The PI System in the Manufacturing Line – Calculating OEE Across Your Factory

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Customer Success Manager

Gothenburg, 17th September 2019

Manufacturing Challenges

Manufacturing Challenges

Run Time

- Uptime
- Planned Downtime
- Unplanned Downtime

Visibility

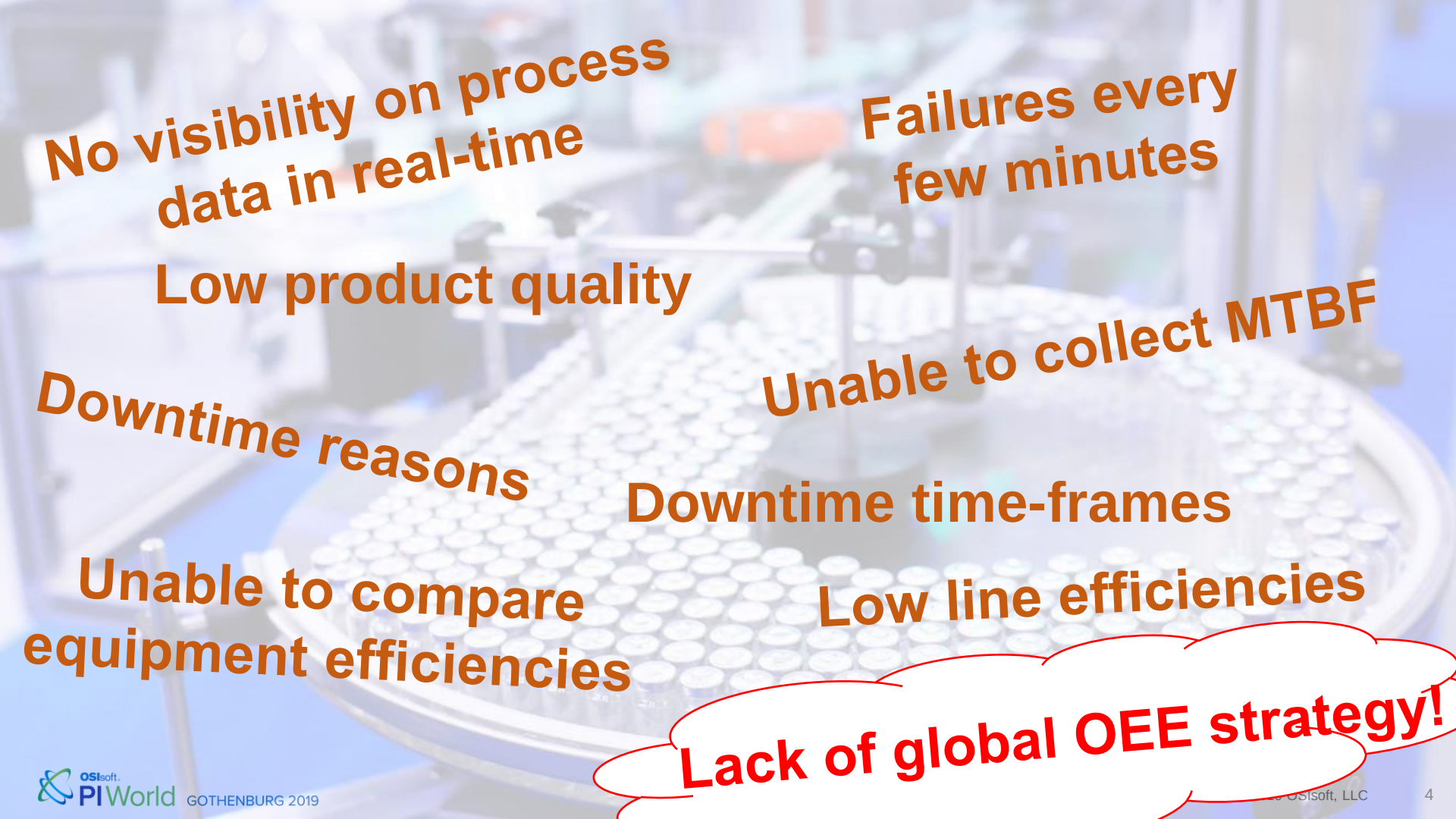
- Reason Code
  - Downtime
  - Losses
- Line/Plant Comparison
- ROI Measurements

Throughput

- Yield
- Units produced
- Speed

Scheduling

- Product Changeover
- Demand vs. Capacity
- Slow Start-up


No visibility on process data in real-time
Failures every few minutes
Low product quality
Unable to collect MTBF
Downtime reasons
Downtime time-frames
Unable to compare equipment efficiencies
Low line efficiencies
Lack of global OEE strategy!


How OEE can help you?

What is Overall Equipment Efficiency (OEE)?

"Standard to measure manufacturing productivity that identifies the percentage of manufacturing time that is truly productive"

OEE = **Availability** x **Performance** x **Quality**

100% OEE

No Stop Time
As fast as possible
Good Parts Only

Running time

Running speed

Good Parts

Typical Losses

Availability

- Unplanned Stops → Equipment Failure
- Planned stops → Setup and adjustments

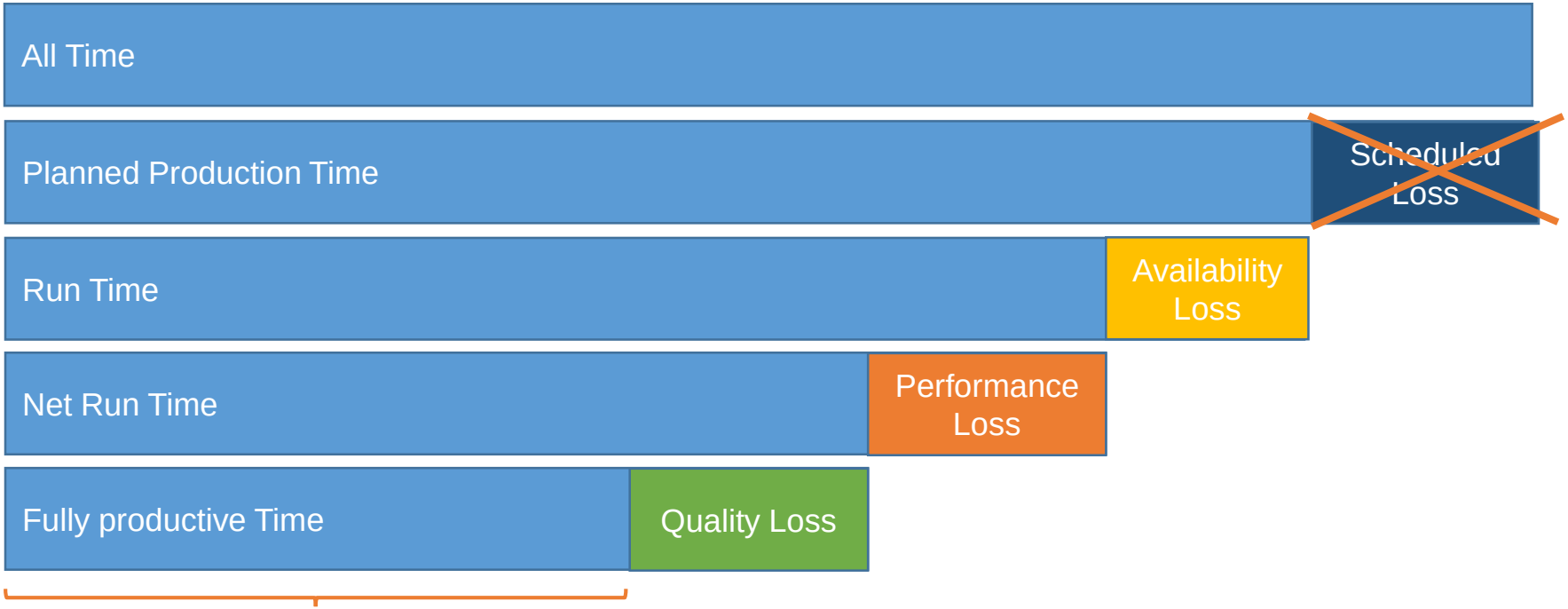
Performance

- Small Stops → Idling and Minor Stops
- Slow Cycles → Reduced Speed

Quality

- Production Rejects → Process Defects
- Startup Rejects → Reduced Yield

Time prospective



STAR BEARINGS COMPANY

EMPIRE QUALITY BEARINGS AND MORE

HOME | SHOP FLOOR | PRODUCTION LINE | LINE PERFORMANCE | INLINE QUALITY ANALYTICS | OEE | OEE ANALYTICS | ABOUT

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EMPIRE QUALITY BEARINGS AND MORE

