

Increasing Internal Reliability with Smart Asset IoT Technology...

and making/saving money doing it...

Gilbert Meyer-Gauen

Director of Asset Management
National Oilwell Varco

November 19th, 2017

internet of **manufacturing**.

#IoTMan

iB internet of **business**.

Vinelake.



Overview

- Company/Industry Introduction
- Core Maintenance Principles in our Industry:
 - Reliability Centered Maintenance (RCM)
 - ISO 14224
- Predictive Maintenance via NOV Max™
- NOV's Internal Maintenance Software Stack
- Lessons Learned

Who Are We?

- Leader in the Design, Manufacture, Sale and Service of Oil Field Equipment
- Established: 1841
NYSE: NOV
Employees: 36,000
Revenue (2016): \$7.25B
- 178 Manufacturing Facilities Worldwide:



- *We Power the Industry that Powers the World*

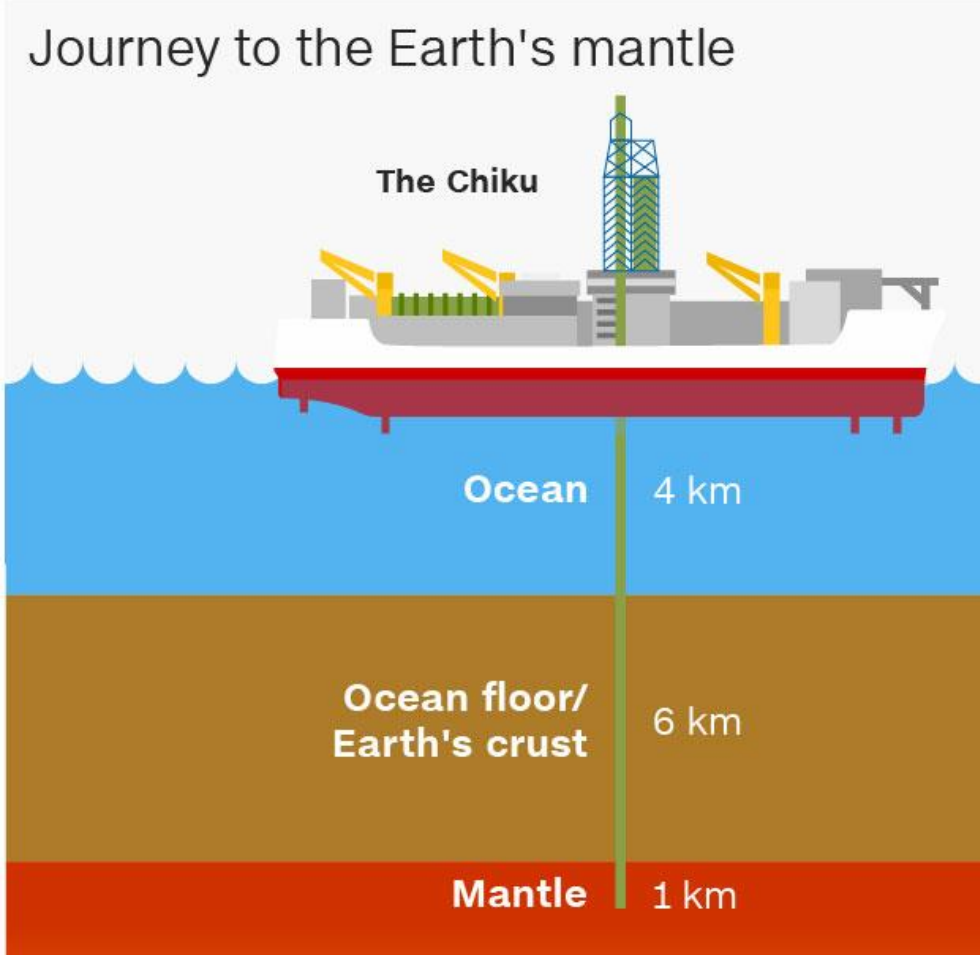
Not Just The Oilfield...

