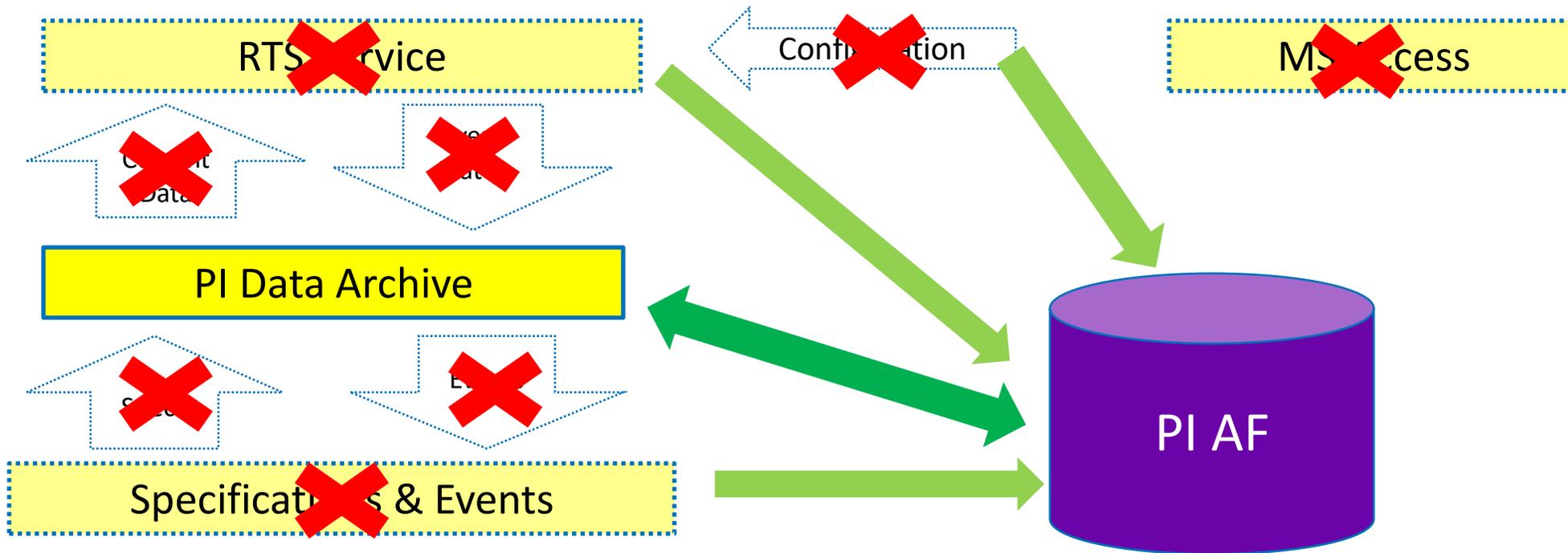
INTERNATIONAL PAPER						
RTS Monthly Report Downtime Summary				Date <b>07/20/21</b>		
				Mill		
				Equipment		
EQUIVALENT DOWNTIME	For Month			Year-To-Date		
	No. of Events	Duration (Hr)	Equival. DT (%)	No. of Events	Duration (Hr)	Equival. DT (%)
Slowback Mode	33	47.5	0.7%	241	1182.9	0.3%
Downtime Mode	0	0.0	0.0%	0	0.0	0.0%
<b>Total</b>			<b>0.7%</b>			<b>0.3%</b>
<b>Overspeed Mode</b>	0	0.0	0.0%	0	0.0	0.0%
<b>Availability (100 - Downtime %)</b>	480.0	100.0%		4824.0	100.0%	
<b>Avg. Time Between DT Events</b>	0.0	hr		0.0	hr	
<b>Average Downtime Event Time</b>	0.0	hr		0.0	hr	



