



Digital journey to operational excellence continues for leading-edge container terminal operator

Presented by:





The Digital Journey to Operational Excellence

Mark Jensen, Jack Lei





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ABOUT TRAPAC – WHO ARE WE

- Container terminal operator and vessel stevedore that provides port terminal services to the West Coast of USA
- Leading edge in container-terminal automation in North America
 - Innovative
 - Value superior customer service
 - Safe
 - Sustainable

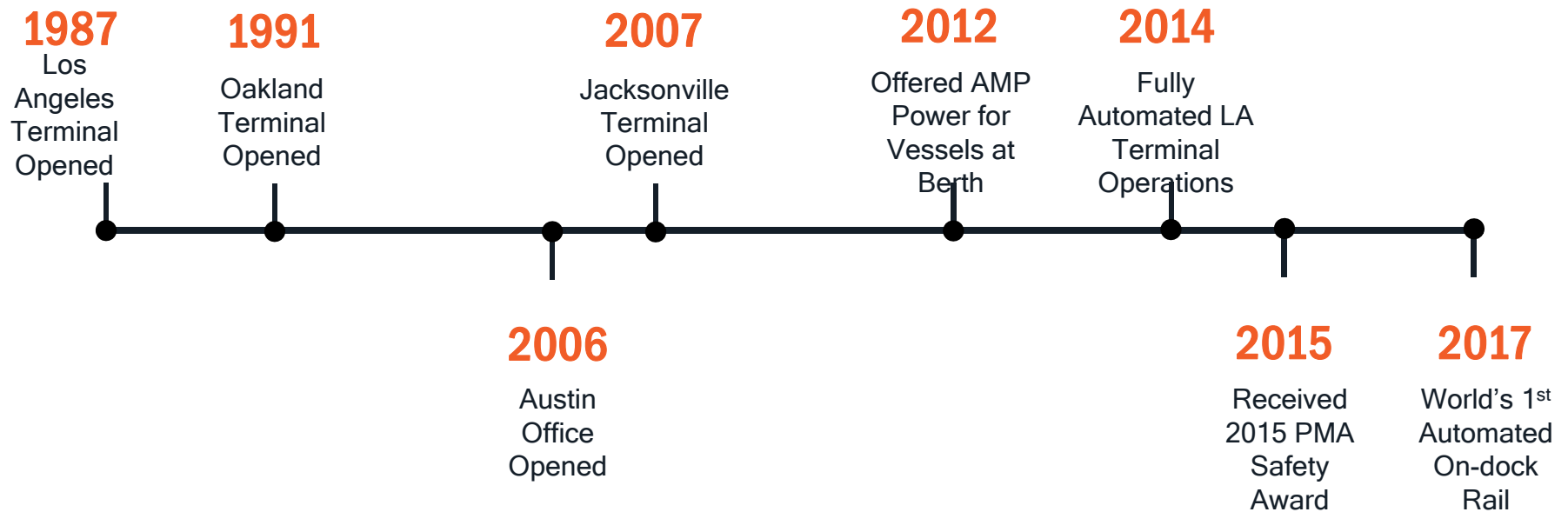


ABOUT TRAPAC – WHO ARE WE

- Among the first to implement and combine:
 - Automated straddle carriers with automated stacking cranes and automated on-dock rail system
 - Terminal-wide PI System



TraPac has been innovating the way cargo moves since 1985.



The cleanest terminal operations at the Port of Los Angeles.

99%

**NOx
Reduction**

98%

**PM
Reduction**

96%

**GHG
Reduction**

Metrics above compare the environmental performance of TraPac's cargo handling equipment operations to the Port of Los Angeles' average, using the Port's 2016 Emissions Inventory.

TECHNOLOGY SHOWCASE



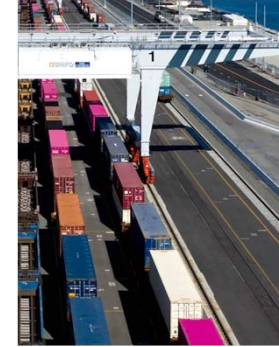
Automated
Straddle
Carrier
("Auto-Strad")



Automated
Rail Mounted
Stacking
Cranes
(ASC)

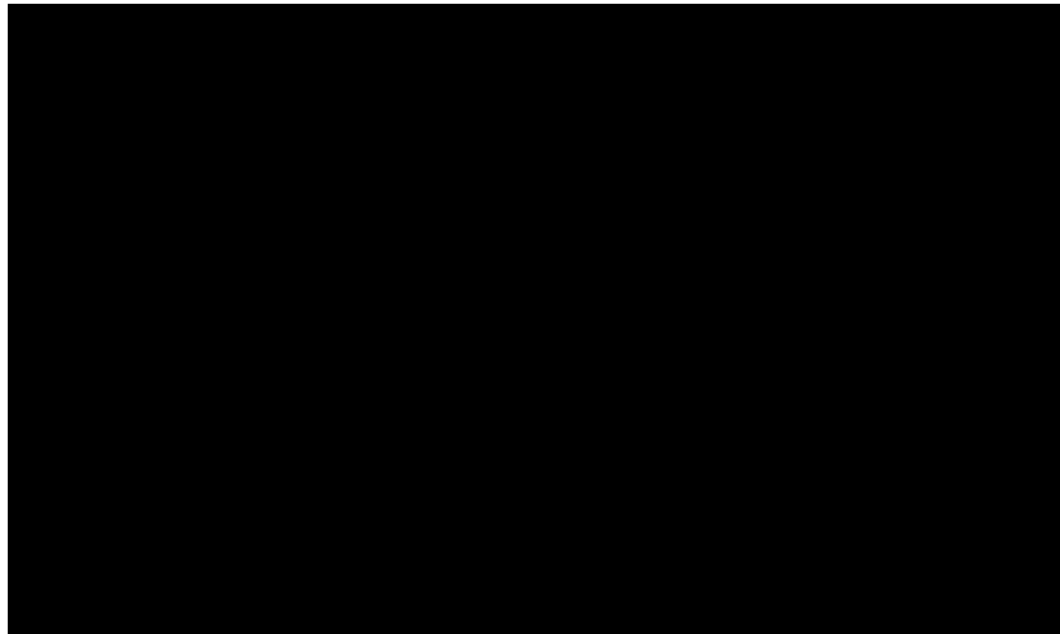


Automated
Truck
Handling
System



Automated
Rail Mounted
Gantry
Cranes
(On-Dock
Cranes)