- We solve really big problems



Scientists want to be first to drill into the Earth's mantle

By Ben Westcott and Junko Ogura, CNN
⌚ Updated 1251 GMT (2051 HKT) April 14, 2017



Drilling Equipment:

Type	Model
Drilling Control System	NOV Hitec DCIS
Drawworks	NOV EH-V-5000
Traveling Block	NOV Hydralift HTB1380
Top Drive	NOV Hydralift HPS 1000 2E AC
Rotary Table	NOV Varco BJ RST 60-1/2
Pipe Racking System	NOV Hydralift Hydra Racker IV
Hydraulic Roughneck	NOV Hydralift HRN-166
Pipe Transfer System	NOV Hydralift 3-1/2" to 30" pipe, SWL 20 ton
Riser Transfer System	NOV Hydralift 90' riser & slip joint, SWL 45 ton
Coring Winch	NOV Dual Drum 19mm x 10,000 m.
Mud Pump	NOV 14-P-220
Heave Compensator	NOV Hydralift CMC1000-25
Riser Tensioners	NOV Hydralift N-line direct acting tensioner
Lower Marine Riser Package	NOV Shaffer Dual Annular

Source: <http://edition.cnn.com/2017/04/07/asia/japan-drill-mantle/index.html>

Challenges We And Our Customers Face

- Extremely remote locations
- Extremely rugged (rough neck proof)
- Low connectivity
- Extremely expensive when things break
 - Antonov AN 124 rented to fly equipment
- Technology averse (unless it turns to the right!)
- Tried and failed a few times... no trust it will work!



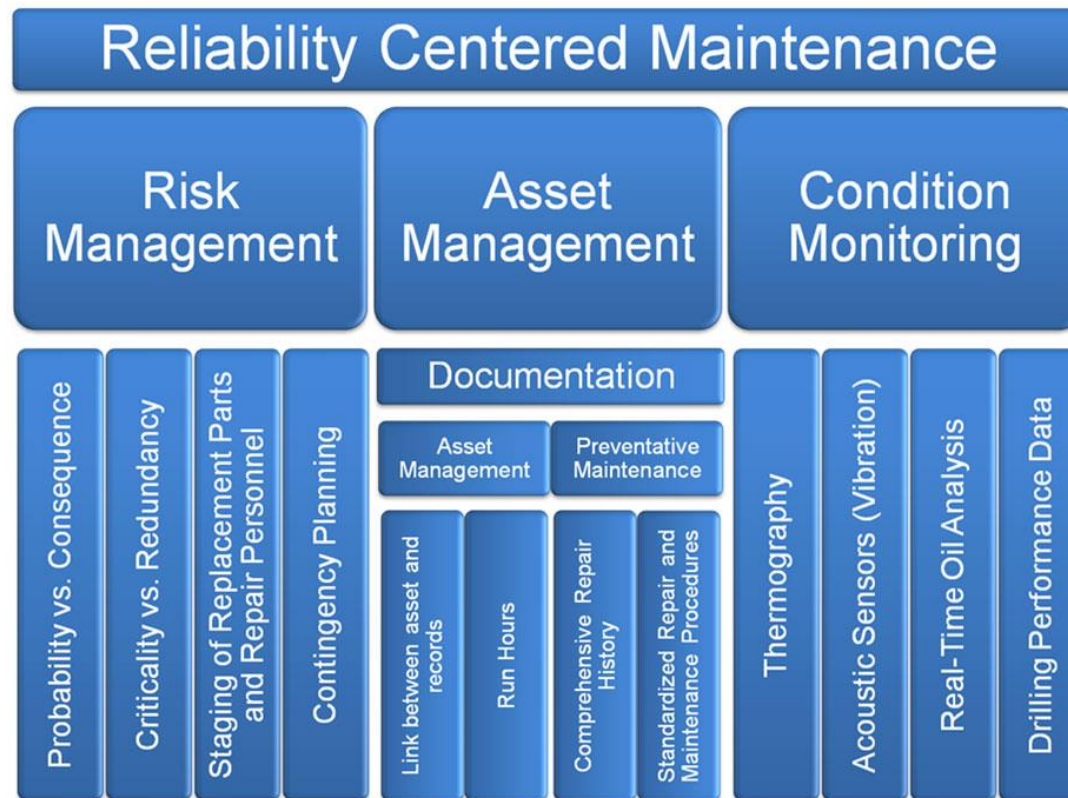
Core Maintenance Principles

- Reliability-Centered Maintenance (RCM)
- ISO 14224:
Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment



