



OEE Model for Canning Craft Beer

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Agenda

1. About the Brewery
2. Can Line Project
3. Downtime Visibility and Accuracy Challenge
4. OEE or TEEP Model
5. PI System Configuration
6. Reporting





DESCHUTES BREWERY

- Family and Employee owned since 1988
- Production facility in Bend, Oregon
- New research and development brewery
- Pubs in Bend and Portland, Oregon
- 10th Largest craft brewery in U.S.A

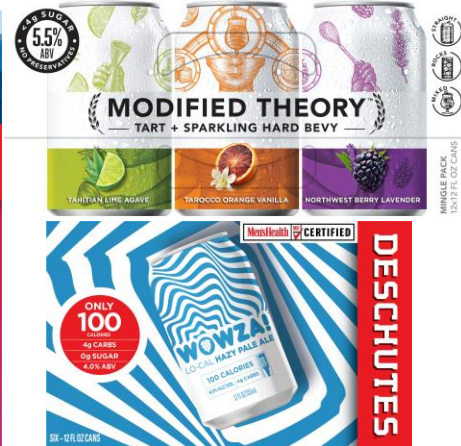
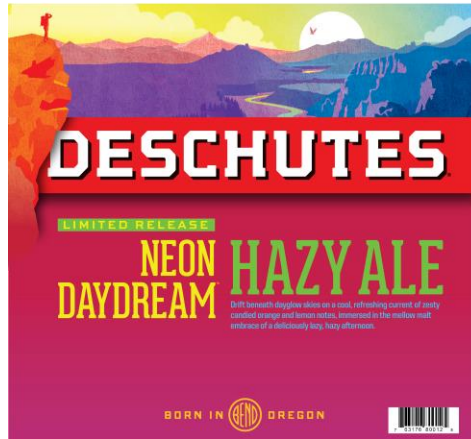
Our Mission

Profitably deliver the world's finest adult beverages and cultivate extraordinary experiences.

1. Craft distinct and diverse premium adult beverages that our customers value
2. Be the employer and brand of choice in craft beer
3. Be financially disciplined and eliminate waste



Products

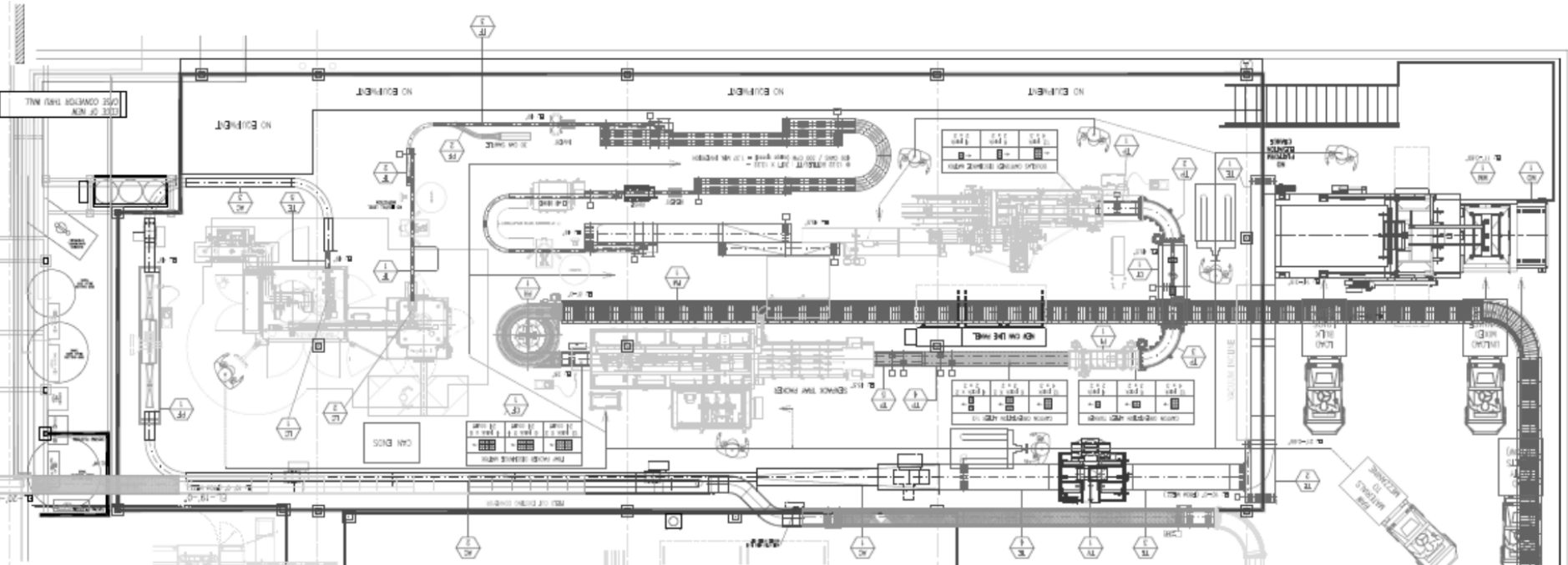


Can Line Project

- Added capacity for canned products in Q2 2018
- Ability to fill 12 ounce and 19.2 ounce cans
- Small footprint due to space constraints
 - Mezzanine level was built for canning
 - All integrated machines are from different OEM's
- Integration with plant SCADA, MES, and ERP systems
- Integration with data collection network and PI System was a requirement.