# Downtime Data Flow (2002-Present)



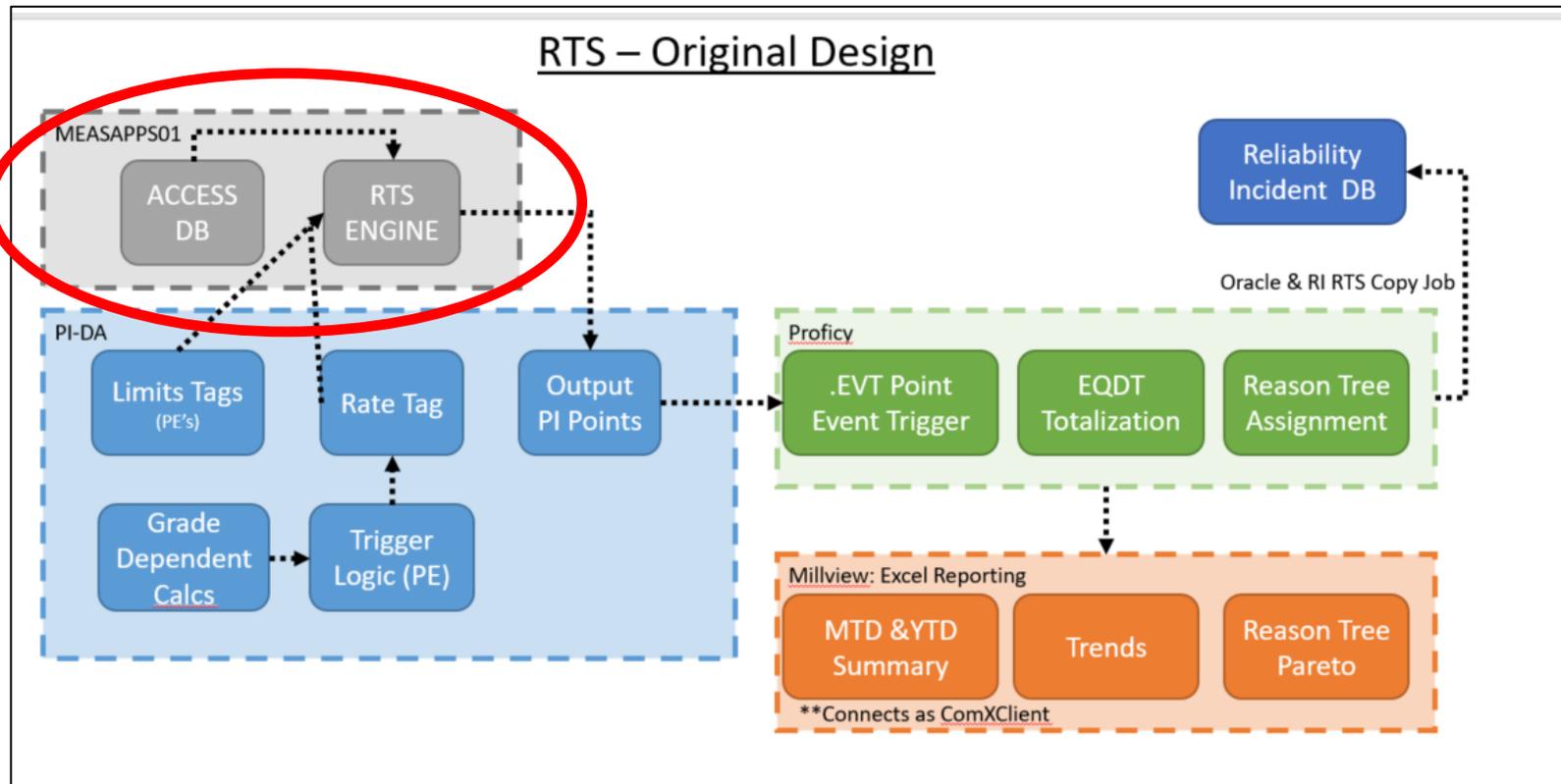
# Future Downtime Data Flow from 2015 Concept...



Event name	Start time	End time	Duration	Target.Average	Value.Average
EF_RTS_RTS-Test1_SS_2014-09-12 06:50:00	12-Sep-14 06:50:00			40.00	45.67
EF_RTS_RTS-Test1_SS_2014-09-16 06:20:00	16-Sep-14 06:20:00	16-Sep-14 06:31:00	0 0:11:00	40.00	27.75
EF_RTS_RTS-Test1_SS_2014-09-16 06:50:00	16-Sep-14 06:50:00	16-Sep-14 11:22:00	0 4:32:00	40.00	8.11
EF_RTS_RTS-Test1_SS_2014-09-16 18:32:00	16-Sep-14 18:32:00	16-Sep-14 23:07:00	0 4:35:00	40.00	9.42
EF_RTS_RTS-Test1_SS_2014-09-16 23:11:00	16-Sep-14 23:11:00	16-Sep-14 23:32:00	0 0:21:00	40.00	26.70

# 2018 Project Scope

- Transition the RTS engine to PI-AF.
- Rewrite the engine to closely match results with a seamless transition.



# 2021 Project Transition

- February 2021 technical lead left the company.
- Complex code with limited documentation.
- Project was expanding to replace another event tracking tool.

SBGradeCheck	TagVal('SlowbackMaximumTag',GradeChecktime)
SBNow	TagVal('SlowbackMaximumTag','*')
LookFor	<pre>if (SheetBreak = true) then   if ('Sheetbreak Setup Sheetbreak Tag' &lt;&gt; PrevVal('Sheetbreak Setup Sheetbreak Tag','*')) then     '*'   else     parsetime("01-Jan-2018 00:00:00") else if (OldIncident = 1 and GetIncident = 0) then   if SlowbackMaxChange then     '*'   else     findLE('RateTag','*','*-30d','SlowbackMaximumTag') else if (OldIncident = 2 and GetIncident = 0) then   if ('Downtime Method' = "Indicator") then     '*'   else     findLE('RateTag',StartTime,'*-30d','DowntimeMaximumTag') else if (OldIncident = 0 and GetIncident = 1) then   if (SheetBreakEnd = true) then     '*'   else if (SlowbackIncrease = true or SlowbackMaxIncrease = true) then     parsetime("01-Jan-2018 00:00:00")   else if (GradeNext &gt; GradePrevious) then     '*'   else     findGE('RateTag',StartTime,'*-30d','SlowbackMaximumTag') else if (OldIncident = 2 and GetIncident = 1) then   if ('Downtime Method' = "Indicator") then     '*'   else     findGE('RateTag',StartTime,'*-30d','DowntimeMaximumTag')</pre>