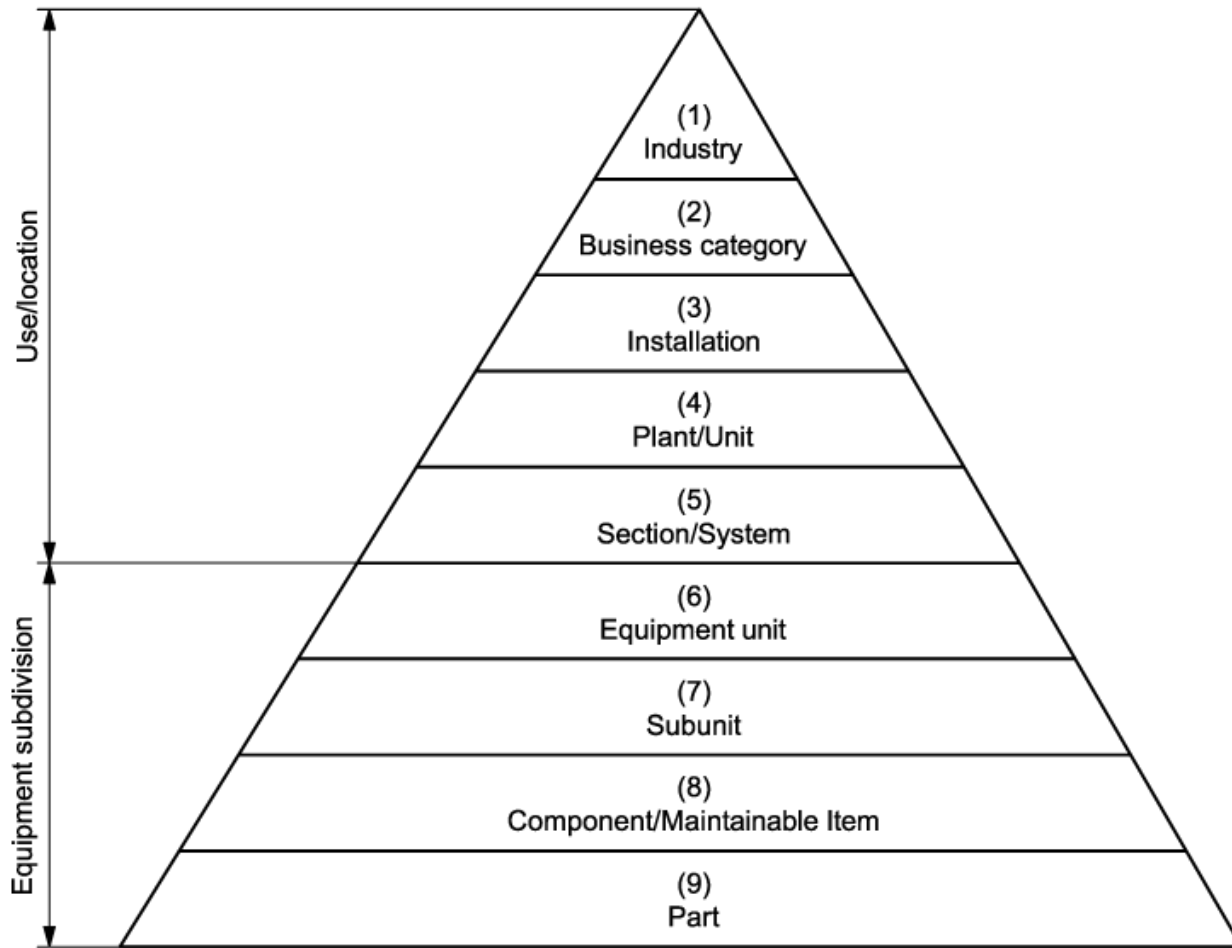
Reliability-Centered Maintenance (RCM)