CORPORATE VIDEO



BUSINESS CHALLENGES – MAKING THE CASE

- Complex automation solution that involves multiple systems from different vendors resulting in dissimilar data
- Inadequate data-acquisition tools for in-depth analysis of existing metrics

**DESIRE TO TAKE CUSTOMER SERVICE TO THE NEXT LEVEL
& FURTHER IMPROVE OUR SUSTAINABILTY**

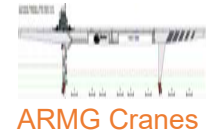
CHALLENGES OPPORTUNITIES

Superior Customer Service →
Understand and optimize operation
by making good data-driven
decisions

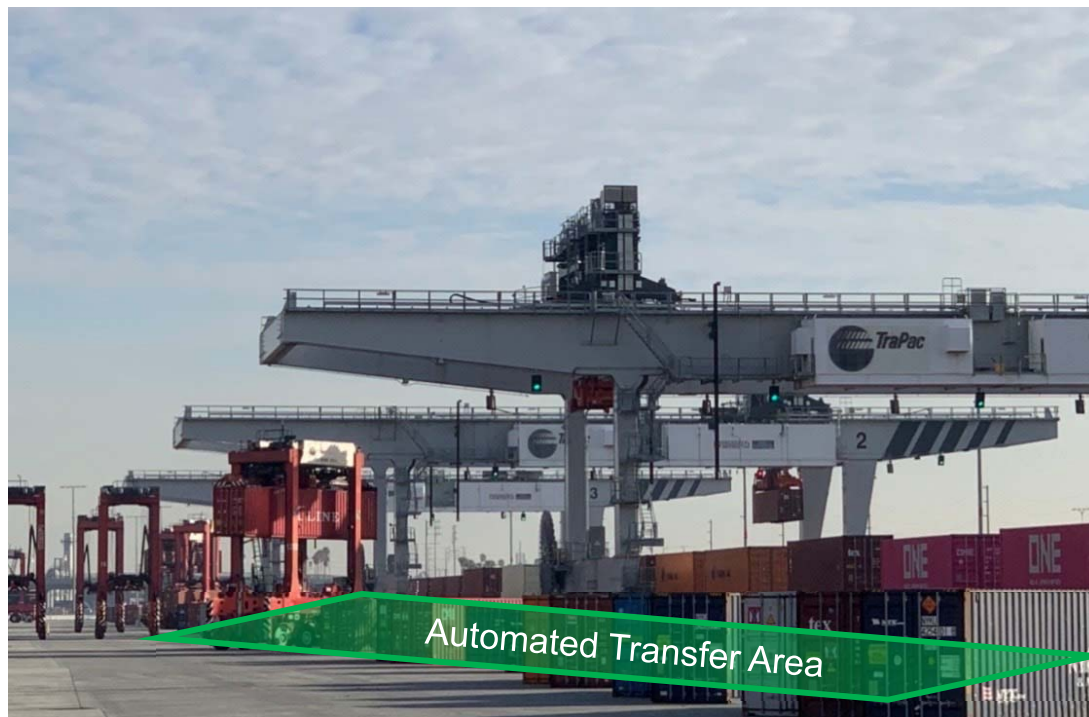
Improve Sustainability →
Operate at best efficiency