Mezzanine Level Can Line

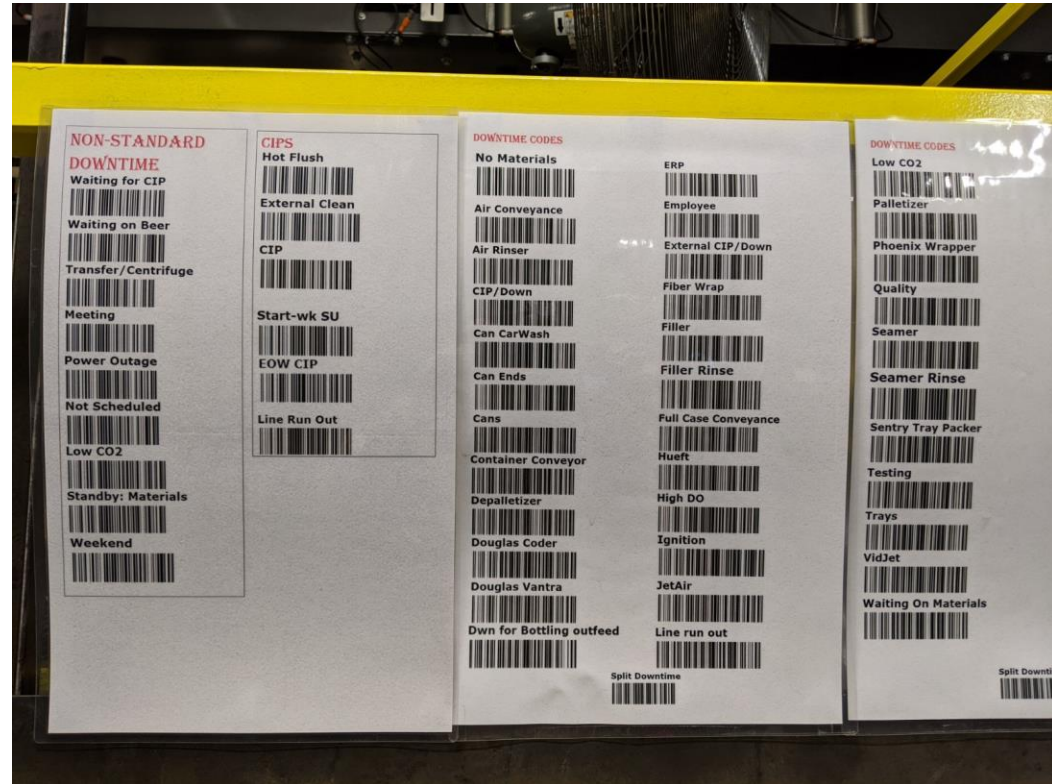


Mezzanine Level Can Line



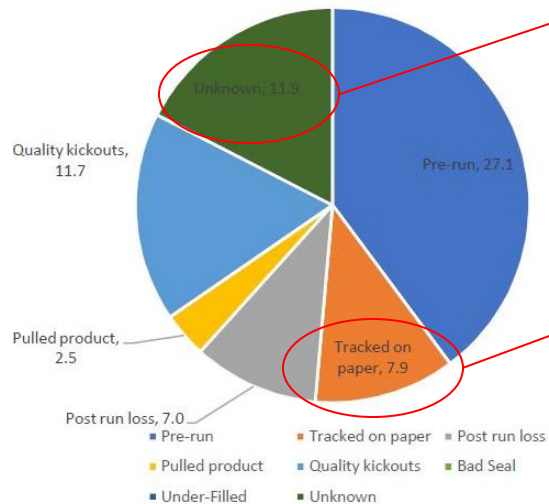
Tracking Downtime Reason and Duration

- Status and Messages only accessed on disparate HMI's
- Difficult to identify root cause or first fault
- Operators have limited downtime reason codes to scan
- Scans are subjective
- Downtime events stored in SQL database with limited access



Reporting Manually Captured Downtime

Quality loss calculated from ERP output

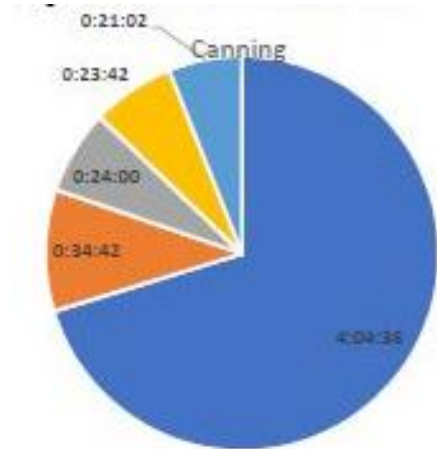


Unknown beer loss requires investigation.