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# 2021 Project Research

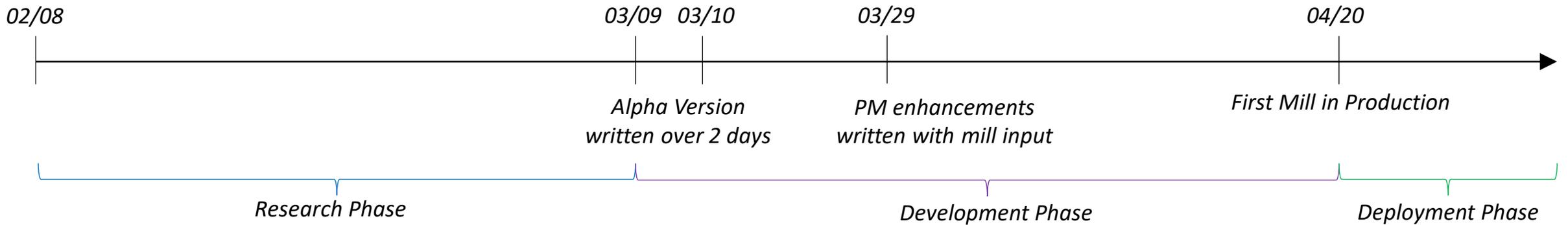
## POTENTIAL CALCULATION IMPROVEMENTS

- **Array handling and operations in PI-AF analytics**
  - **Event Frame Outputs to PI tags**
  - PI Integrator for Business Analytics improvements
  - Consolidation of calculation and evaluation engines to one source
  - Extensible through use of derived templates
- 
- Conducted code reviews, and interviews with various product SME's
  - **Took time to understand** the various methods to calculate the desired outcomes

## POTENTIAL VISUALIZATION IMPROVEMENTS

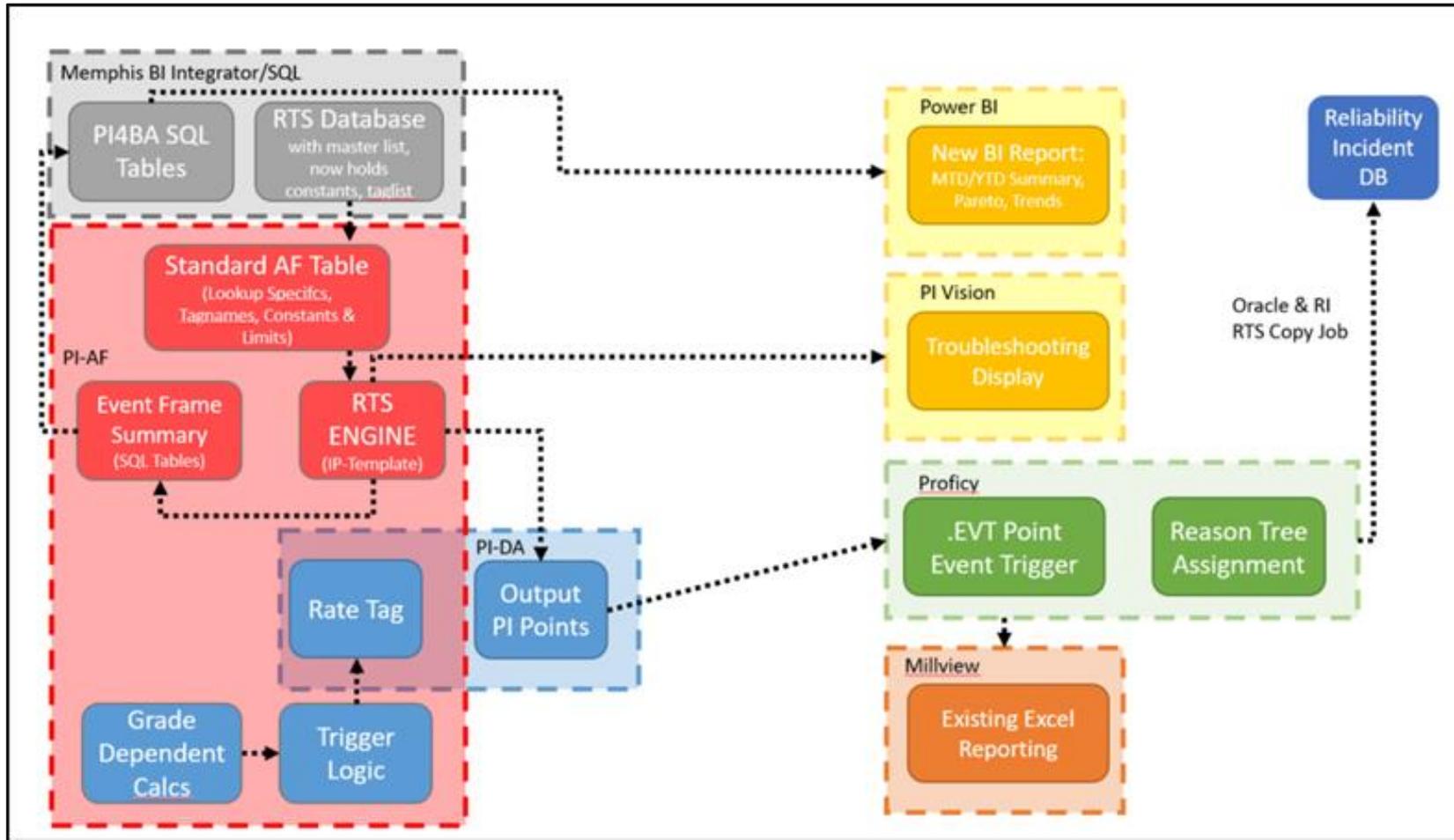
- PowerBI gaining traction within organization
- PI Vision 2020 improvements
- Both products are mobile compatible