- First used by Boeing during the design of the 747
- Since then adapted widely by many industries, incl. aerospace, wind power, mining, and oil and gas production



Source: RCM Principles Provide Predictive Asset Maintenance Benefits, Cost Savings - Frank Breland, et al. (2010) - IADC/SPE 128865

ISO 14224 - Taxonomy



Source: ISO Standard 14224

Example:

Petroleum

Upstream (E&P)

Drilling Rig

Offshore Platform

Compression

Pump

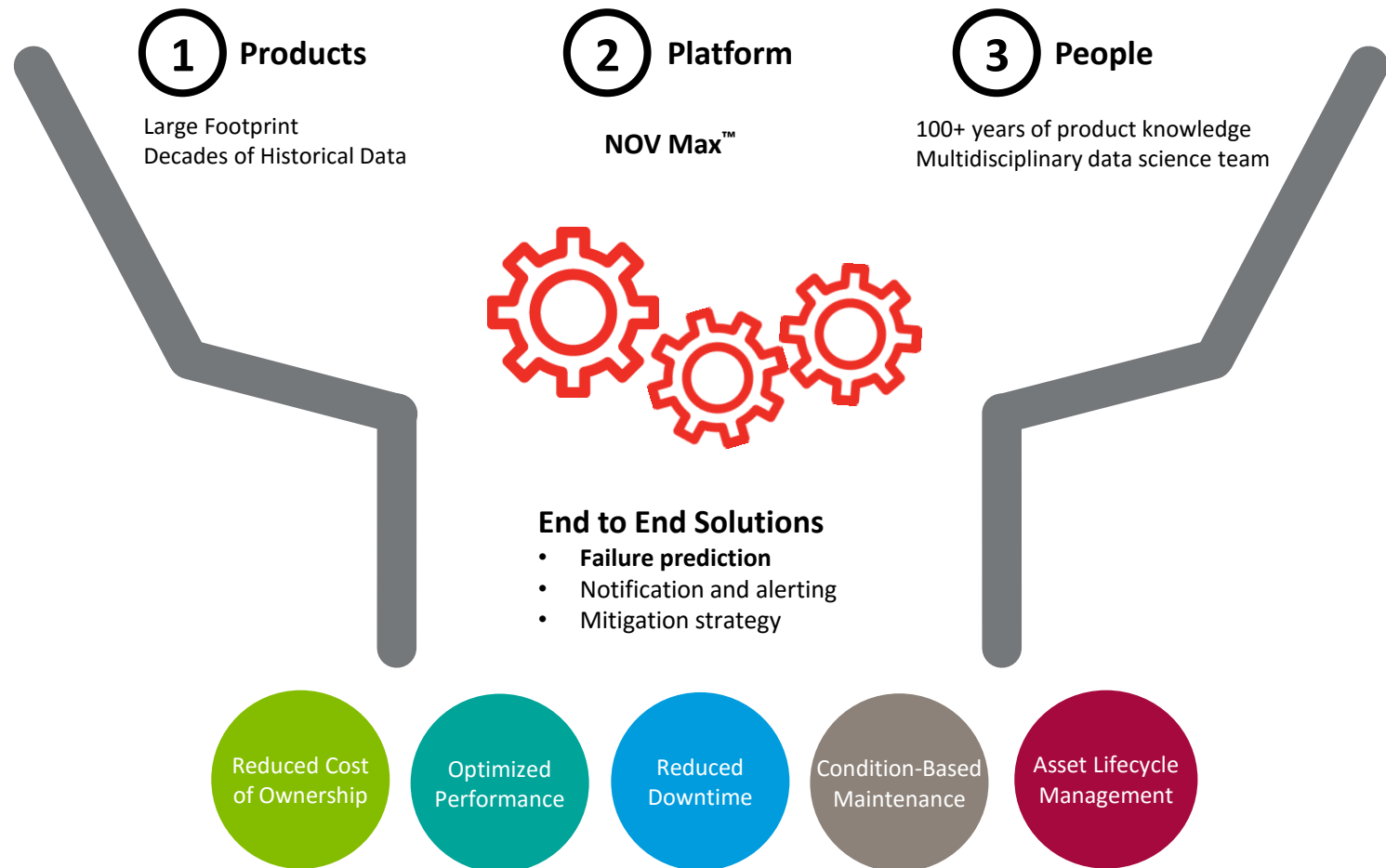
Lubrication

Gearbox

Bearing

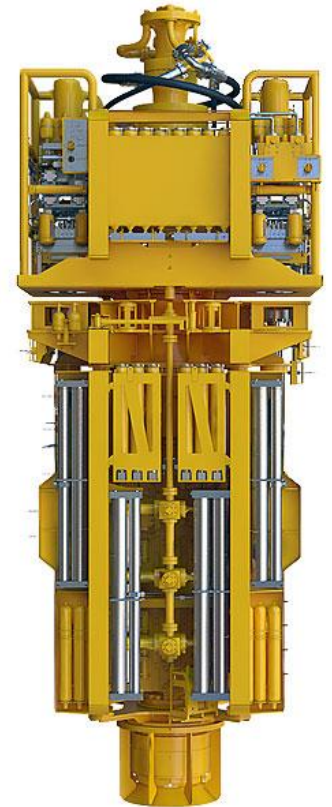
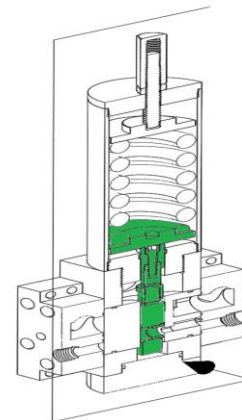
Predictive Maintenance via NOV Max™