What is being tracked on paper?

Reason codes for downtime not included.

Total Machine Downtime



Reason codes for downtime not included.

- Douglas Vantra
- Palletizer
- Depalletizer
- Sentry Tray Packer
- Full Case Conveyance



Requirements for OEE/TEEP

1. Must be calculated using mostly machine data.
 2. PI System Event Frames and PI Data Archive streams will be used for source data.
 3. Independent of personnel scheduling and production scheduling.
 4. User should be able to select a time range.
 5. Be able to determine root cause downtime.
 6. Reporting must be dynamic for end user data exploration.
- Empower the user to choose date parameters and drill down to find machine based reason codes for the six big losses.

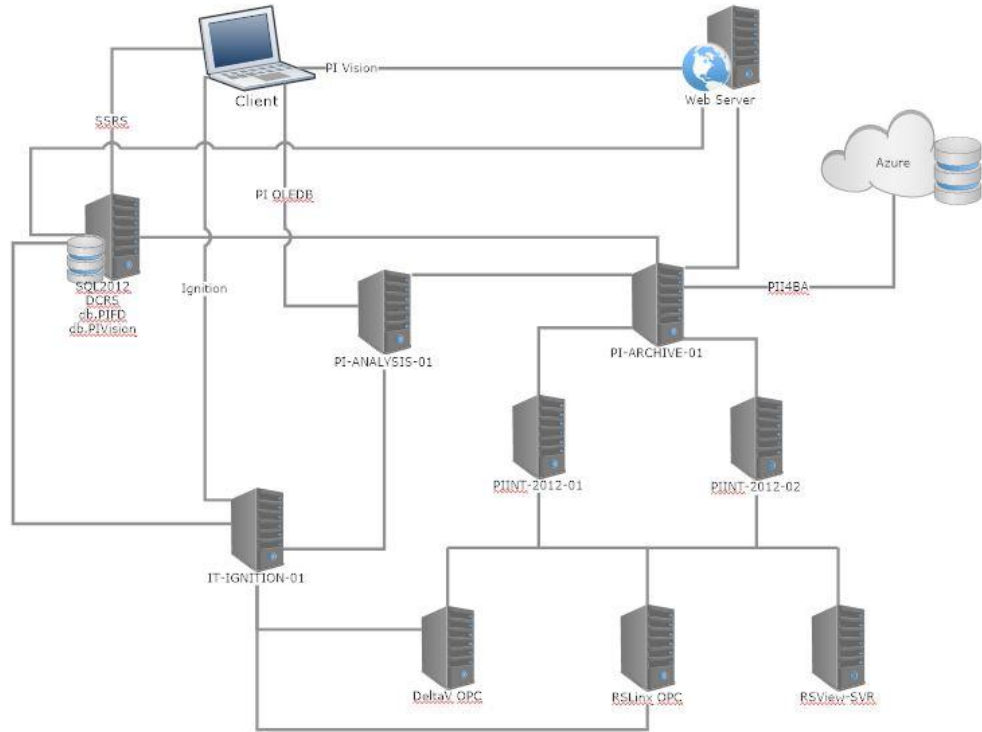


Data Collection Challenges

- Each machine has an independent PLC that communicates over peer to peer network. Several have proprietary controls and only export aggregate data.
- Most of the PLC programs are time intensive to decipher.
- Digital state values can be stored in proprietary HMI.
- Inconsistent connectivity to controllers once connected to the plant data collection network.