# 2021 Project Timeline



- Able to build initial version in 2 days due to power of PI AF functions and analytics
- Springfield mill was the initial pilot and the first mill to reach full production
- Beta site of Cedar River was integral with vetting calculations and improvements
- Subsequent site deployments have been very smooth thus far

# RTS 2021 Design



# Analysis Evaluation Improves Sustainability

- Utilized most up-to-date features within PI-AF such as Arrays and Event Frame Outputs.
- Full form comments added to coach users through each step of the evaluation.
- Analysis preview simplifies troubleshooting.

The screenshot displays the configuration and evaluation interface for the 'MEMPHIS-Sinusoid' analysis. The top section shows a list of analysis elements:

Name	Backfilling
1-RateState	✓
2-FilteredState	✓
3-EquivalentDowntime	✓
4-RTS-Event	✓

The right-hand pane shows the configuration for '1-RateState':

- Name: 1-RateState
- Description:
- Categories: RTS
- Analysis Type:  Expression  Rollup  Event Frame Generation  SQC

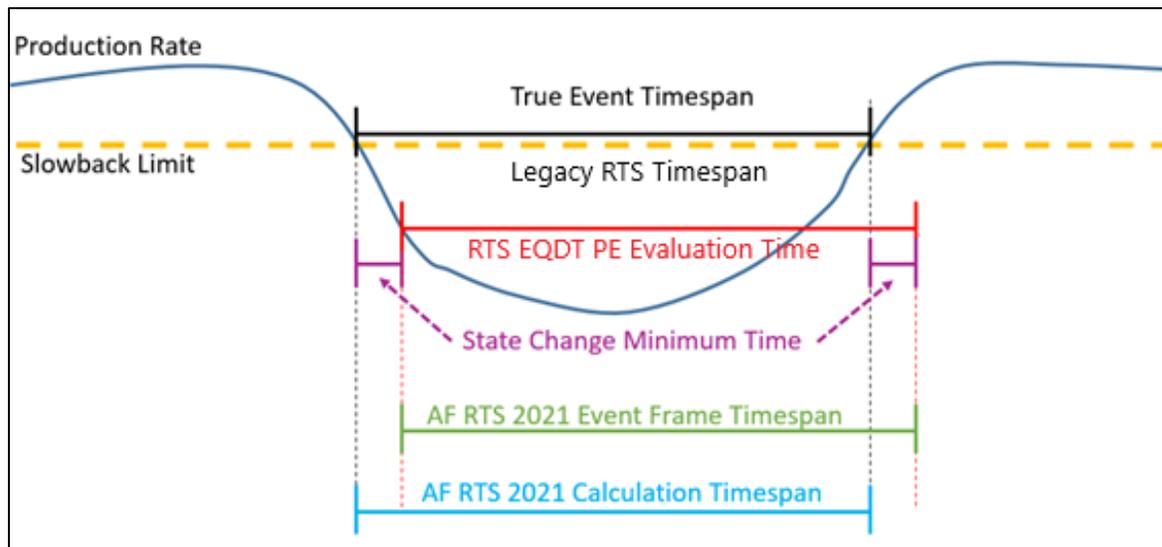
The main table displays the evaluation results for various variables:

Name	Expression	Value at Evaluation	Value at Last Trigg	Output Attribute
vSCMTime	//Minimum time a unit must continuously be in a state before a change has 'StateChangeMinimumTime'	10 min	10 min	Map
vSCMST	//State change minimum timestamp, looks up the values from the proper time ParseTime(Concat("* - ", 'StateChangeMinimumTime', "m"))	8/27/2021 4:20:33	8/27/2021 4:20:00	Map
vRate	//Monitored Rate of Unit, should include all specific or special conditions 'RateTag'	63.747	63.747	Map
vSBTrigger	//Going below this value triggers a slow state 'Limit-Slowback'	45	45	Map
vDTTrigger	//Going below this value triggers a down state 'Limit-Downtime'	15	15	Map
vRateArray	//All of the rate tag values in the time window plus one interpolated value //Recommendation is for RateTag to have at least 1 value per minute and be RecordedValues('RateTag', vSCMST, '*', "Interpolated")	[66.748, 63.747]	[66.974, 63.747]	Map
vStateArray	//For each value in the array full of Rate Tag values, compare that rate //and assigns the appropriate translation to a state MapData(vRateArray, If \$val < 'Limit-Downtime' THEN "DOWN" ELSE IF \$val <	[NORMAL, NO]	[NORMAL, NO]	Map

Additional information at the bottom of the interface:

- Evaluation Time: 8/27/2021 4:30:33 PM Last Trigger Time: 8/27/2021 4:30:00 PM
- Scheduling:  Event-Triggered  Periodic
- Period: 00h 01m 00s
- Total number of values: 3
- AMMEASAS21 Version: 1/1/1970 12:00:00 AM, Revision 20
- Connected to the PI Analysis Service.