- Analytics augments our products



Example: Offshore BOP Monitoring

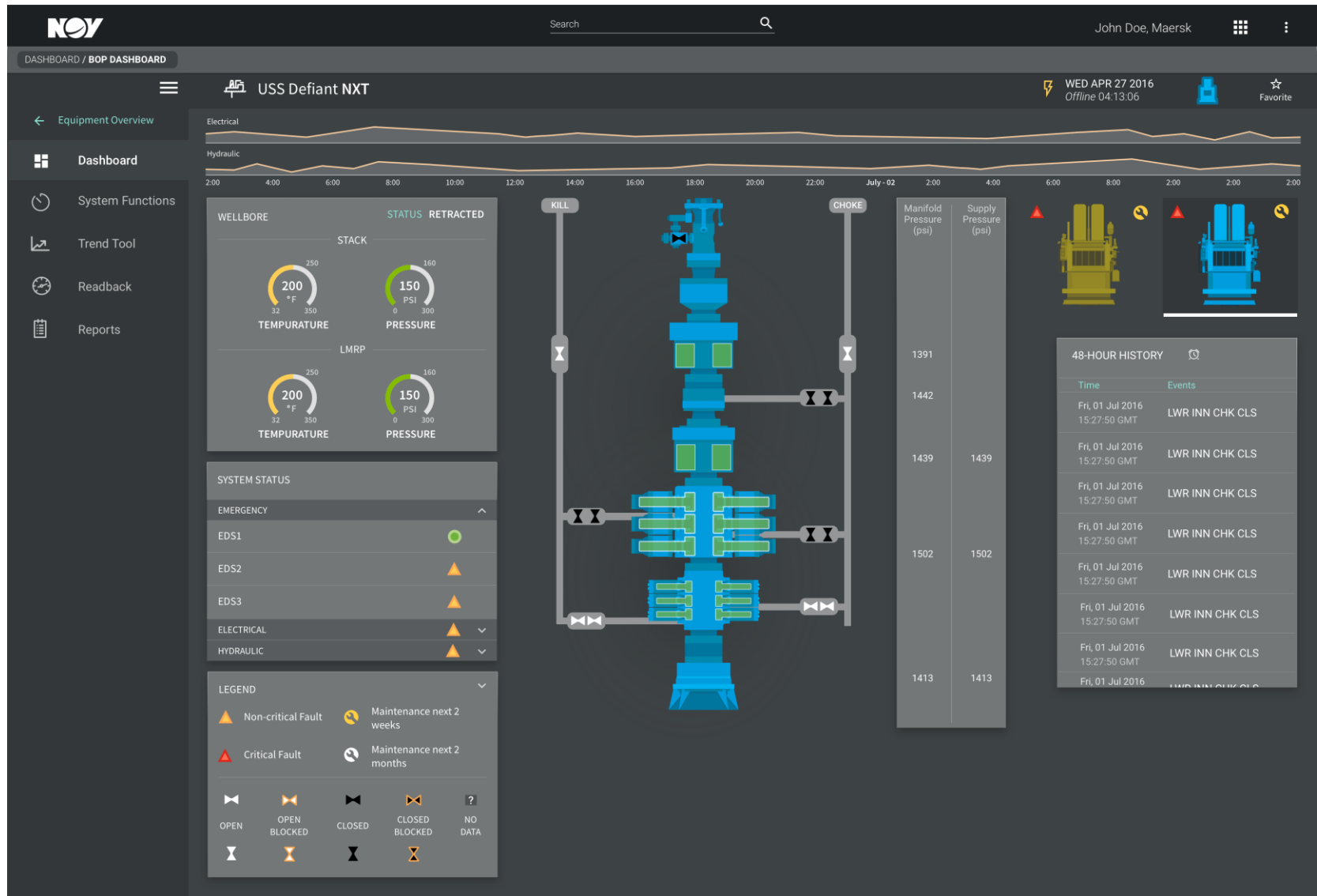
- Large structure used to seal, control and monitor wells to prevent blowouts
- Chosen because of its high criticality and available data:
 - 15 years of data
 - 5 years of detailed maintenance history
 - 8 BOPs
- Focus on pressure regulator failures:



Condition-Based Maintenance



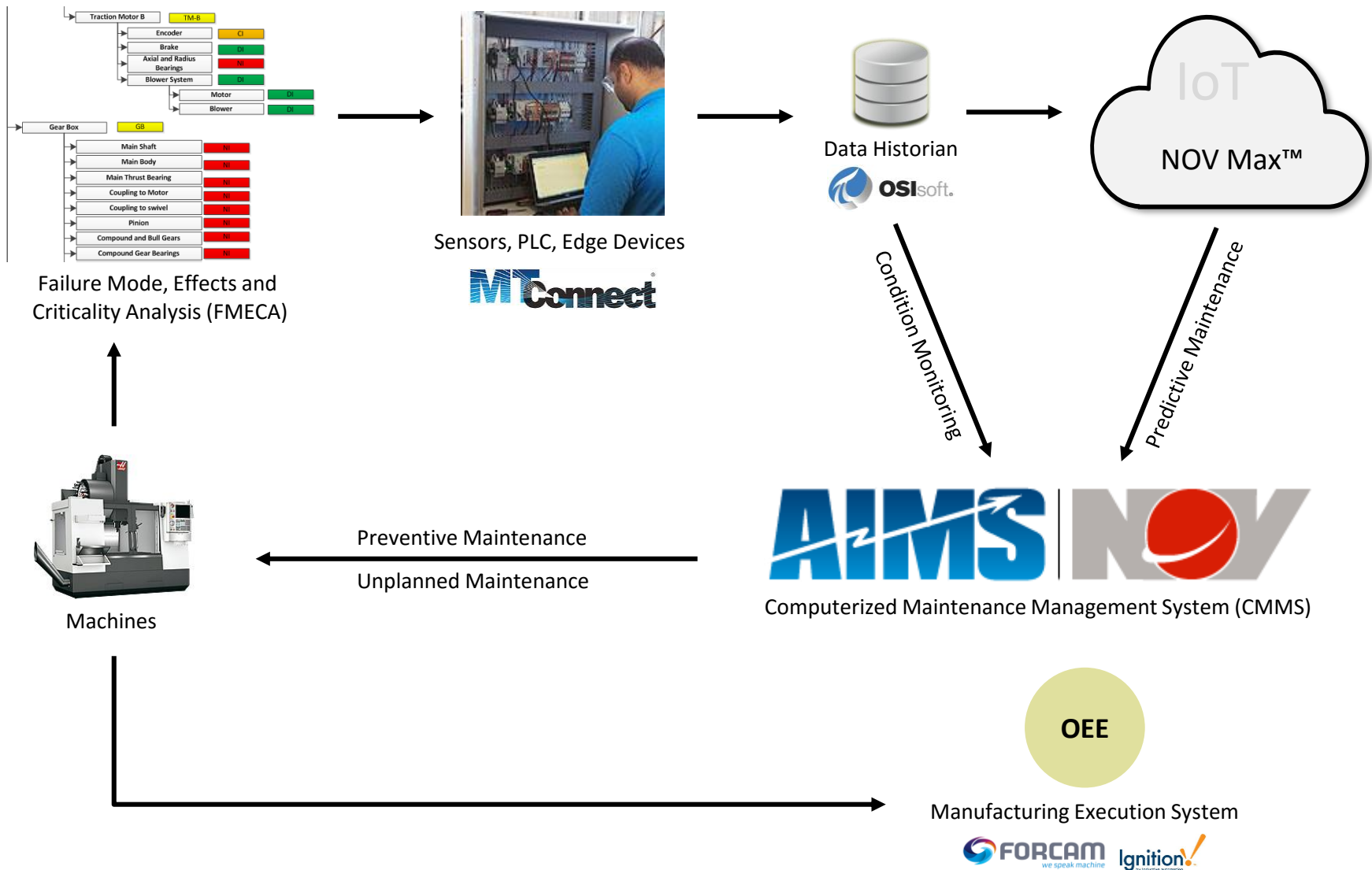
NOV Access Customer Portal



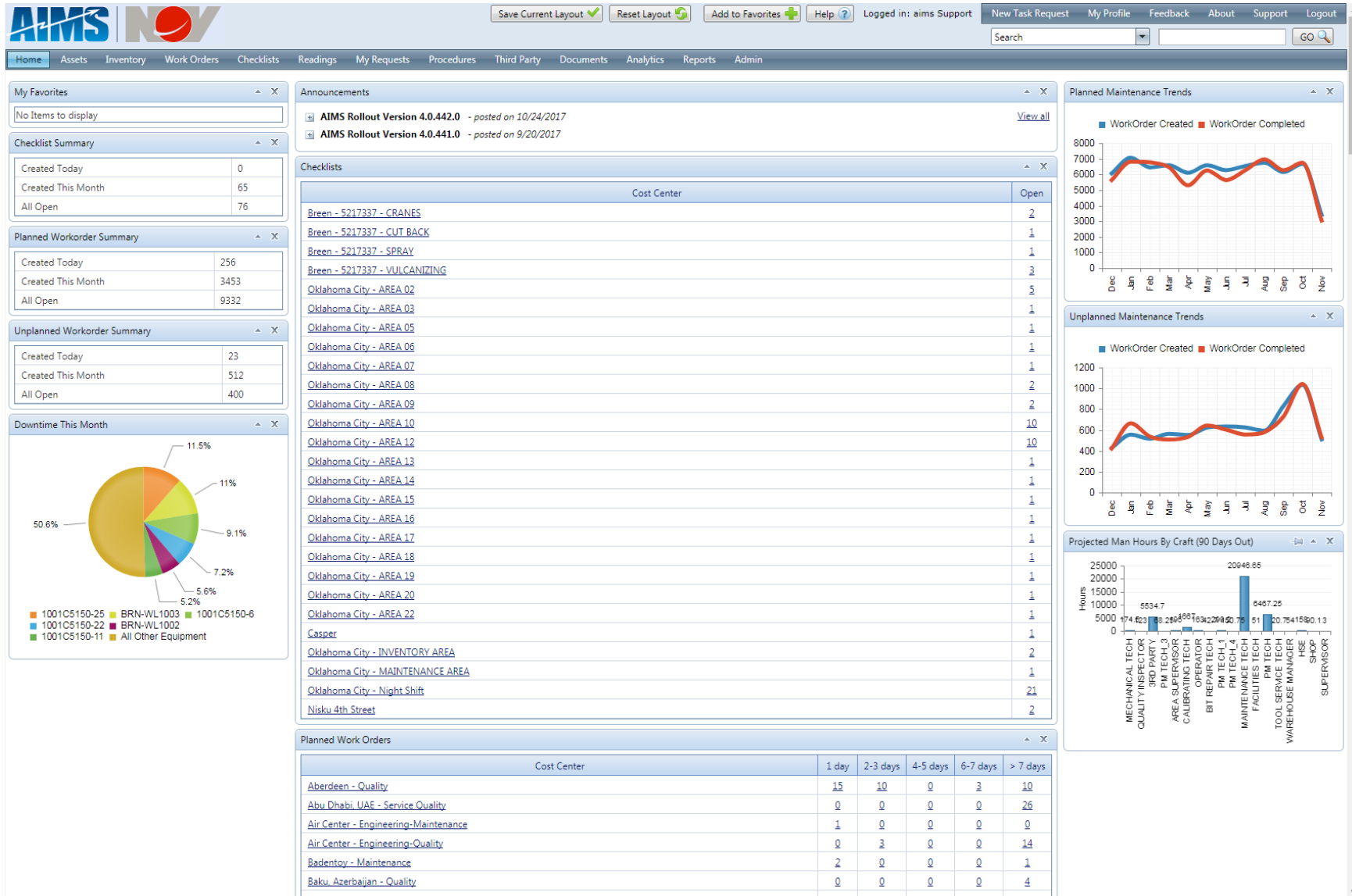
We Sell Great Products, So Why Not Use Them Ourselves?



Overview of NOV's Maintenance Software Stack



Asset Information Management System (AIMS)



Condition Monitoring Work Order

AIMS

NOV

Add to Favorites

Help

Logged in: aims Support

New Task Request

My Profile

Feedback

About

Support

Log Out

Home

Assets

Inventory

Work Orders

Readings

My Requests

My Tasks

Procedures

Transfers

Third Party

Documents

Analytics

Reports