PI System Integration

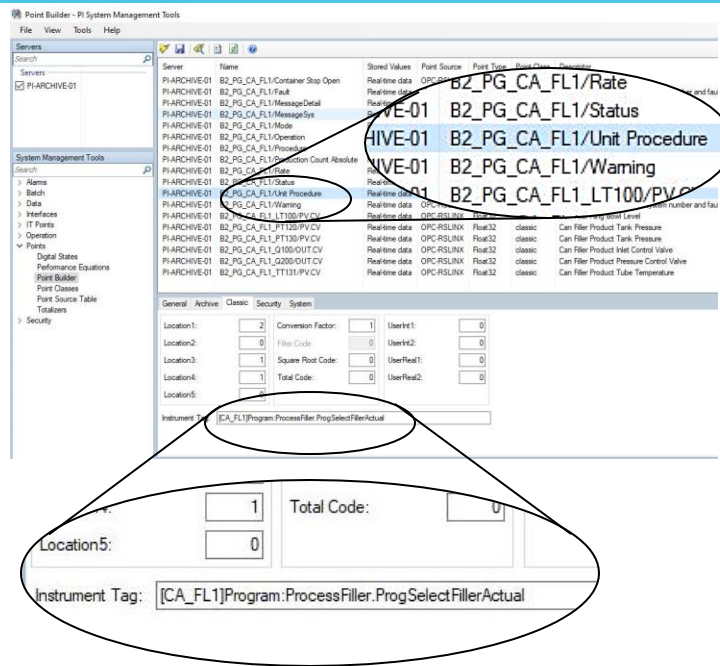


PI System Integration

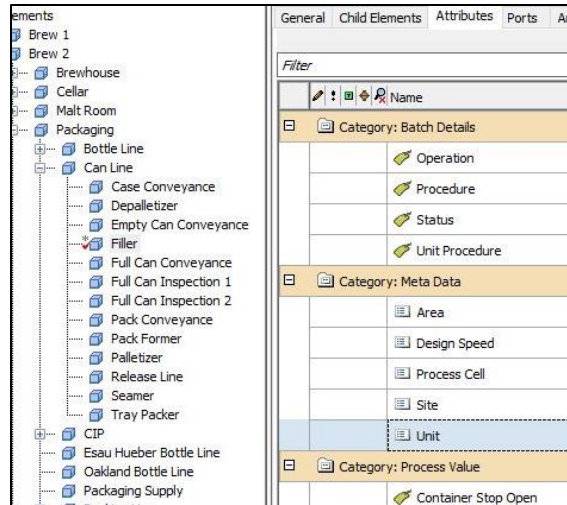
- Utilize PI Interface for OPC DA to collect data from RSLinx OPC server.
- Leverage PI RDBMS interface to query databases where live data is sent.
 - For can inspection equipment, which is the source of reject counts and reasons.
 - Used the distribution approach to store time series data to PI Tags for each counter and reject code.
- Configuration of Asset Framework
 - Necessary for Asset Analytics and Event Frame generation
- Use PI System Access and PI Web API to query for report data.



PI System Development Strategy



Use enterprise naming standard for tags for consistency throughout systems.



Start with configuring only what is immediately needed for the project

- Status
- Counters
- Messages
- Procedure references
- Recipe parameters

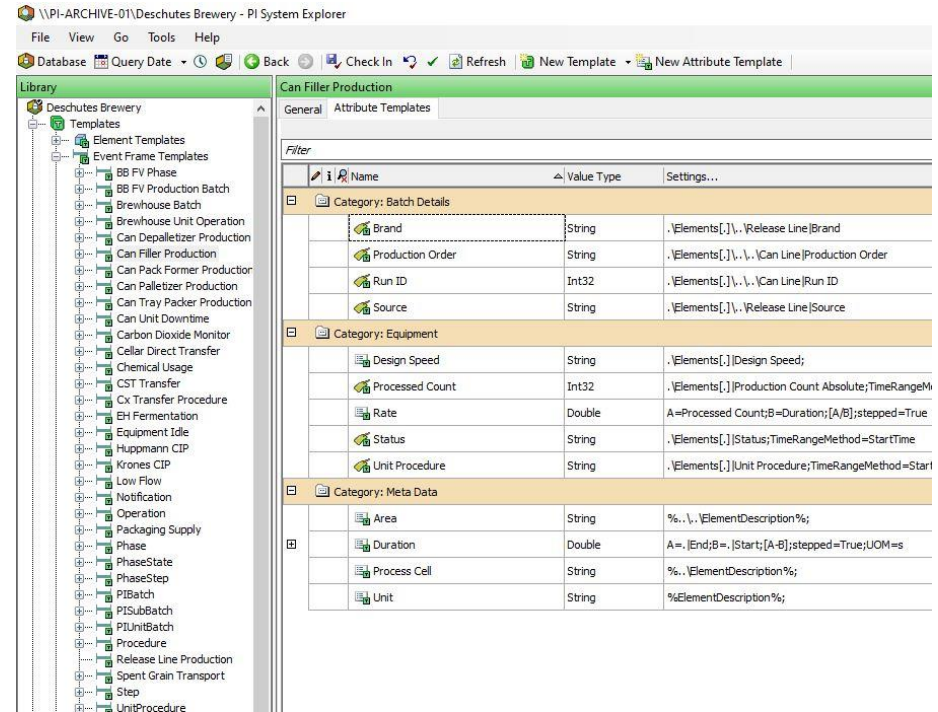
Instrument tag is the PLC tag address. Can be searched for development or troubleshooting.



Event Frame Generation Strategy

Problem: High volume of events and complex conditions can make configuring event frame hierarchy difficult.

Solution: Configure Event Frame Templates that contain external element references to unique identifiers. Generate Event Frames at the Element level, and join when needed in reporting tools.



The screenshot displays the PI System Explorer interface. On the left, a tree view shows the 'Deschutes Brewery' library with various event frame templates. The 'Can Filler Production' template is selected. The main pane shows the configuration for this template, including a 'Filter' section and a table of attributes.