# Event Frame Evaluation Improves Accuracy



☐ Outputs at close	
vActualStart	<code>//EventFrame Start minus the State Change Minimum Time ParseTime(Concat(EventFrame("StartTime"), "-", 'StateChangeMinimumTime', "m"))</code>
vActualEnd	<code>//EventFrame End minus the State Change Minimum Time ParseTime(Concat(EventFrame("EndTime"), "-", 'StateChangeMinimumTime', "m"))</code>
vEventDuration	<code>//Double check of event duration (should match the event frame duration) Convert(Convert(Float(vActualEnd - vActualStart), "s"), "min")</code>
vProdDefEvent	<code>//ProdDeficit for EventFrame and time before including State Change Minimum Time if TagVal('RTS-State', '*-30s') = "DOWN" then 100 else TagAvg('ProdDeficit-Rate', vActualStart, vActualEnd)</code>

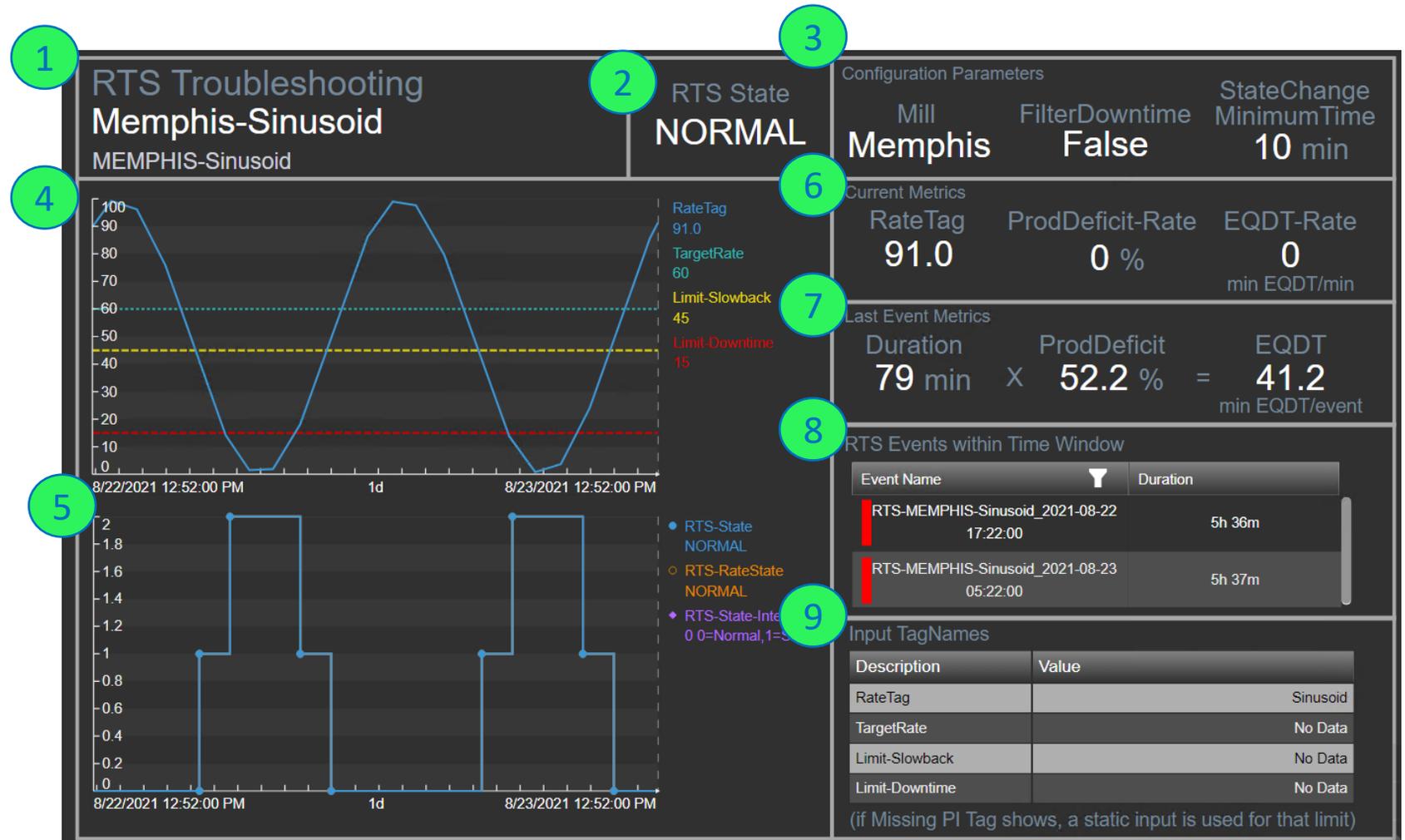
# PI Vision Display Improved Understanding

- PI Vision simplified troubleshoot by highlighting state transitions.
- Single display based on PI AF Templates.
- Automatically picks up any new units added within PI AF.
- Dramatically reduced development labor and standardized consumption.