Continuous Improvement →
Targeted condition-based
maintenance and innovation



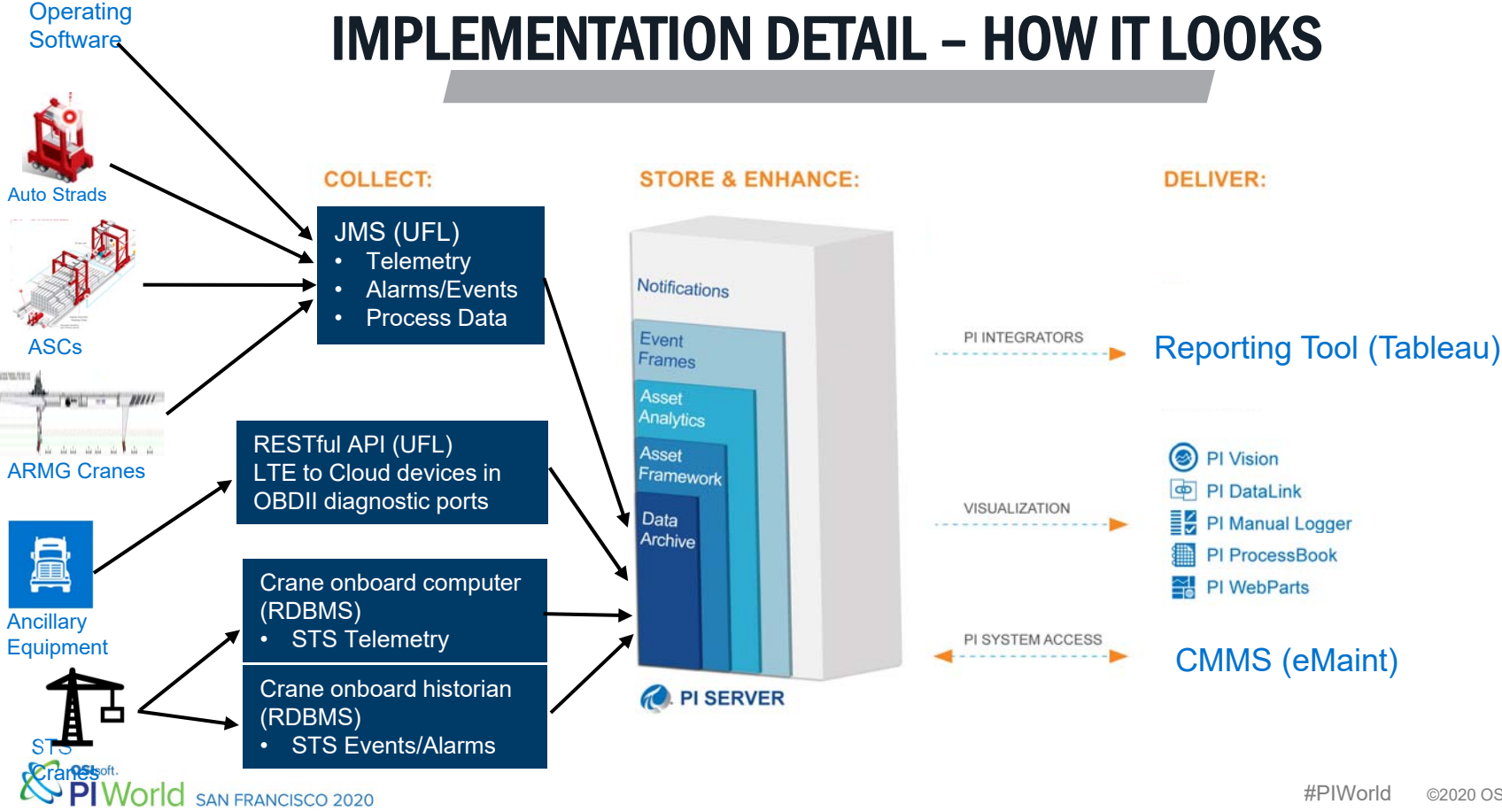


MAKING SENSE OF OUR OPERATION



- Automated Rail Mounted Gantry (ARMG)
- 3 axis of linear movement (gantry, trolley, hoist) and rotation about hoist (slew)
- **Interacts** with Auto-Strads in the automated transfer area
- Scheduler system for routing and automated transfer area reservations

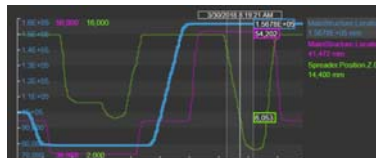
IMPLEMENTATION DETAIL – HOW IT LOOKS



MAKING SENSE OF OUR OPERATION - CYCLES

Equipment cycle captured into phases based on crane movement, job status, remote operator status, transfer area reservation status

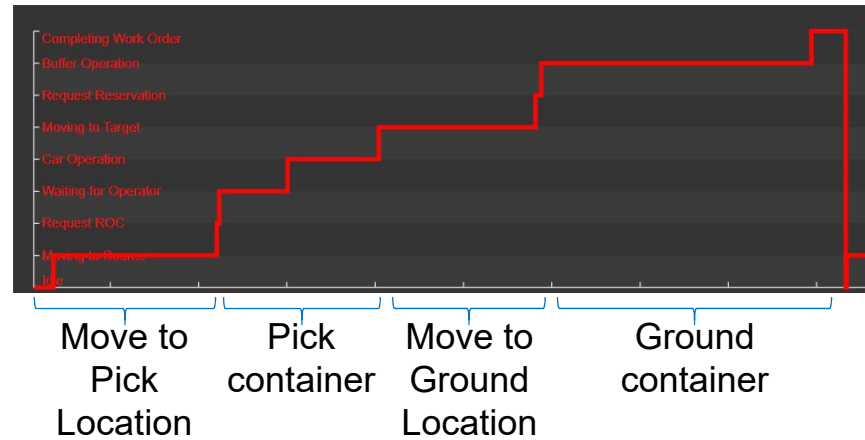
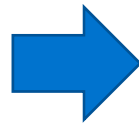
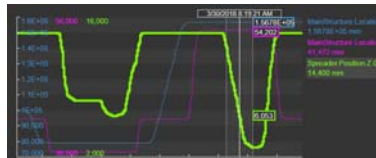
Horizontal