Production Line

	OEE	Availability	Performance	Quality
Inner Ring	79.398 %	79.398 %	75.833 %	94.118 %
Outer Ring	79.861 %	79.861 %	75.833 %	100 %
Rolling Element	82.986 %	82.986 %	80 %	100 %

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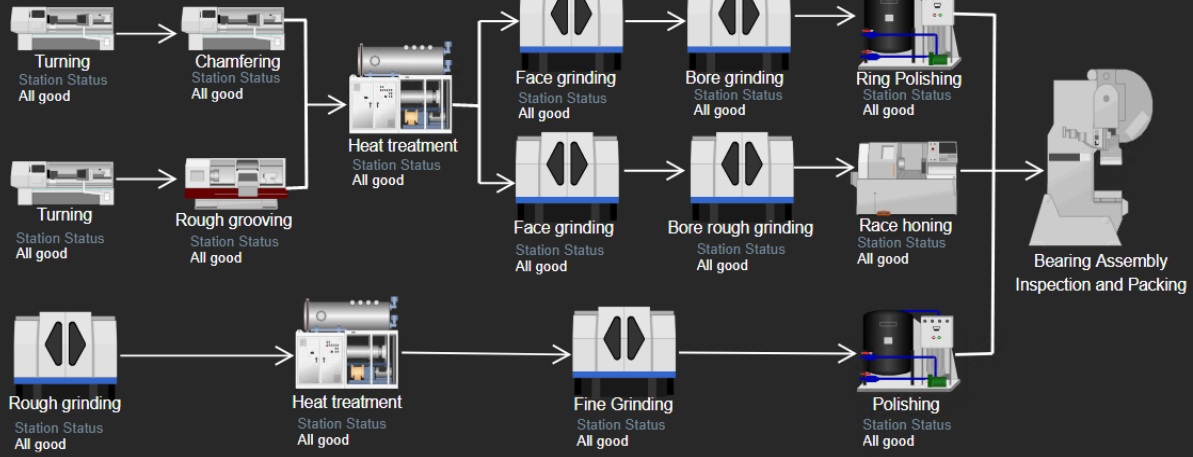
EMPIRE QUALITY BEARINGS AND MORE

Shop Floor

Inner Ring
Materials:
Tubing Bar
AISI 52100

Outer Ring
Materials:
Tubing Bar
AISI 52100

Rolling Element
Materials:
Chromium Alloy Slugs
AISI 52100




localhost/PIVision/#/Displays/331975/discrete-manufacturing_OEE_ProcessInnerRing
OSIsoft
PI Vision
New Display
PISCHOOL\student01
discrete manufacturing_OEE_Proces... *
Asset: CNCLathe004+
Ad Hoc Display
STAR
BEARINGS COMPANY
EMPIRE QUALITY BEARINGS AND MORE
Overall Equipment Effectiveness (OEE)
Process Line Summary and Equipment OEE Details
HOME
SHOP FLOOR
PRODUCTION LINE
LINE PERFORMANCE
INLINE QUALITY ANALYTICS
OEE
OEE ANALYTICS
ABOUT
BY EQUIPMENT TYPE
Bore Grinding
Chamfer
Face Grinding
Fine Grinding
Heat Treatment
Lathe
Polishing
Ring Polishing
Rough Grinding
Rough Grooving
BY PROCESS LINE
Inner Ring
Outer Ring
Rolling Element
EQUIPMENT ALARM
Inner Ring Process Line OEE KPIs of the Latest Hour
82.986 %
AVAILABILITY
80 %
AVAILABILITY
100 %
AVAILABILITY
Process Line - Inner Ring Equipment List (Double-click on equipment in list to view more details >>)
Asset | Station | Machine T... | Machine S... | Availability | Performance | Quality | OEE
BoreGrinder002 | Station 5 | Bore Grinder | Running | 58.333 | 60 | 100 | 35
CNCLathe004 | Station 1 | Lathe | Running | 58.333 | 60 | 100 | 35
CNCLathe005 | Station 1 | Lathe | Running | 66.667 | 60 | 100 | 40
RingPolisher001 | Station 6 | Ring Polishing | Running | 66.667 | 60 | 100 | 40
RingPolisher002 | Station 6 | Ring Polishing | Running | 66.667 | 60 | 100 | 40
FaceGrinder002 | Station 4 | Face Grinding | Running | 83.333 | 75 | 80 | 50
CNCChamfer001 | Station 2 | Chamfer | Running | 75 | 75 | 100 | 56.25
Furnace002 | Station 3 | Heat Treatment | Stopped | 75 | 75 | 100 | 56.25
CNCChamfer003 | Station 2 | Chamfer | Running | 83.333 | 75 | 100 | 62.5
Furnace001 | Station 3 | Heat Treatment | Running | 83.333 | 75 | 100 | 62.5
RingPolisher003 | Station 6 | Ring Polishing | Running | 83.333 | 75 | 100 | 62.5
CNCChamfer002 | Station 2 | Chamfer | Running | 91.667 | 90 | 83.333 | 68.75
FaceGrinder001 | Station 4 | Face Grinding | Running | 83.333 | 90 | 100 | 75
BoreGrinder001 | Station 5 | Bore Grinder | Running | 91.667 | 90 | 100 | 82.5
BoreGrinder003 | Station 5 | Bore Grinder | Running | 91.667 | 90 | 100 | 82.5
CNCLathe006 | Station 1 | Lathe | Running | 91.667 | 90 | 100 | 82.5
FaceGrinder003 | Station 4 | Face Grinding | Idle | 100 | 90 | 100 | 90
EQUIPMENT DETAILS
CNCLathe004
OEE KPIs of the Latest Hour
58.333 %
AVAILABILITY
60 %
PERFORMANCE
100 %
QUALITY
Equipment Name: CNCLathe004
Equipment No: 004
Manufacturer: TAKISAWA
Model: M18
Installation Date: 5/30/2016 5:00:00 AM
Last Maintenance Date: 7/26/2019 5:00:00 AM
Part Count: 4
Product: 6921
Cycle Time: 540 s
Machine State: Running
Parts Count and Bad Parts Count Trend
Part Count
4
Bad Part Count
0
8/23/2019 11:45:51 AM
7d
8/30/2019 11:45:51 AM
8/23/2019 11:45:51 AM
7d
Now
8/30/2019 11:45:51 AM

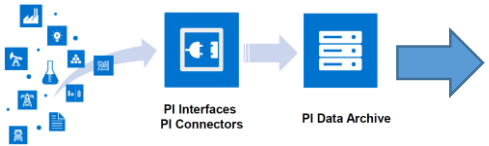
Recipe to implement OEE

Recipe to implement OEE

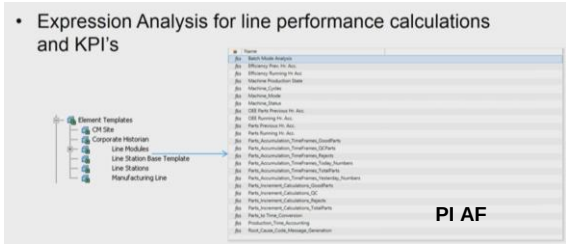
Take Action, Implement Changes, Continuous improvement

Connect, Collect & Store → Assign Context → Execute Condition Logics → Track Alerts, Downtime & Notify → Visualize → TAKE ACTION