# RTS Troubleshooting – Data Overview

- 1) Unit Description & Element Name
- 2) Current Unit State Value
- 3) Configuration Parameters
- 4) Rate Trend
- 5) State Trend
- 6) Current Metrics
- 7) Last Event Metrics
- 8) RTS Events in Time Window
- 9) Input TagNames



# RTS Troubleshooting – Navigation Overview

1) Asset Navigation

Drop Down

2) Event Frame Pane

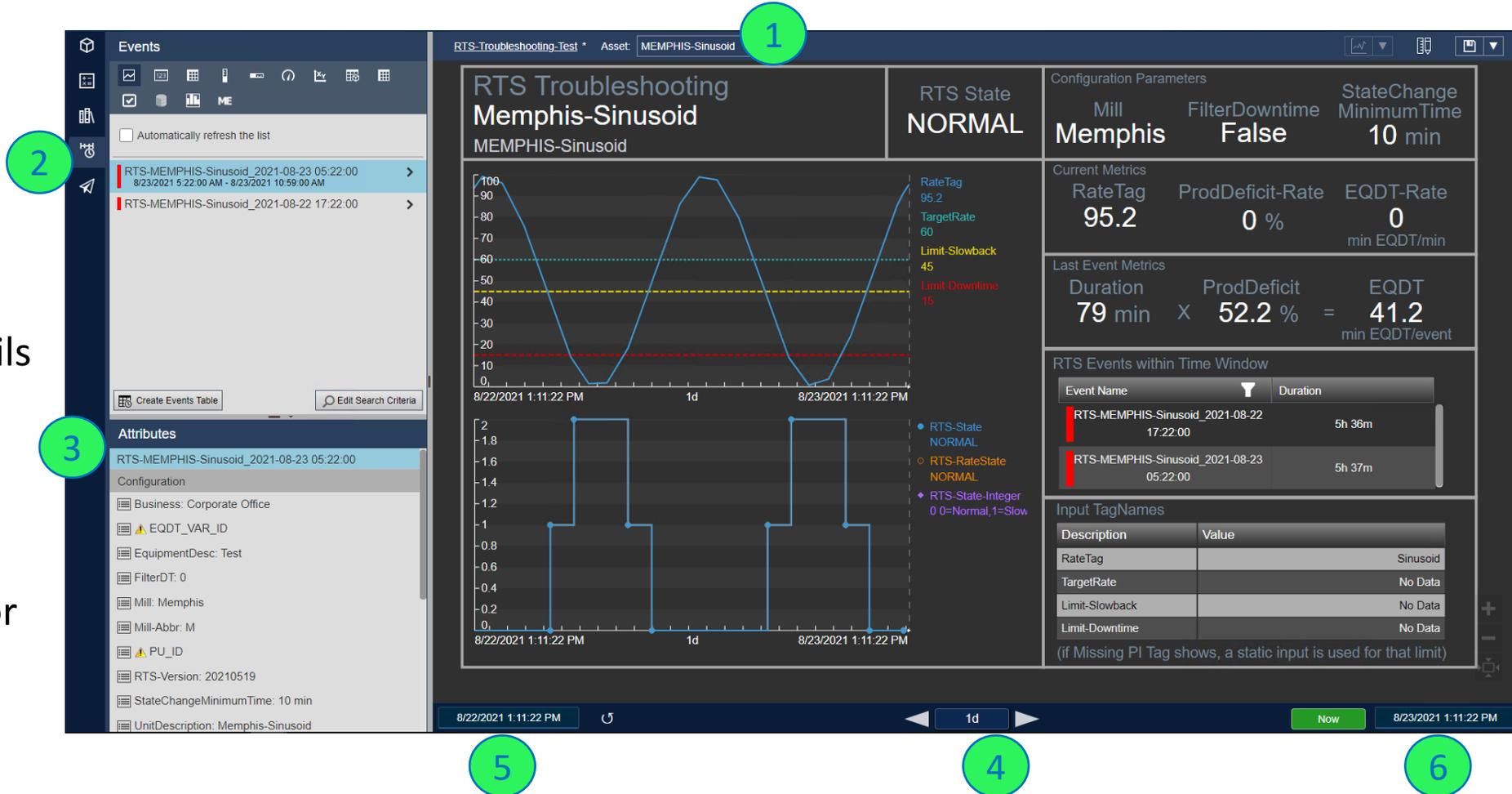
3) Event Frame Details

4) Display Timespan

Selector

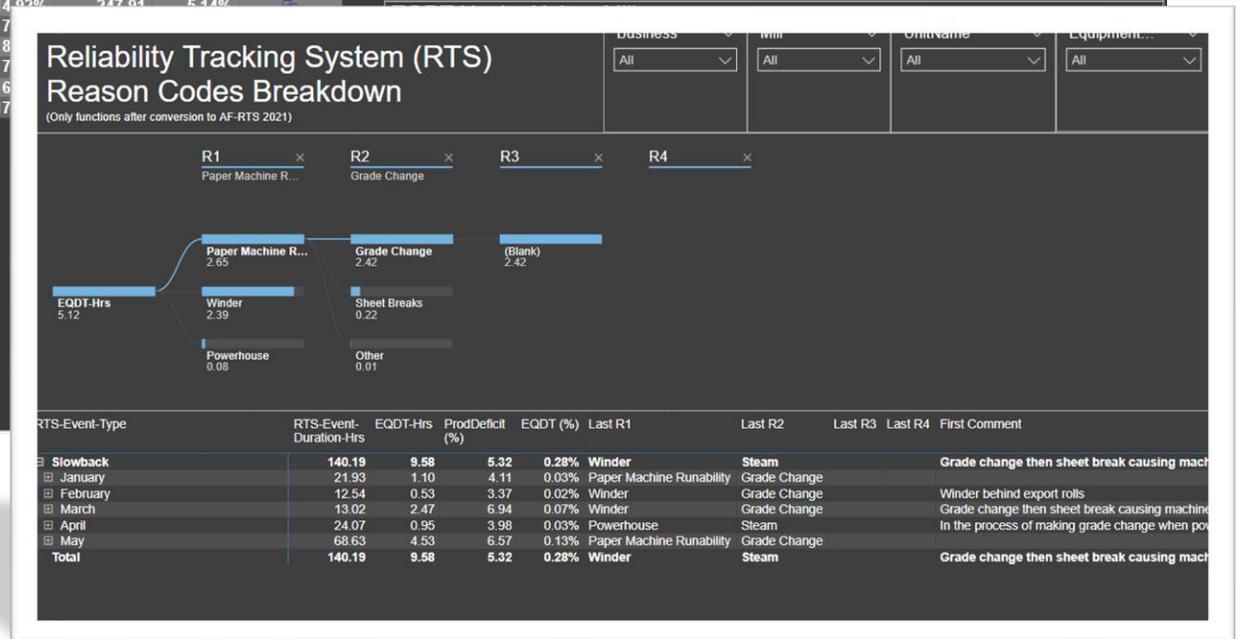
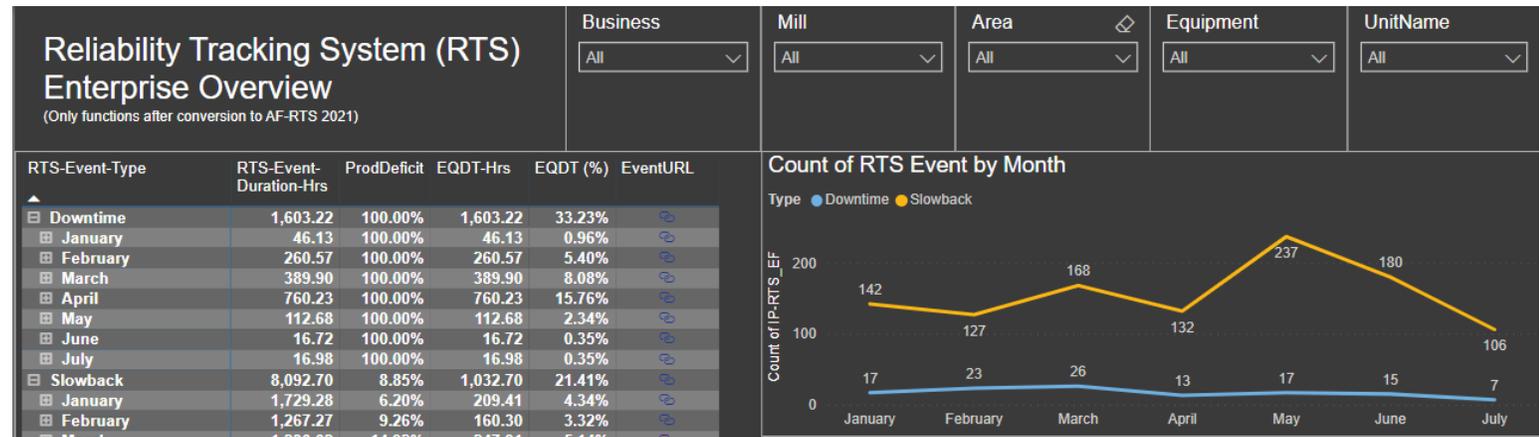
5) Start Time Selector

6) End Time Selector



# PowerBI Data Visualization

- PowerBI improved long term trending, reporting and data consumption.
- Slicers allow for interactive data discovery by slicing values by reason code or comparing unit to unit or mill to mill.
- PowerBI links back the facility RTS Event in PI Vision for further analysis



# Link Power BI to PI Vision & Documentation

- Power BI hosts links to each unit's PI Vision display and the overall support documentation.
- 'Versions' tab was included in the Power BI Report help keep all units up-to-date.