Lateral



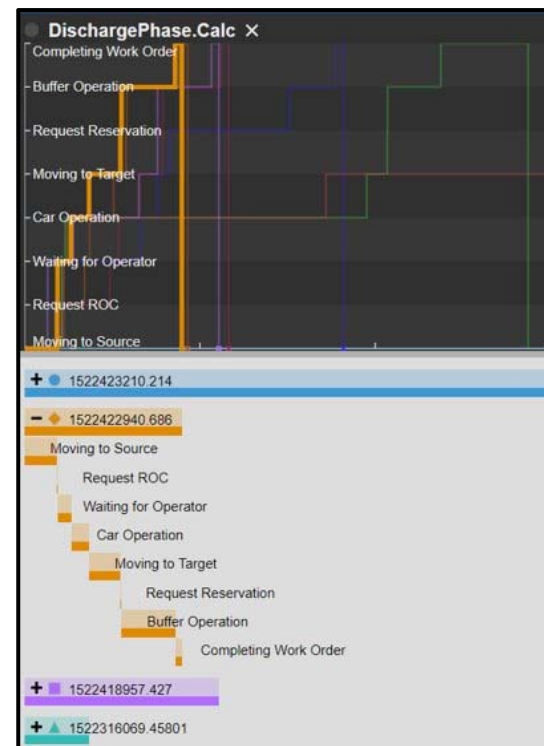
Vertical



MAKING SENSE OF OUR OPERATION - CYCLES

Cycle Modeling

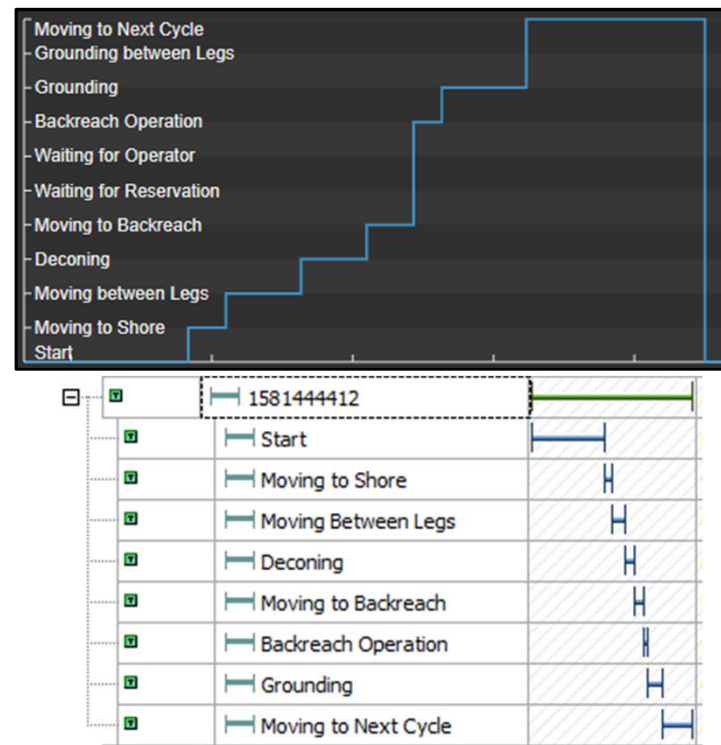
- Event frame used to capture each cycle
 - Compare to a known baseline
 - Identify optimization opportunities



MAKING SENSE OF OUR OPERATION - CYCLES

Cycle Modeling

- Expanded to other equipment
 - Automated and non-automated



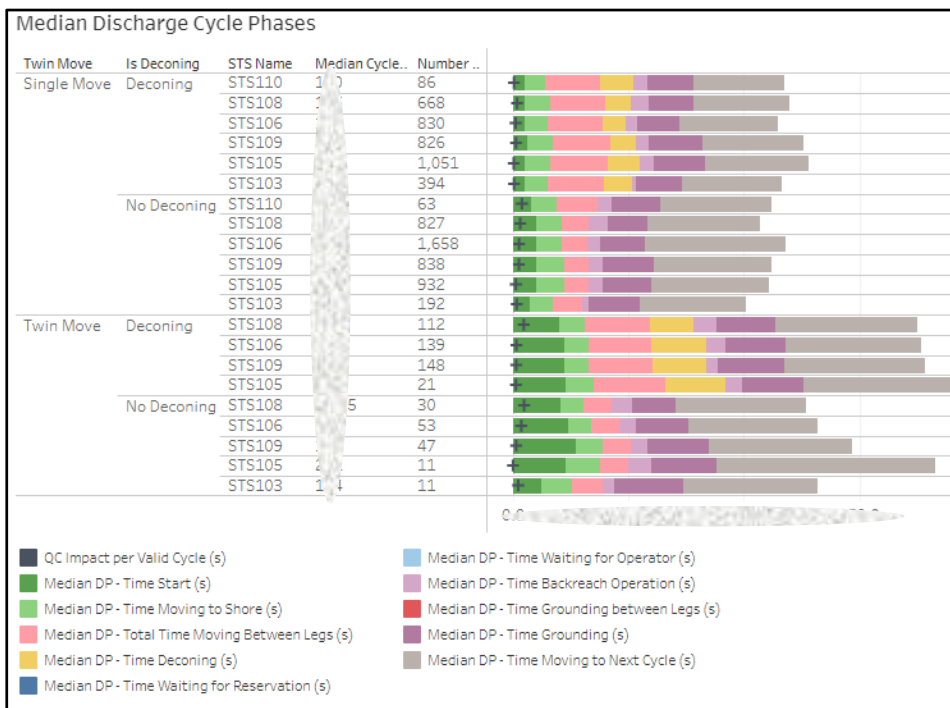
WHAT'S IN A CYCLE?

Calculations made within cycles can provide insight into conditions during each phase of a cycle.