1. Connect, Collect&Store



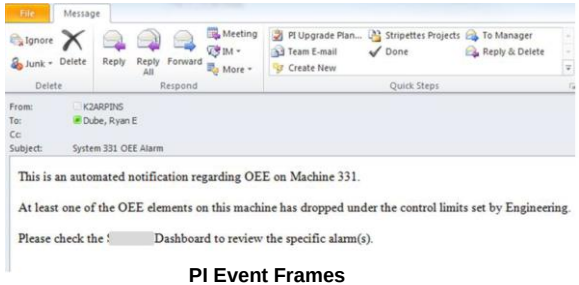
2. Contextualize



3. Execute condition logic

PI Analytics

4. Track Alerts, Downtime & Notify



PI Event Frames

5. Visualize

PI Vision
PI Datalink
BI Tools

STAR BEARINGS COMPANY

Flow 01: Inner ring

Materials:
Tubing bar
AISI 52100

Turning

Chamfering

Heat treatment

Face grinding

Bore grinding

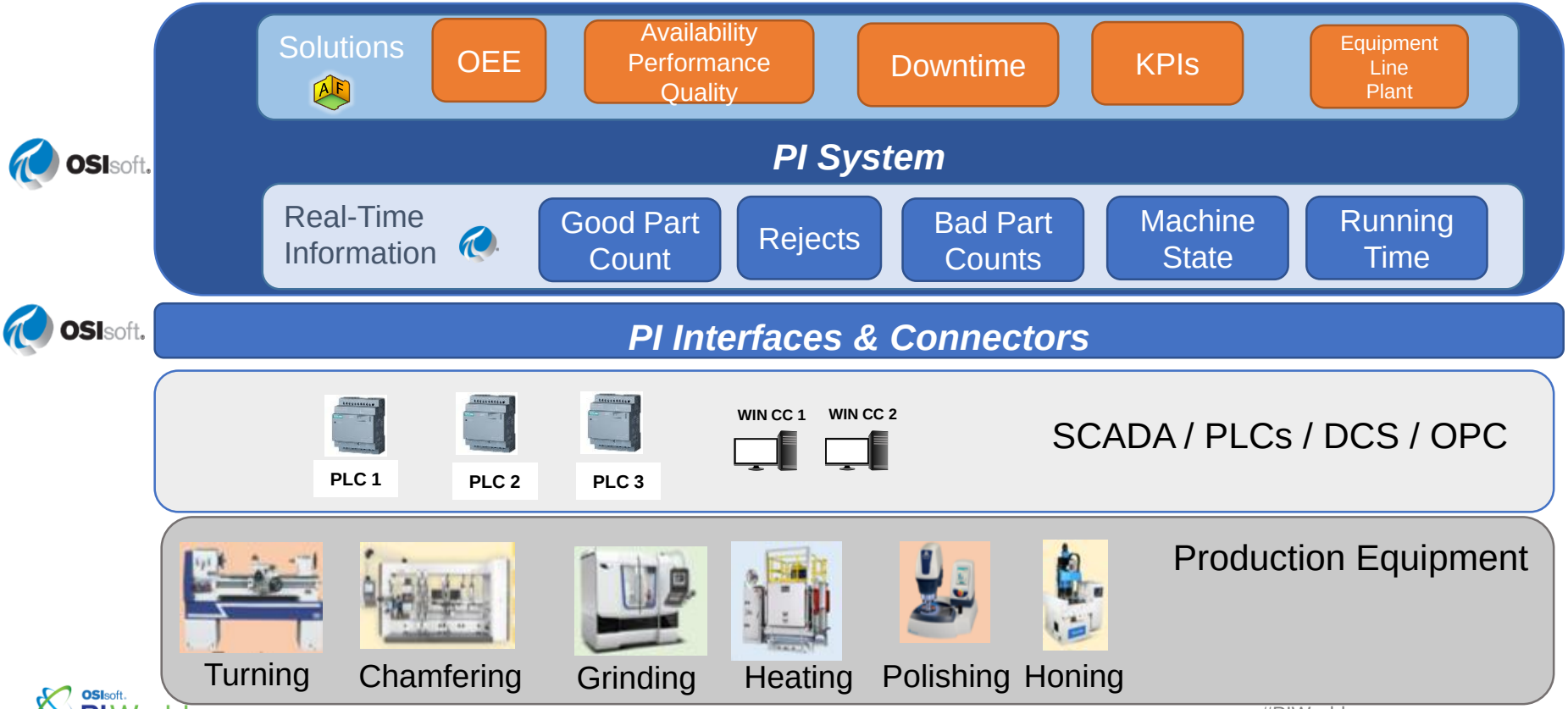
Ring Polishing

Assembly, inspection, and packing station

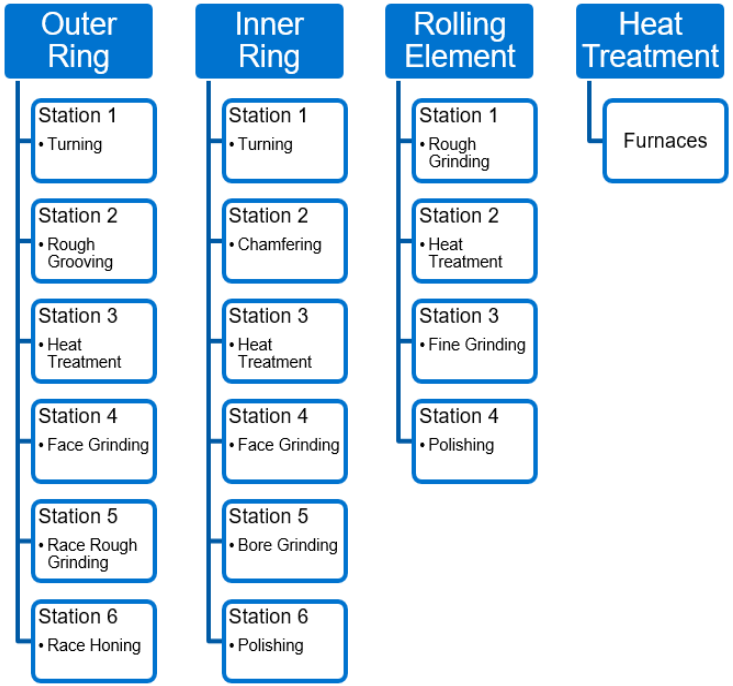