Can Filler Production

General | Attribute Templates

Filter

Name	Value Type	Settings...
Category: Batch Details		
Brand	String	.\Elements[.]\.\Release Line\Brand
Production Order	String	.\Elements[.]\.\Can Line\Production Order
Run ID	Int32	.\Elements[.]\.\Can Line\Run ID
Source	String	.\Elements[.]\.\Release Line\Source
Category: Equipment		
Design Speed	String	.\Elements[.]\Design Speed;
Processed Count	Int32	.\Elements[.]\Production Count Absolute;TimeRangeM
Rate	Double	A=Processed Count;B=Duration;[A/B];stepped=True
Status	String	.\Elements[.]\Status;TimeRangeMethod=StartTime
Unit Procedure	String	.\Elements[.]\Unit Procedure;TimeRangeMethod=Start
Category: Meta Data		
Area	String	%.\.\ElementDescription%;
Duration	Double	A=.\End;B=.\Start;[A-B];stepped=True;UOM=s
Process Cell	String	%.\ElementDescription%;
Unit	String	%ElementDescription%;



Event Frame Generation Strategy

Problem: How do we ensure generation of end to end events to capture all downtime and production?

Solution: Use machine status attributes in step triggers, or use a combination of status, message, and boolean attributes for explicit triggers

The screenshot shows the 'Pack Former' interface with the 'Analyses' tab selected. A table lists three analyses: 'Downtime', 'Produced Cans', and 'Production', each with a green checkmark in the 'Backfilling' column. Below this, the 'Generation Mode' is set to 'Explicit Trigger' and the 'Event Frame Template' is 'Can Unit Downtime'. The 'Start triggers' section contains a rule for 'StartTrigger1' with the expression 'Unit Active' = 0 AND 'Status' <> "Execute". The 'Outputs at close' section contains two rules: 'ChangeOver' with a complex IF/THEN/ELSE expression involving 'Recipe Number' and 'EventFrame("StartTime")', and 'ChangeOverType' with an expression concatenating 'Recipe Name', 'EventFrame("StartTime")', and 'Recipe Name'.

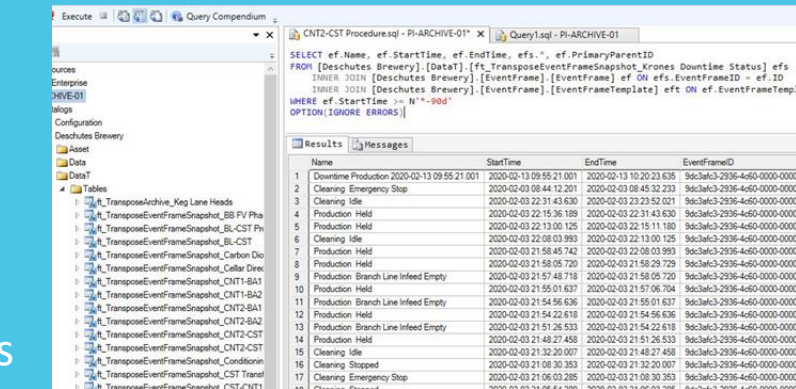
- Utilize output attribute features for summarized values, or condition identification.

The screenshot shows the 'Filler' interface with the 'Analyses' tab selected. A table lists four analyses: 'Downtime Procedure', 'Downtime Status', 'Production', and 'Unit Procedure', each with a green checkmark in the 'Backfilling' column. Below this, the 'Generation Mode' is set to 'Step' and the 'Event Frame Template' is 'Can Unit Downtime'. The 'Triggering Input' is set to 'Status' and the 'Zeroth States' is set to 'Operating'. A note at the bottom states: 'All transitions would close the open event frame and start a new event frame unless the transition is to a zeroth state'.



Reporting

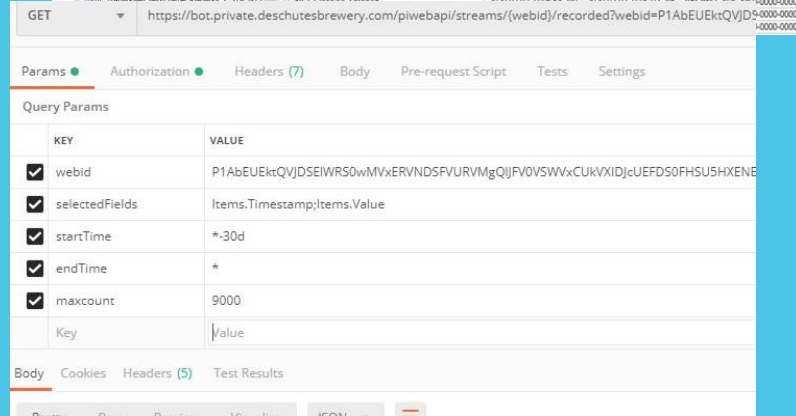
- Explain how the data is captured.
- Use a report platform that allows access to current data.
 - PI OLEDB Enterprise for Event Frame queries
 - PI Web API for tag values
- Flexibility for end user analysis.
 - Nothing is excluded by the source queries
 - Enable report level exploration and analysis