oDurDeconing	<pre>// oDurDeconing IF (oIsGoodCycle = 1) THEN TimeEq('DischargePhase.Calc', vTimeStampStart, vCurTime, "Deconing") ELSE 0</pre>
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vTwinMove	<pre>IF (vContainerNamePos2 <> "NA") THEN 1 ELSE 0</pre>
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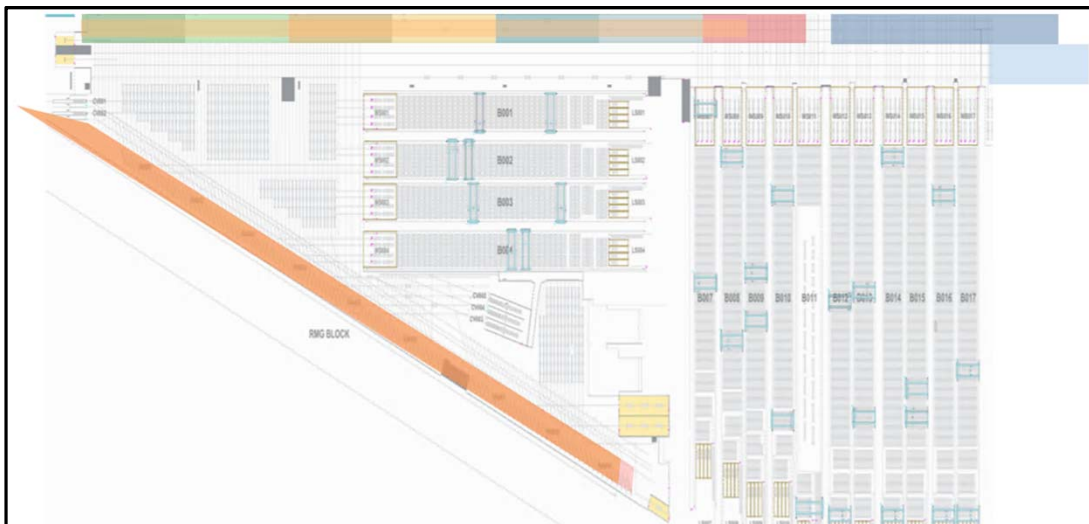
ANALYTICS USING SUMMARIZED DATA



- Data can be rolled up using BI tools to create charts for meaningful analysis
 - Removes expensive summary calculations from PI AF



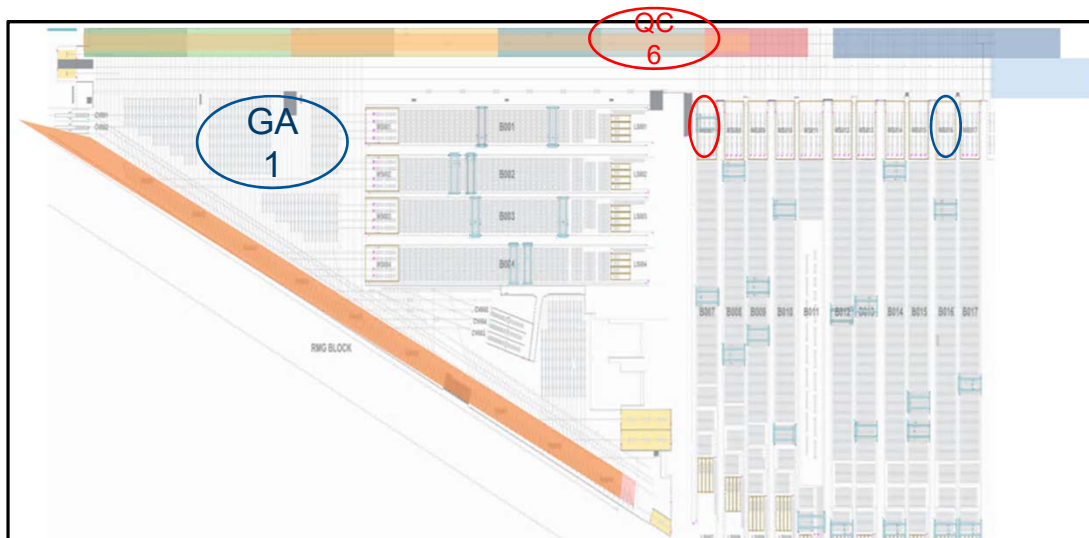
LOCALITY-TRIGGERED CALCULATIONS



- Using spatial (x,y,z) coordinates to trigger calculations
- Including coordinate attributes for analysis in event frames
 - Heat Maps

```
vInMaintenance // Maintenance area in the top left
                IF yPos >= 960 AND xPos <= 100 THEN True
                // Maintenance area in the top right - north of STS cranes
                ELSE IF xPos >= 1272.219 AND yPos >= 945.000 THEN True
                ELSE IF yPos < 500 THEN True
                ELSE False
```

LOCALITY-TRIGGERED CALCULATIONS



How long does it take an auto-strad to pick from one location and drop off in another?

- Distance
- Routing options
- Permitted speed
- Traffic

CONDITIONED BASED MAINTENANCE FROM DATA

- Pareto Charts used to analyze
 - Top occurring warnings
 - Top occurring faults
- Fleet and individual equipment metrics
 - Identify unit level issues
 - Identify fleet level issues
 - Map warnings and faults to a locality, identify locality issues
 - Trending
 - Side by Side Comparison

PARETO FAULT ANALYSIS



3 bad actors

1 bad actor

Every unit?