Warehouse

Shop Floor Structure

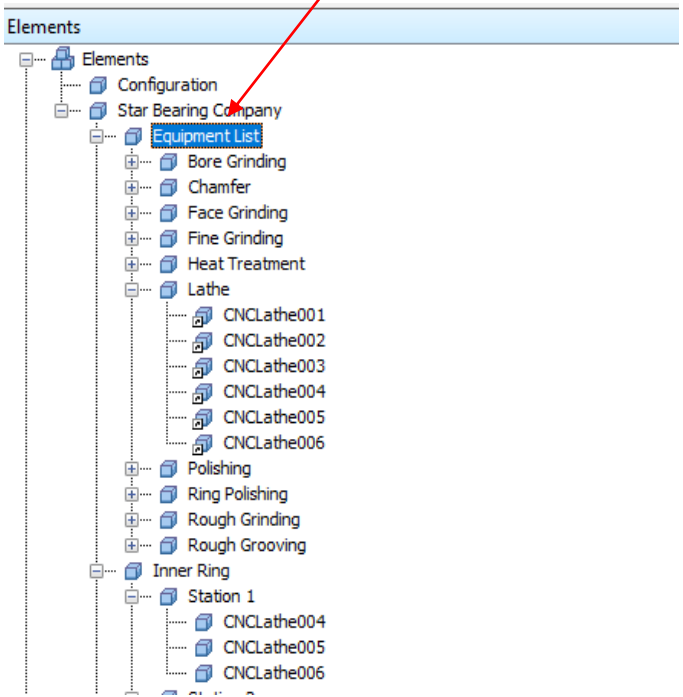
1. Connect your sources



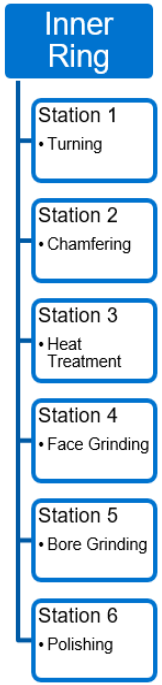
2. Build your context

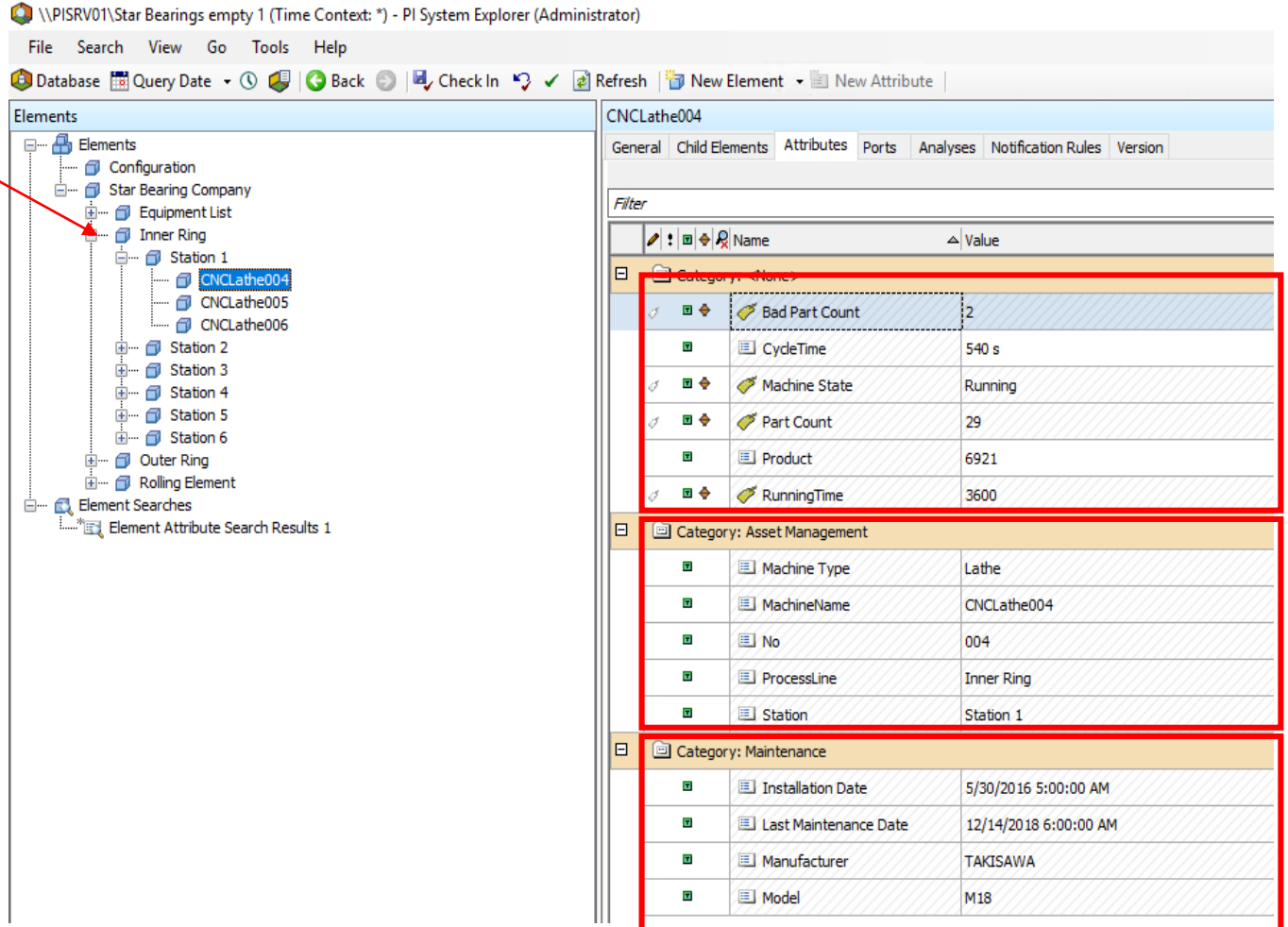


All Equipment View

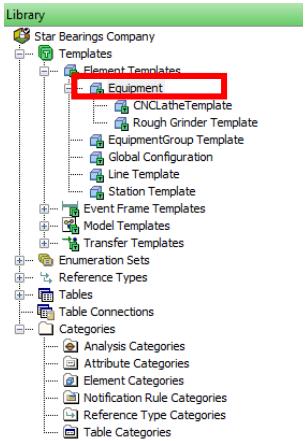


Area View





3. Execute Condition Logic @ *Template level*



Availability	Operating Time / Planned Production Time
Performance	Part Count / (3600/Cycle Time)
Quality	Good Part Count / Part Count
OEE	Availability*Performance*Quality