The screenshot shows a SQL query execution window with the following query:

```
SELECT ef.Name, ef.StartTime, ef.EndTime, efs, ' ' as PrimaryParentID
FROM [Deschutes Brewery].[Data].[ef_TransposeEventFrameSnapshot kronos Downtime Status] efs
INNER JOIN [Deschutes Brewery].[EventFrame].[EventFrameID = ef.ID
WHERE ef.StartTime >= '2020-02-13 09:55:21.001'
OPTION (IGNORE ERRORS)
```

The results are displayed in a table with columns: Name, StartTime, EndTime, and EventFrameID. The table contains 17 rows of data, including events like 'Downtime Production', 'Cleaning Emergency Stop', 'Cleaning Idle', 'Production Held', 'Production Branch Line Infeed Empty', and 'Production Branch Line Infeed Empty'.

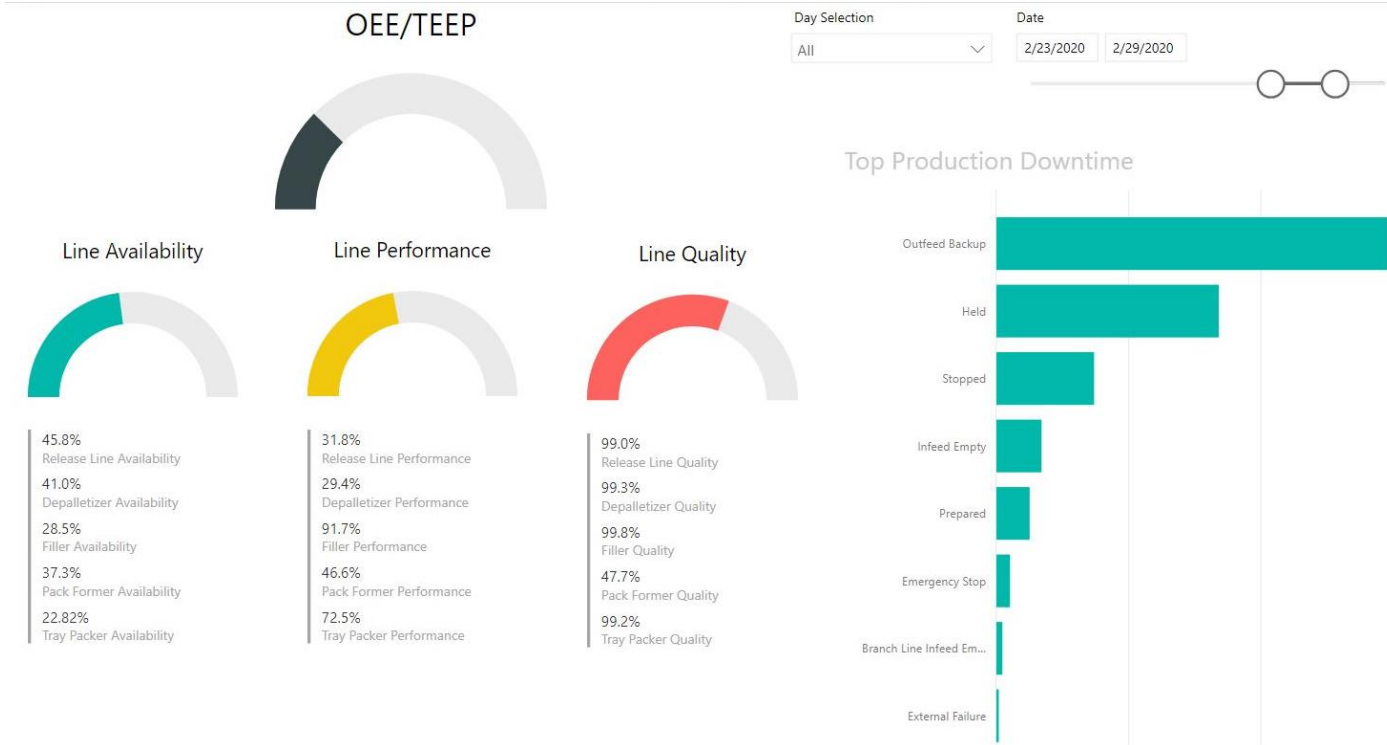


The screenshot shows a web browser window with the URL: <https://bot-private.deschutesbrewery.com/piwebapi/streams/{webid}/recorded?webid=P1AbEUektQVJD5>. The browser shows the 'Query Params' section with the following parameters:

KEY	VALUE
webid	P1AbEUektQVJD5EiWRS0wMVxERVND5FVURVMgQJFV0VSWXwCUXXIDJcUEFD50FHSU5HXENE
selectedFields	Items.Timestamp;Items.Value
startTime	*-30d
endTime	*
maxcount	9000
Key	/value