MFG IT PIM MADR Mfg PIM Project Status Mill of the Future EHS Tech & Mfg Reliability

OSISoft PI - Reliability Tracking System (RTS)

Reliability Tracking System (RTS) Monitor - PI-AF 2021 Rewrite

AF-RTS 2021 is a system for comparing Rates against their Targets for a given Unit to determine Slowback or Downtime states by performing a rate comparison. These production losses are expressed in AF-RTS 2021 as the traditional EQDT (time losses) as well as the newly introduced metrics of Production Deficit (loss as a %). In addition to this, a Machine Speed based Paper Machine specific version has been created to allow for this percentage loss to be applied against a secondary Tonnage Target to allow for speed related events to be translated to Lost Tonnage.

Other improvements include:

- A rewritten engine that utilizes the most advanced PI-AF function available: Arrays and Event Frame Outputs
- A PI Vision Troubleshooting Page has been developed that allows users to see the configuration of each monitored unit as well as visualize the behavior of the RTS system as it evaluates the rates, targets and limits of the unit.
- A Power BI display for consuming long-term RTS data in a new and empowering way. Allowing unit-to-unit comparison as well as the ability to slice data as the user sees fit.
- Updated support documentation, highlighting changes, core concepts and detailed code analyses: [HERE](#)

RTS Troubleshooting Lime Kiln 4  
RTS State: **DOWN**  
Filter/Downtime: False  
StateChange MinimumTime: 5 min

Reliability Tracking System (RTS) Enterprise Overview

Reliability Tracking System (RTS) Reason Codes Breakdown

Count of RTS Event by Month

EQDT-Hrs by Unit or Mill

RTS Event Type

RTS Event Type	EQDT Hours (Target)	EQDT (%)	Production (%)	EQDT (Hrs)	Last 10	Last 30	Last 90	Filter Comment
Slowback	142.18	1.00	0.00	0.00%	0.00%	0.00%	0.00%	State change then slow back causing month
Downtime	21.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%	State change then slow back causing month
Change	12.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%	State change then slow back causing month
Stop	20.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%	State change then slow back causing month
Start	142.18	1.00	0.00%	0.00%	0.00%	0.00%	0.00%	State change then slow back causing month
Total	142.18	1.00	0.00%	0.00%	0.00%	0.00%	0.00%	

Reliability Tracking System (RTS) Current Versions of AF-RTS 2021 (Only functions after conversion to AF-RTS 2021)

Mill	UnitDescription	RTS-Version	PI Vision Link
<b>Cedar River</b>			
CR-PM1	PM1 Slowback	20210519	<a href="#">Link</a>
CR-PM2	PM2 Slowback	20210519	<a href="#">Link</a>
<b>Franklin</b>			
FR-F-Bleach	F-Bleach	20210519	<a href="#">Link</a>
FR-K1	K1	20210519	<a href="#">Link</a>
FR-LK4	Lime Kiln 4	20210519	<a href="#">Link</a>
FR-RB6	RB6	20210519	<a href="#">Link</a>
FR-TG9	9TG	20210519	<a href="#">Link</a>
<b>Riegelwood</b>			
RW-BP3	Bleach Plant #3	20210519	<a href="#">Link</a>
<b>Springfield</b>			
SP-PM2	PM2 Slowback	20210519	<a href="#">Link</a>

prise RTS 2021 Power BI report.

# Deployment Status and Plan (4 deployment teams)

- ❑ Goal is to be fully converted to AF-RTS 2021 by End of Year 2021 and have all instances of RTS Service Stopped
  - ❑ Plan to finish remediation of any legacy RTS installation or PI tags by end of Q4 2021
- ❑ Deployment is occurring in 4 parallel paths by region:

Tom Lee	East Region	RW	EO	TI	GT	SV	RM			
Lee Parker	Midwest Region	HE	PE	MV	PR	PH	RD	NP	VB	
Todd Moore	West Region	RR	MA	VA	BG	OR				
Charles Copeland	Pilots/GCF	SP	CR	FR	GP	CF	CM	NB	PW	FL

Green = Production, Orange = Checkout, Yellow = Dev, Blue = Research; Purple = Not Started

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## Understand and Solve the Problem, Don't Recreate the Solution

- By performing thoughtful **research** we were able to not only replace but drastically improve an essential product in the IP application portfolio.
  - It guaranteed the sustainability of the application by migrating to a relatively new platform that is part of the strategic direction moving forward.
  - It opened up access to the underlying code and should drastically broaden the supportability and understanding of the application.
  - It allowed for the modernization of how we interact with and consume the data, instead of just updating the back end with another black box.



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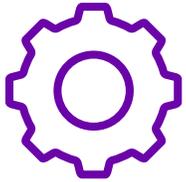
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# Tracking Downtime and Slowbacks



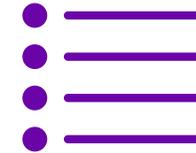
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- Deployed the latest AVEVA PI System technology including PI AF, PI Vision and PI Integrator for Business Analytics to Improve Reliability Tracking.



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