Roll up calculations to station, lines, groups

Station
Availability
Performance
Quality
OEE

Line

Availability
Performance
Quality
OEE

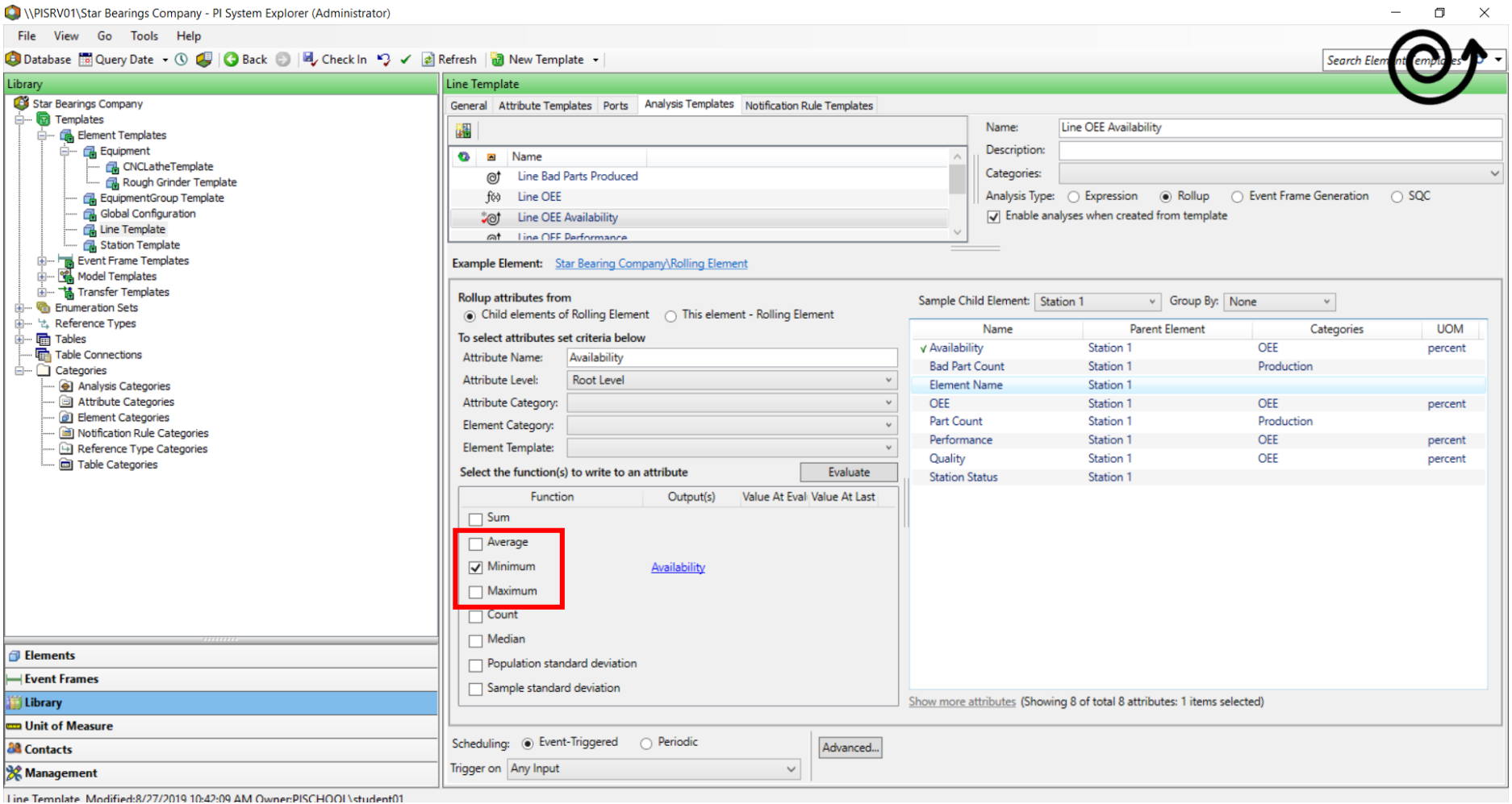
Equipment

Availability
Performance
Quality
OEE

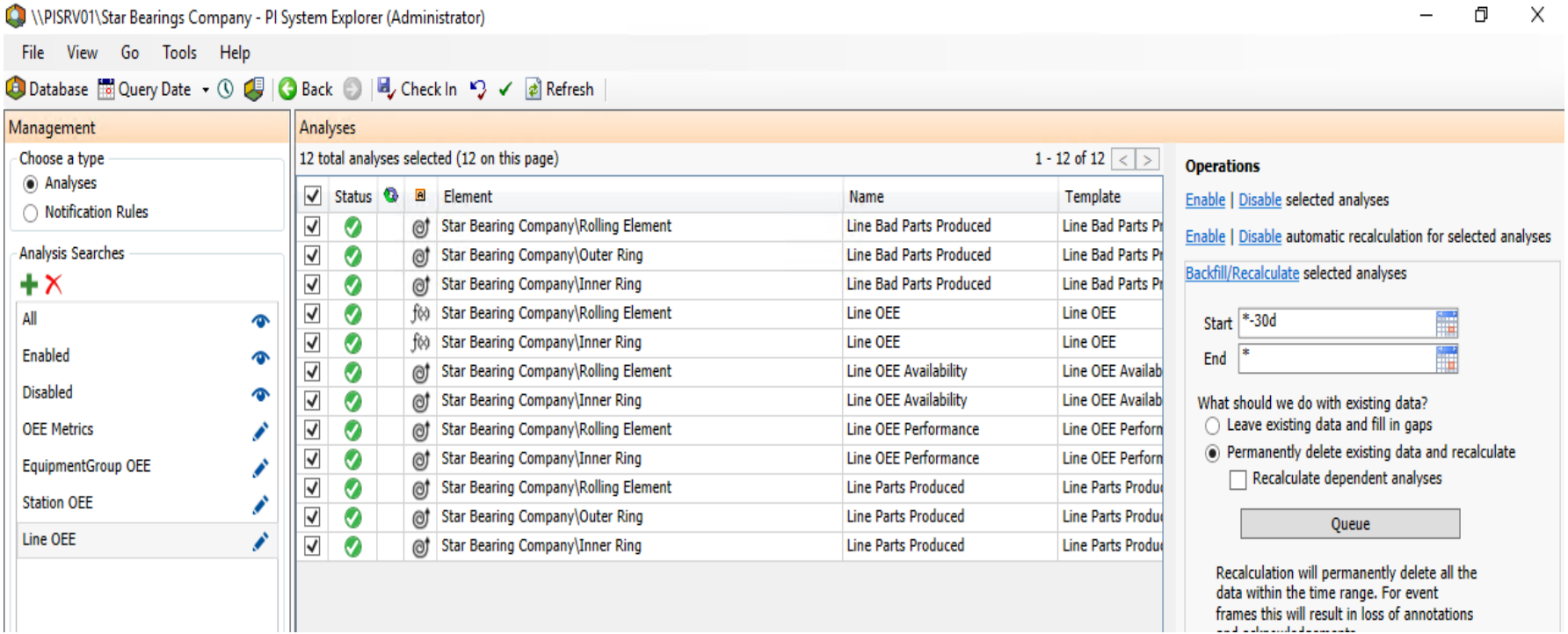
Equipment

Availability
Performance
Quality
OEE

Equipment

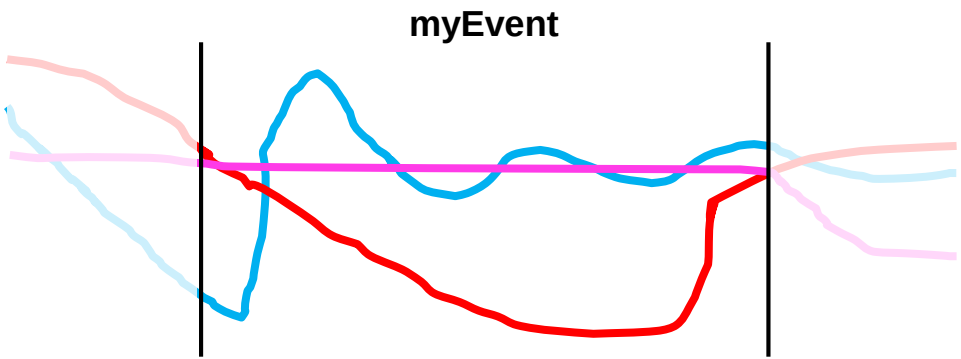


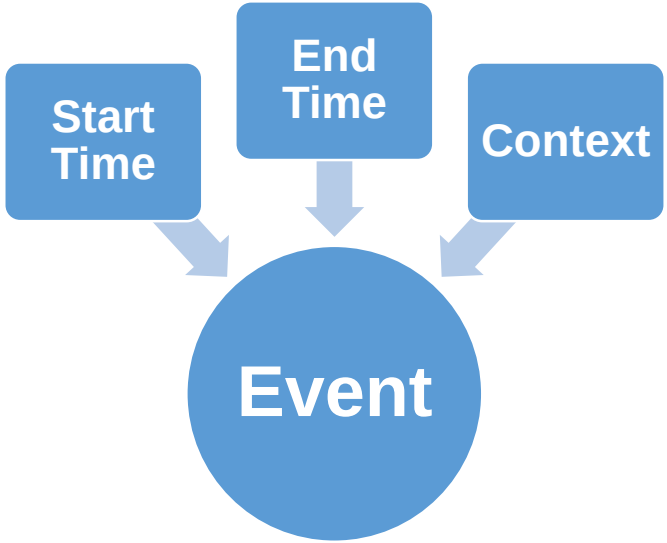
Backfill the results to get data from the past!



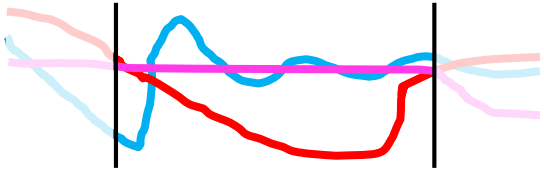
4. Track, Alert & Notify

- Use Event Frames to track downtime and establish reason codes.