OEE Report



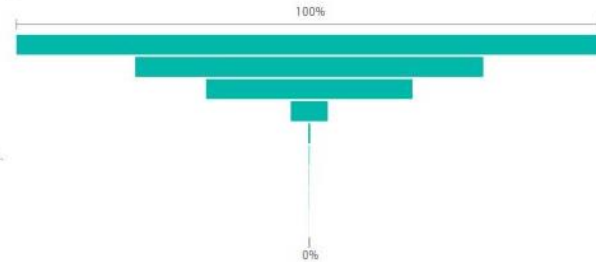
Availability Analysis

Day Selection
☐ Select all
☐ Sunday
☒ Monday
☒ Tuesday
☒ Wednesday
☒ Thursday
☐ Friday
☐ Saturday

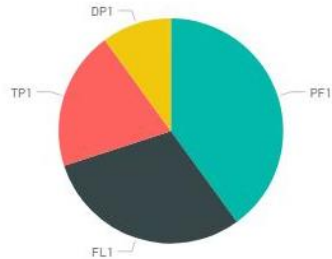
Date
2/2/2020 2/29/2020
Unit
All

Filler Unit Procedure Ratio

Blowing Out and Pressurization
Basic Position
Production
Product Admission
Rinsing Without CIP Cups
Displacement By Sterile Air Into CL
Production Preparation
CIP Circuit With Draining
CIP Circuit Without Draining