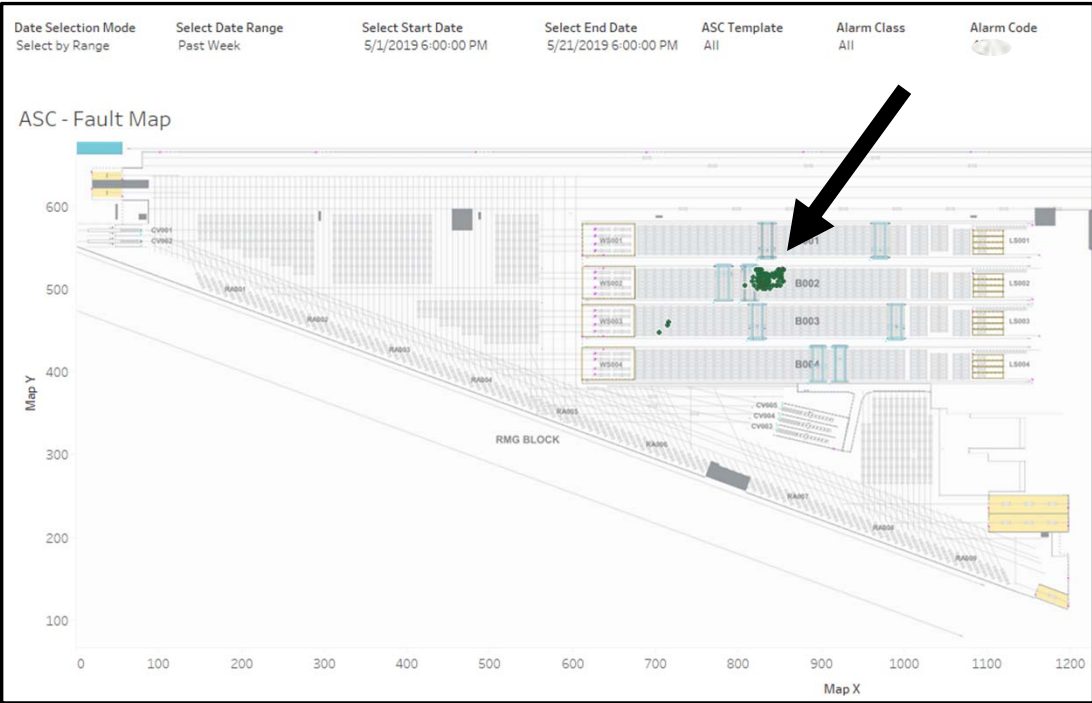
Every unit?

Where are the problems located?



LOCALITY BASED PROBLEMS

Finding the needle in the field of haystacks



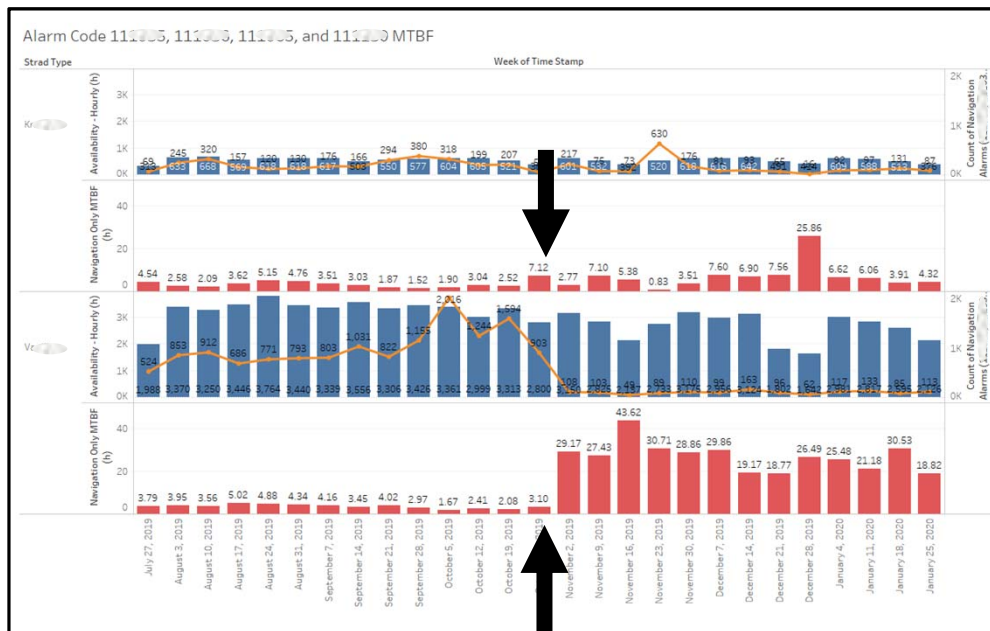
EFFECT OF CHANGE

Was that a good idea?

- Fleet level reliability can be impacted

by:

- Configuration settings
- Software updates
- Locality issues

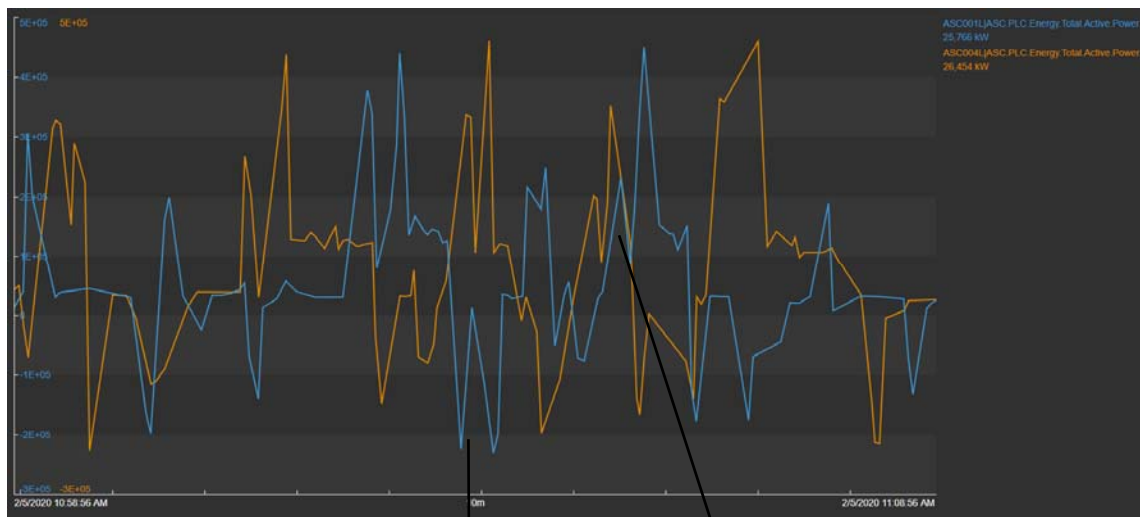


Measure Names
 Availability - Hourly (h)
 Count of Navigation Alarms (111005, 111006, 111005, and 111000 MTBF)
 SUM([SC - Maintenance Metrics].[Availab..])