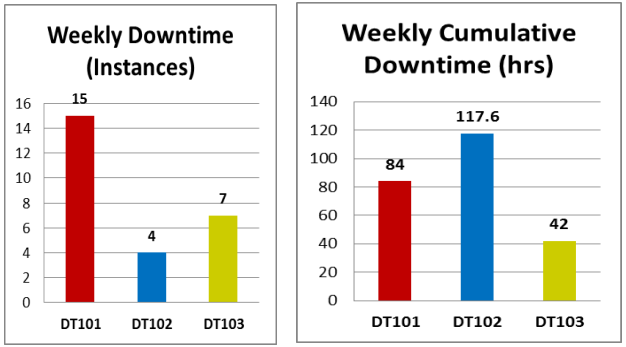




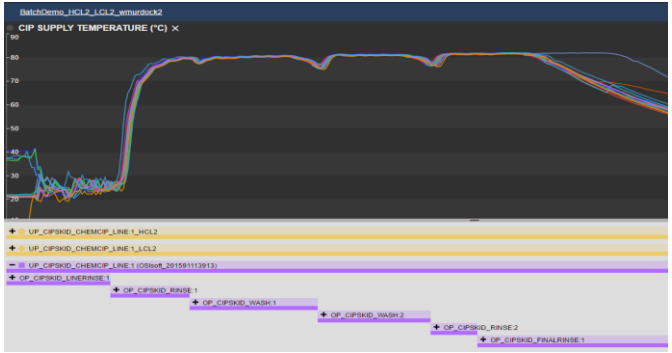
Events will help you to…



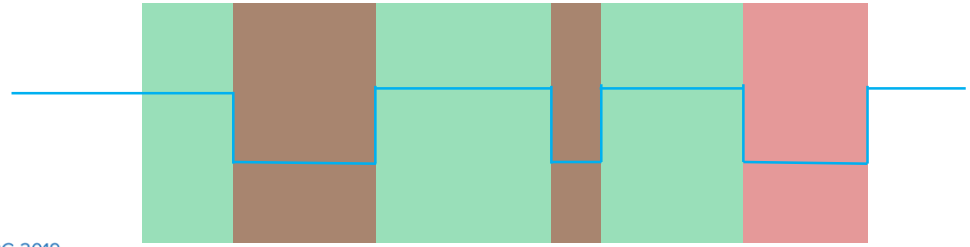
1) Perform Asset Comparisons



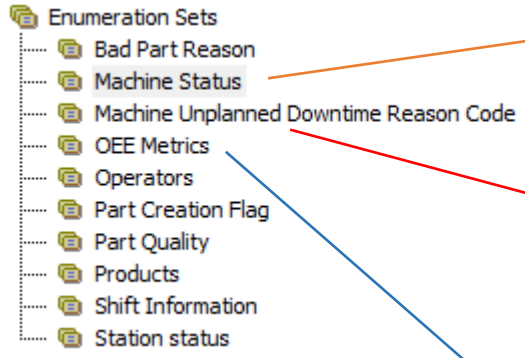
2) Compare similar behaviours



3) Track downtimes



Use Enumeration Sets as reason codes



Name: Machine Status
Description:
Hexadecimal Security

Value	Name
0	Running
1	Idle
2	Stopped
3	Unplanned Stopped

Name: Machine Unplanned Downtime Reason Code
Description:
Hexadecimal Security

Value	Name
0	Electrical failure
1	Mechanical failure
2	Cuts not within tolerance

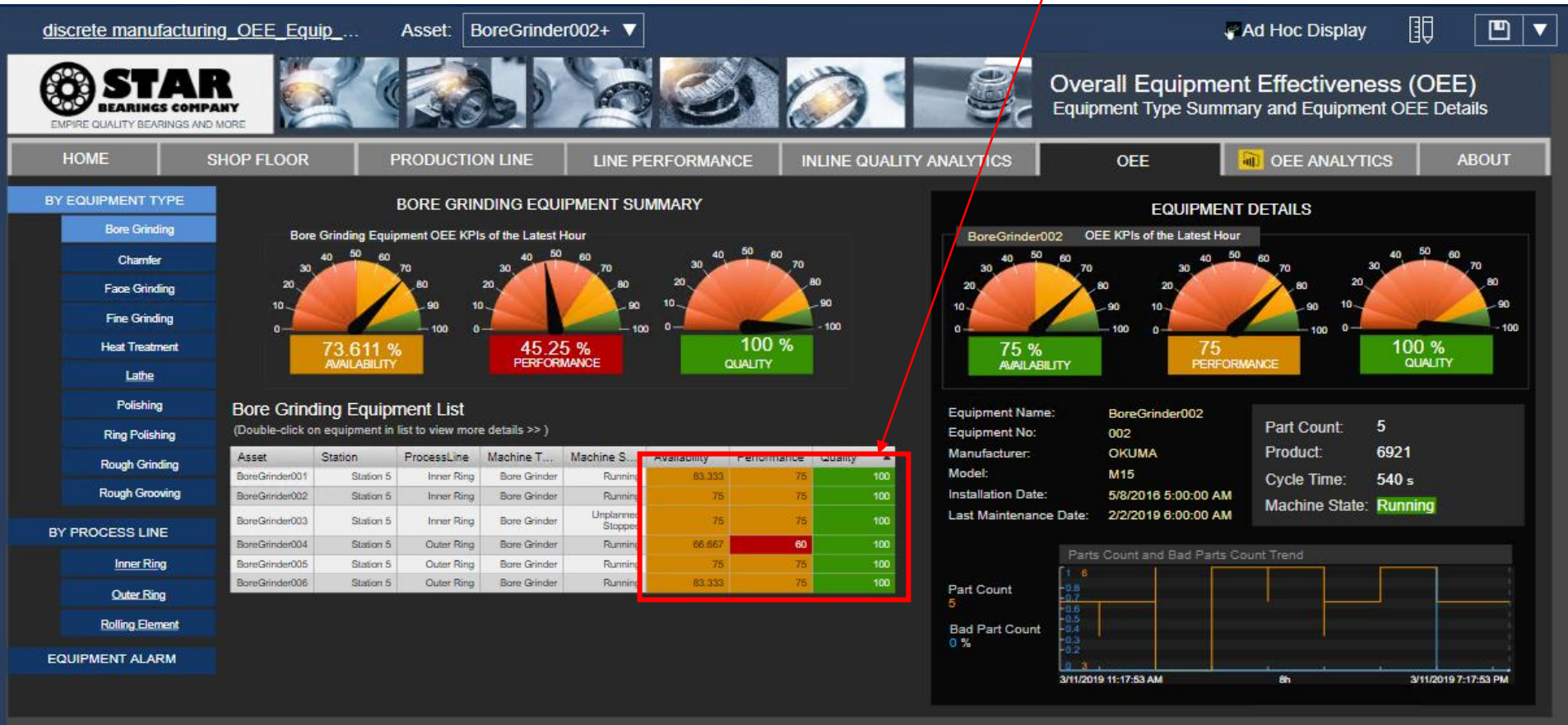
Name: OEE Metrics
Description:
Hexadecimal Security

Value	Name	Description
0	Productive Time	Valuable Operating Time
1	Unplanned Stops	Equipment Failure
2	Planned Stops	Setup and Adjustments
3	Small Stops	Idling and Minor Stops
4	Slow Cycles	Reduced Speed
5	Production Rejects	Process Defects
6	Startup Rejects	Reduced Yield

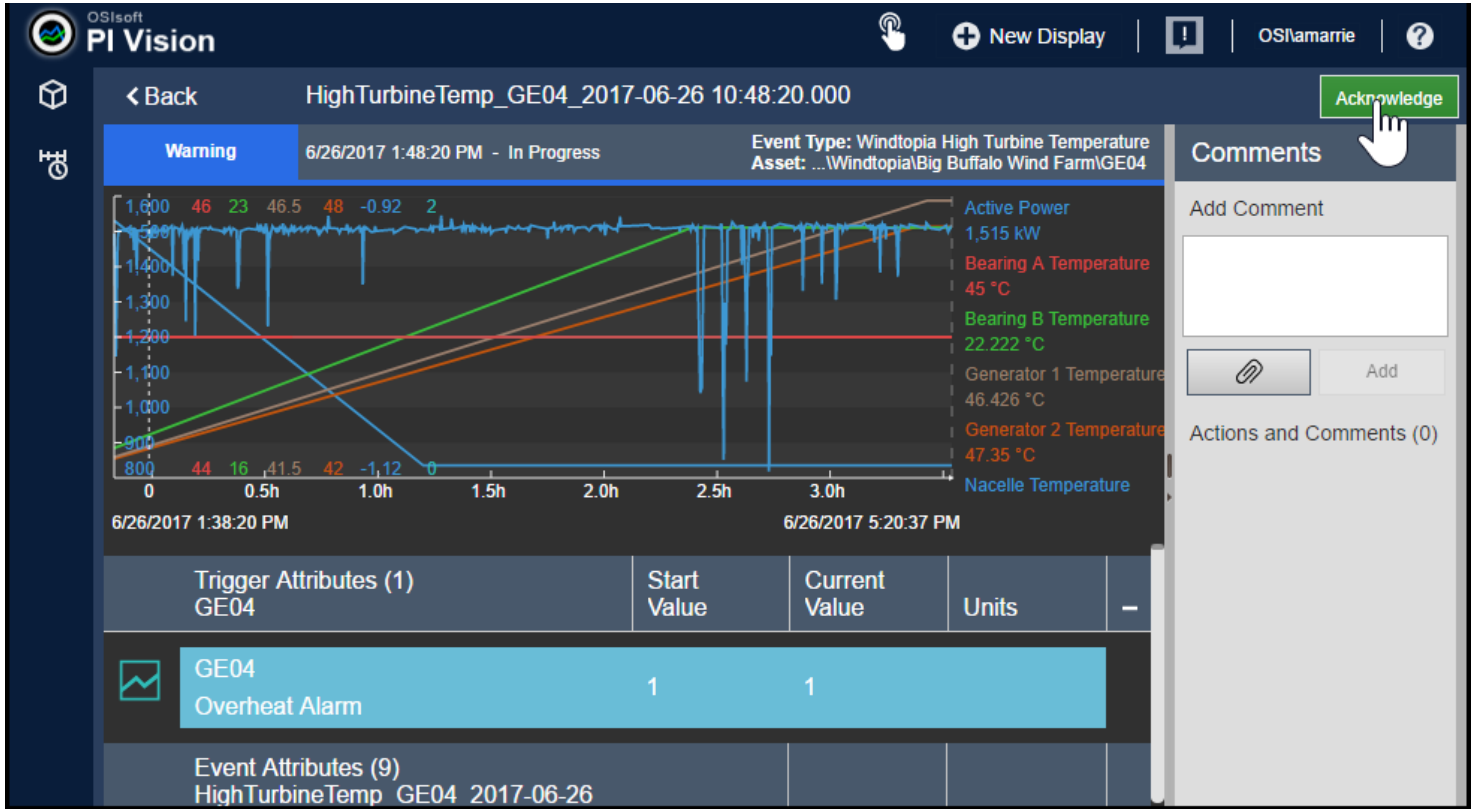
Availability Loss	Unplanned Stops	Equipment Failure
	Planned Stops	Setup and Adjustments
Performance Loss	Small Stops	Idling and Minor Stops
	Slow Cycles	Reduced Speed
Quality Loss	Production Rejects	Process Defects
	Startup Rejects	Reduced Yield
OEE	Fully Productive Time	Valuable Operating Time