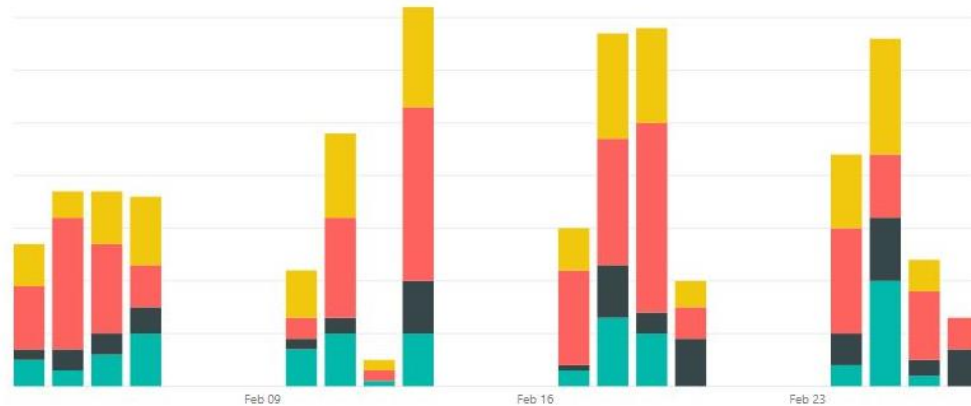


Ratio of Change Over Times



Unplanned Downtime

Status ● Emergency Stop ● Equipment Failure ● Idle ● Stopped



Performance Analysis

Day Selection

- ☐ Select all
- ☒ Monday
- ☒ Tuesday
- ☒ Wednesday
- ☒ Thursday
- ☐ Friday

Date

2/3/2020

2/29/2020

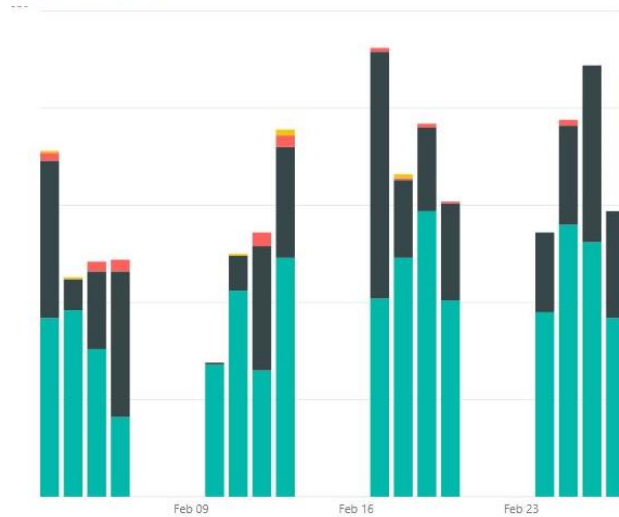


Unit

PF1

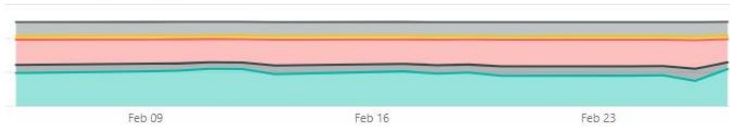
Number of Downtime Events

Unit: FL1 PF1 PT1 RL1

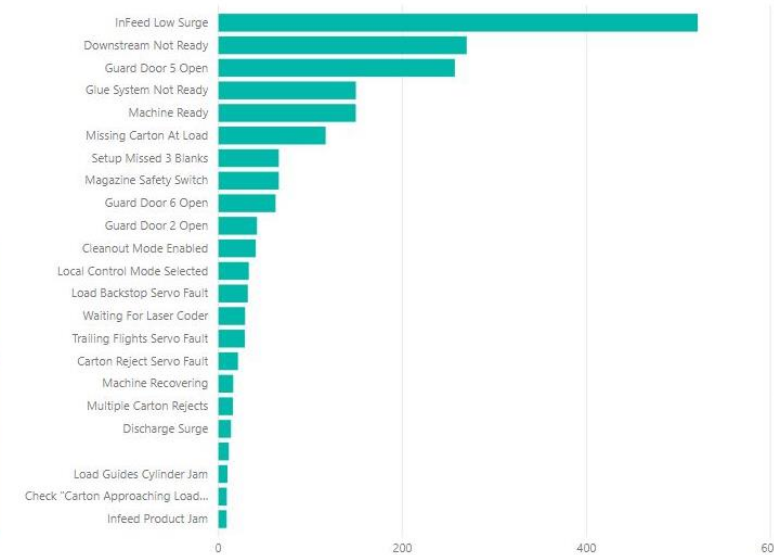


Average Steady-State Runtime

Filler Pack Former Palletizer Tray Packer Release Line



Accumulated Downtime By Reason



Quality Analysis

Day Selection

- ☐ Select all
- ☒ Monday
- ☒ Tuesday
- ☒ Wednesday
- ☒ Thursday
- ☐ Friday
- ☐ Saturday

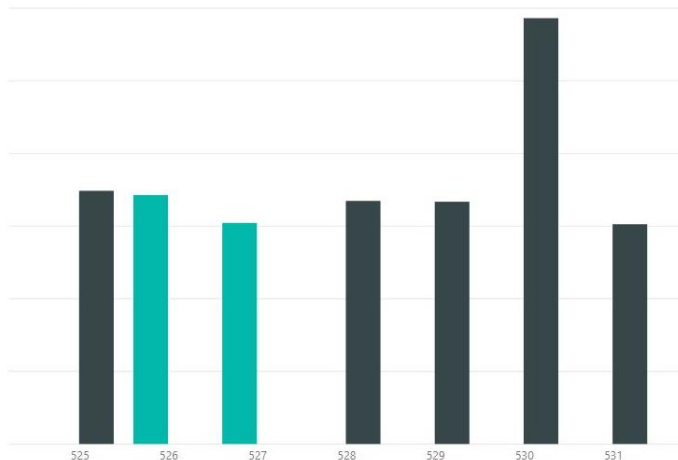
Date

2/24/2020 2/29/2020



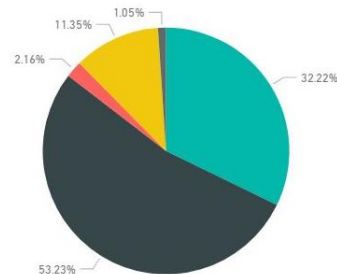
Release Line Loss

Beer Waste Type ■ High DO ■ High EBC



Full Can Rejects

■ Filler Rejects ■ Underfills ■ Seamer Rejects ■ Sampling ■ No Closure

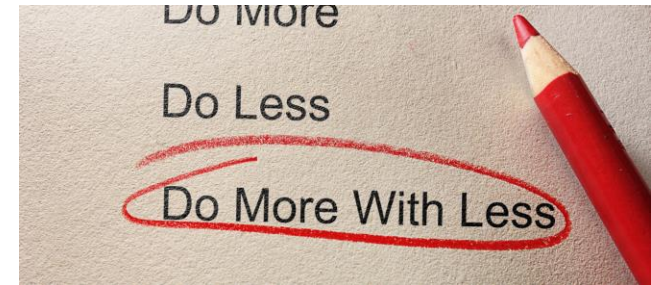


Can Loss



Conclusion

- We were able to create PI tags for all of the PLC tags of interest on the canning line.
- Efficiently configured Asset Framework and implemented an efficient strategy for event frame generation.
- Developed dynamic reporting for improved data integrity and analytic capabilities for end users.
- Immediately recognized significant losses outside of what was being manually scanned.



Next Steps

- Experiment with different reporting platforms.
- Refine Event Frame Templates.
- Increase drill down and analytic capabilities.
- PI Vision display of real-time fault location for operators.
- Use similar strategy for cellars, brewhouse, and other packaging lines.



OEE Model for Canning Craft Beer

DESCHUTES
BREWERY®

CHALLENGES

- Lack of detail for can line downtime events.
- Downtime and quality loss tracking has been subjective.
- Can Line has disparate systems.

SOLUTION

- Use the PI System to historize data from each system, allowing generation of machine based uptime, and downtime events.
- Develop dynamic reporting and analysis for all users.

BENEFITS

- Increased visibility of can line operation.
- Immediately recognized, and quantified processes generating greatest waste.
- Prioritization of action items.



“

While we are just starting to collect machine data from our can line and measure OEE with it, we are already seeing exciting results and revealing low-hanging fruit for efficiency improvements.

Kyle Kotaich, Senior Data Analyst, Deschutes Brewery

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Presenters



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Questions?

Please wait for
the **microphone**

State your
name & company



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Complete Survey!

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