ELECTRICAL TELEMETRY

- PI Vision dashboards from various smart power quality meters
 - Start to understand demand
 - Observe demand and regen phases of ASC operational cycle
 - Visibility to harmonics and power factor
 - Visibility to line side disturbances

ELECTRICAL TELEMETRY



More regen
offsetting
demand

Less
concurrent
demand

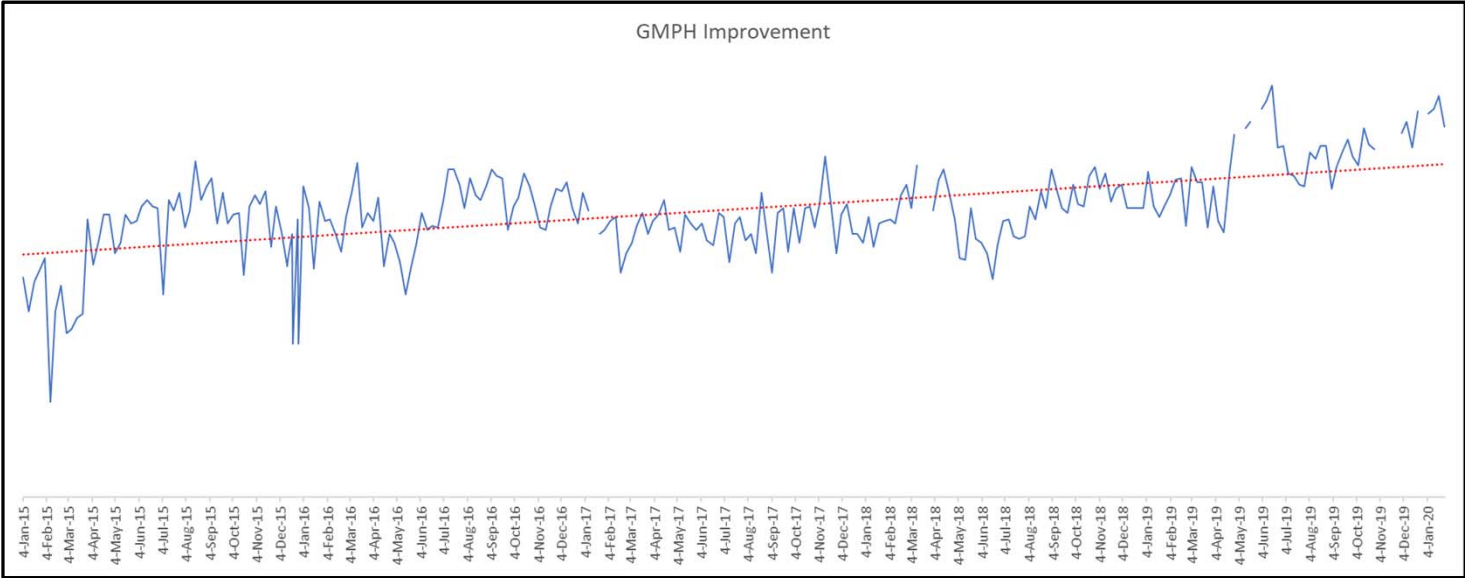
- Can I reduce demand?
- Why do identical cranes with similar utilization consume vastly different amounts of electricity?

IMPACT OF CHANGE

- ✓ Sustained improvement in customer service metrics
 - Happier Customers
- ✓ Optimizing our operation
 - More Efficient
 - More Sustainable
- ✓ Shift towards a data-centric pragmatic approach
 - We get there faster
- ✓ Defect identification and elimination
 - We continue to get better