5. Visualise

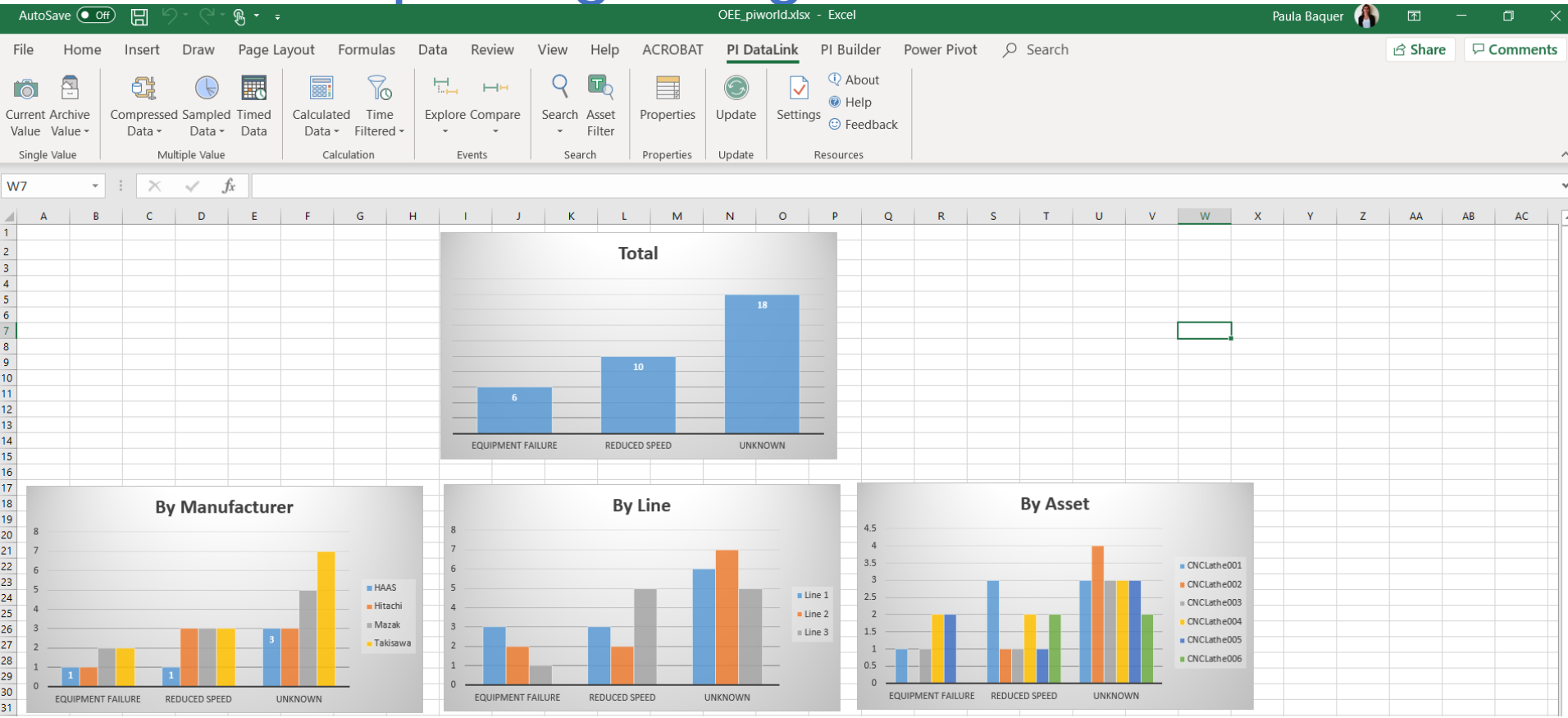
Multi-state symbols



View and respond to events



Excel Reporting using PI DataLink



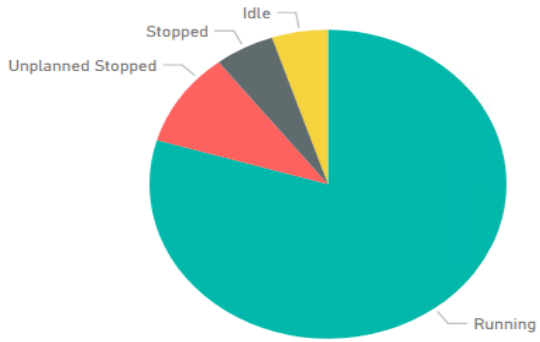
Build dashboards with drill-down capabilities

Star Bearing Company - OEE Analysis

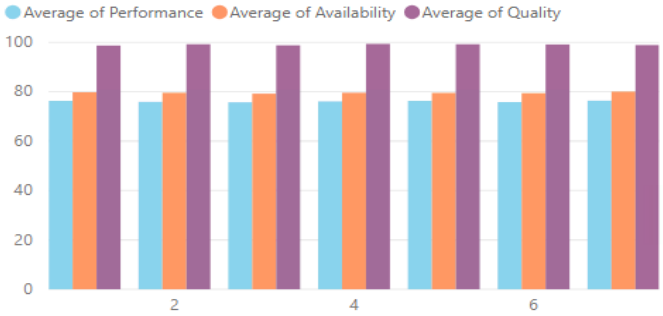
Line Template
- Inner Ring
  - Station 1
    - CNCLathe004
    - CNCLathe005
    - CNCLathe006
  - Station 2
  - Station 3
  - Station 4
  - Station 5
  - Station 6
- Outer Ring
- Rolling Element

Line Template	Average of Performance	Average of Availability	Average of Quality
Inner Ring	75.13	78.53	99.19
Outer Ring	76.77	80.33	99.03
Rolling Element	76.56	80.24	98.85
Total	**76.07**	**79.58**	**99.06**

Machine States proportion



Average of Performance, Average of Availability and Average of Quality by D...



TimeStamp

3/1/2019 3/7/2019

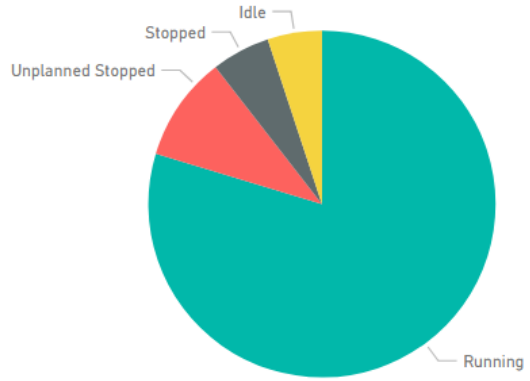
Star Bearing Company - OEE Analysis

Line Template

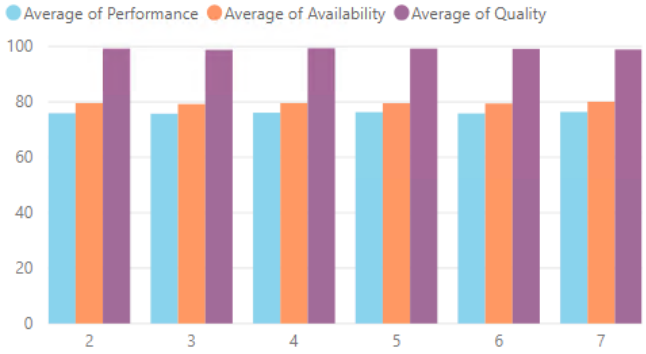
- Inner Ring
  - Station 1
    - CNCLathe004
    - CNCLathe005
    - CNCLathe006
  - Station 2
  - Station 3
  - Station 4
  - Station 5
  - Station 6
- Outer Ring
- Rolling Element

Station	Average of Performance	Average of Availability	Average of Quality
Station 1	72.18	75.23	99.19
Station 6	76.29	79.76	99.52
Station 5	76.31	79.92	99.02
Station 4	76.60	80.21	98.83
Station 2	76.98	80.64	99.20
Station 3	77.03	80.65	99.11
Total	**76.03**	**79.55**	**99.12**

Machine States proportion



Average of Performance, Average of Availability and Average of Quality by D...



TimeStamp

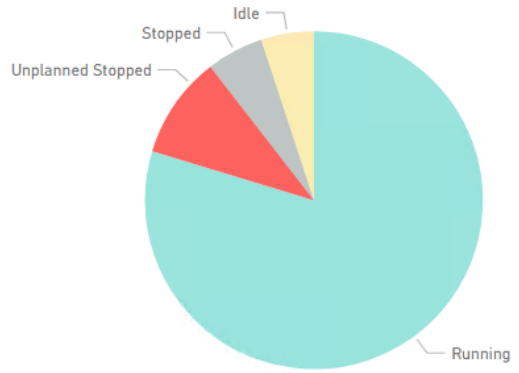
3/2/2019 3/7/2019

Star Bearing Company - OEE Analysis

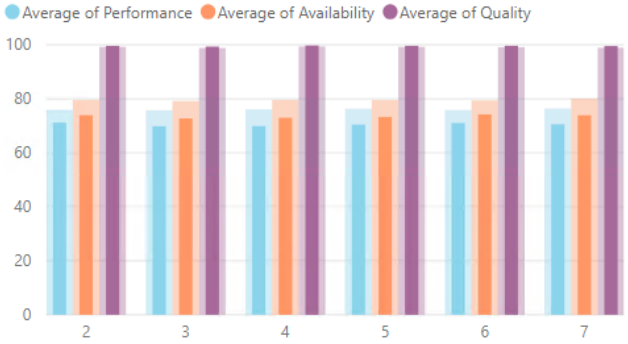
Line Template
- Inner Ring
  - Station 1
    - CNCLathe004
    - CNCLathe005
    - CNCLathe006
  - Station 2
    - CNCChamfer001
    - CNCChamfer002
    - CNCChamfer003
  - Station 3
  - Station 4
    - FaceGrinder001
    - FaceGrinder002
    - FaceGrinder003
  - Station 5
    - BoreGrinder001
    - BoreGrinder002
    - BoreGrinder003
  - Station 6
    - RingPolisher001
    - RingPolisher002
    - RingPolisher003
- Outer Ring
- Rolling Element