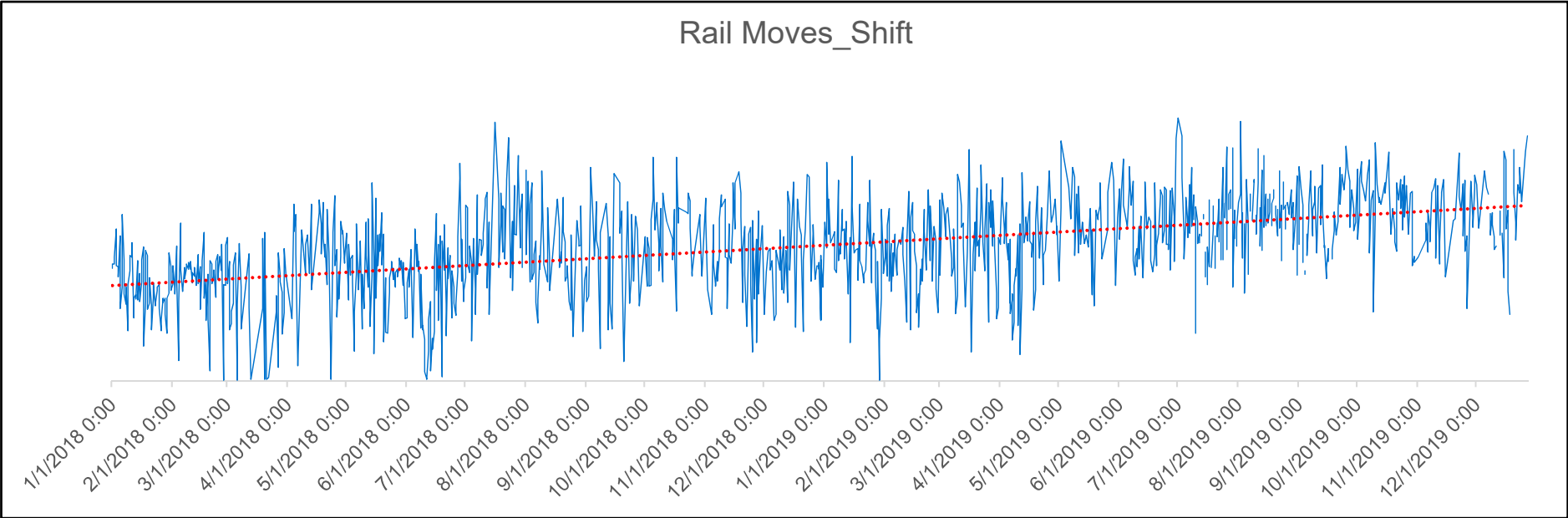
IMPACT OF CHANGE

STS GMPH, trending upward improvement



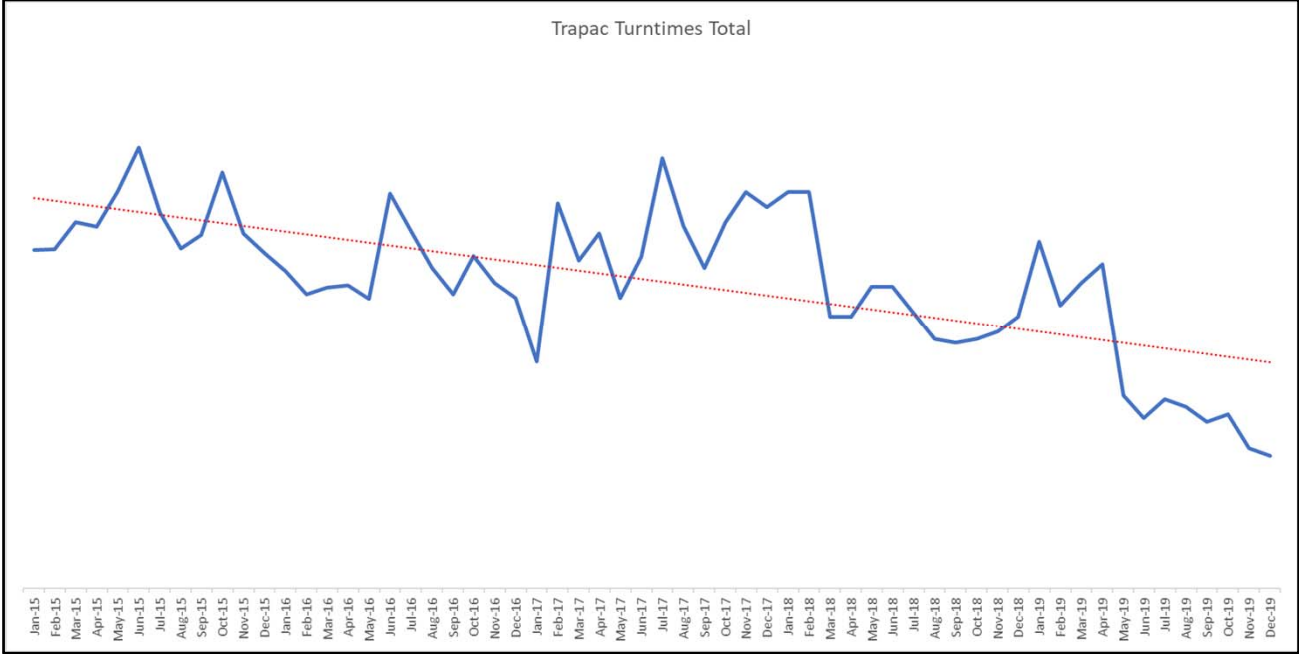
IMPACT OF CHANGE

Rail moves per shift, trending upward improvement



IMPACT OF CHANGE

In-terminal truck turn time, trending downward improvement





CHALLENGES

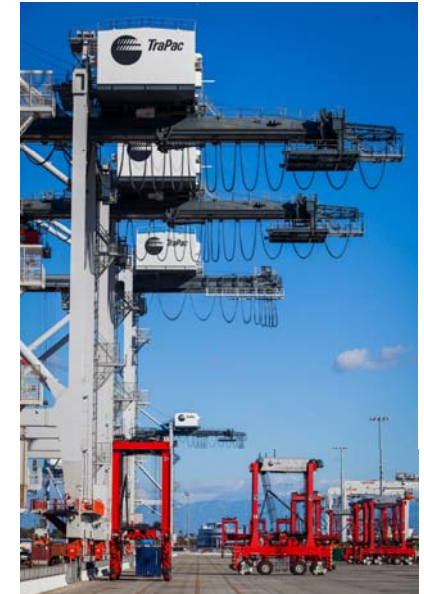
- Dissimilar data sources
- Time sensitive transactional type data
- Multitude of stakeholders

SOLUTION

- Intelligent use of OSIsoft PI and associated tools
- Developed custom application along with PI Connector for UFL to historicize JMS messages

BENEFITS

- Improvement in key customer service metrics
- Increasing clarity towards an optimal operation



Data has got our people talking about our problems and empowering them to make decisions. Decisions with a positive impact to our business performance including the service level provided to our customers.

Mark Jensen, Vice President, Asset Management



Contact Information



- Mark Jensen
- Vice President, Asset Management
- TraPac, LLC
- mark.jensen@trapac.com



- Jack Lei
- Operational Excellence Analyst
- TraPac, LLC
- jack.lei@trapac.com

Questions?

Please wait for
the **microphone**

State your
name & company



Save the Date...



AMSTERDAM
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