Equipment	Average of Performance	Average of Availability	Average of Quality
CNCLathe004	44.28	43.78	100.00
CNCLathe001	69.00	71.88	99.79
Polisher003	69.04	71.89	99.16
BoreGrinder004	69.95	72.28	99.83
BoreGrinder005	69.19	72.29	99.25
CNCLathe002	70.63	72.92	99.77
FaceGrinder003	71.11	73.15	100.00
FaceGrinder005	69.94	73.16	99.53
FaceGrinder004	69.04	73.19	99.80
Furnace002	70.12	73.39	100.00
FaceGrinder001	70.78	73.44	99.06
RingPolisher001	69.85	73.45	99.80
CNCLathe003	69.53	73.53	98.90
Total	**70.47**	**73.49**	**99.58**

Machine States proportion



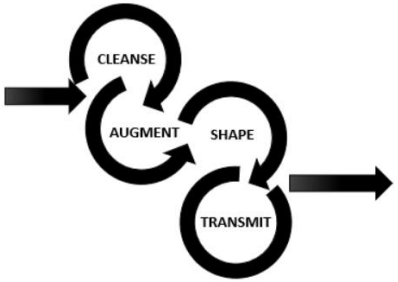
Average of Performance, Average of Availability and Average of Quality by D...

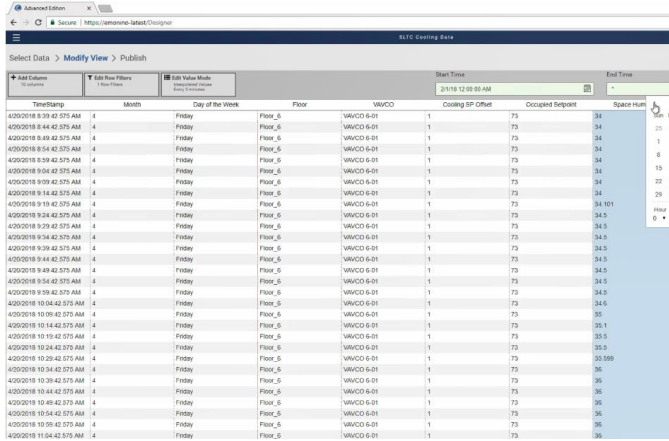


TimeStamp

3/2/2019 3/7/2019

PI Integrators enable Advanced Analytics





Why it matters?

Time-series data is not naturally aligned

Same type of equipment will have different measurements

Required for feature selection

Data has connection to the physical world

Correlate

Identify patterns visually

Apply Algorithms

Predict with known levels of accuracy

STAR BEARINGS COMPANY

EMPIRE QUALITY BEARINGS AND MORE

A success in just 3 months!

- Pilot site Performance improvement of 40%
- Pilot site Availability improvement of 21%
- Pilot site OEE improvement of 30%

Summary

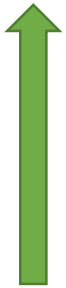
CHALLENGES

- Unable to reach the production target.
- Unable to explain reasons on bad pieces produced.
- Unable identify downtime reasons
- Lack of reporting and analytics capabilities

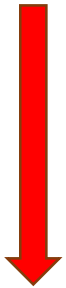
SOLUTION

- **5 step Recipe to success**
- capture information across the whole site.
- Standards to compare effectively equipment across sites.
- Track downtime events and associate reason codes.
- Visibility across production line in real-time.
- Platform for global data management, reporting and fast access for continuous process improvement.

BENEFITS



- Capacity
- Production
- Equipment efficiency
- Quality



- Downtime
- Start-up Time
- Product Rejects
- Maintenance Costs

And you? Are you ready to transform your world?

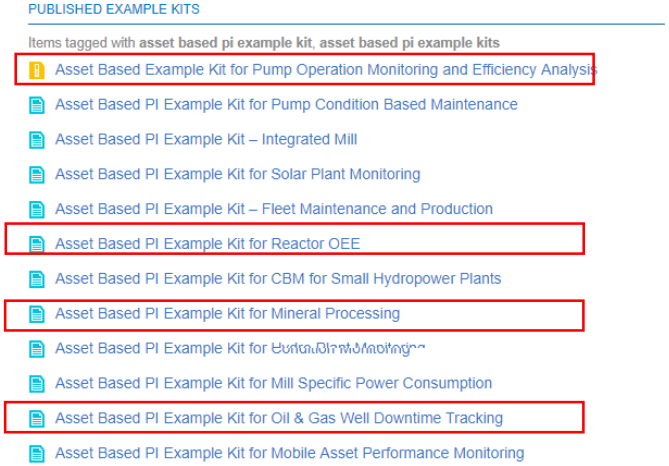

Resources to Help you Succeed

Where to start?

PI Square

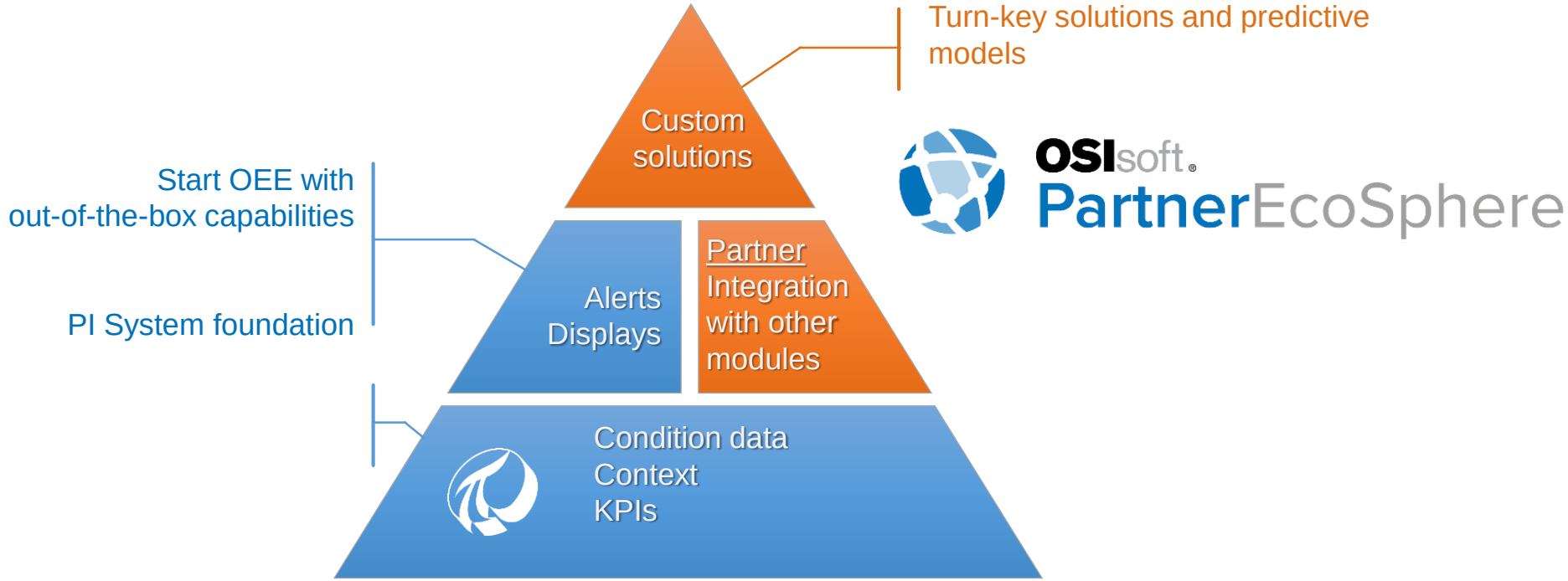
The OSIsoft Community

Asset Based PI Example Kits



https://pisquare.osisoft.com/community/all-things-pi/af-library/asset-based-pi-example-kits

Don’t forget that partners are also here to help!



… and during PIWorld? Tech-Lab!

Using AF to Analyse Asset Performance

- **When:** Thursday 19th September 9AM-12.15 PM
- **Where:** *Lab 3, GT: J2, 2nd floor*

Let’s stay connected!

Paula Baquer
pbaquer@osisoft.com

Customer Success Manager
OSIsoft

Questions?

Please wait for the **microphone**

State your **name & company**

Please remember to…

Complete Survey!

Navigate to this session in mobile agenda for survey