Admin

Created By aims Support on 8/5/2014 1:18:54 PM

Print Work Order

WO Number: UWO005431

Created Date: 8/5/2014

Equipment No: CNC-88

Equipment Description: Orange CNC-88

Status: Open

Cause: Circuit failure

Priority: 1- MACHINE DOWN

Downtime: ☐ No ☒ Yes Hrs: 10.00

Comment: CBM Asset Health Alert Detected Tag Name: Tag Value: Rule Policy Tag Condition: DataWarehouse::"16389.spindletemp1" > 33 OR DataWarehouse::"16389.spindletemp2" > 33 Rule Policy Evaluate Condition: 0 > 33 OR 36 > 33 Alert Severity: Alert Description: Machine Name: SRVHOUOTTMP05 Reliability Characteristics Failure Class: Problem Code: Cause Code: Remedy Code:

Additional Comment:

PO Number:

Company Doing Work: NOV

Person Doing Work: Support, aims

Tasked To: Electrician

Permit To Work Number:

JSA:

Category: Condition Monitoring System: CNC Machines Tier 3: N/A Tier 4: N/A

Man Hours: 10

+ Add new record

Refresh

Man Hours	Performed By	Comments	Created By	Create Date
10	Support, aims		Support, aims	8/19/2014

Cost Details: \$0.00

+ Add new record

Refresh

Cost Type	Items	Description	Qty	Cost (each)	Total Cost
No records to display.					

Delay Reasons: None

+ Add new record

Refresh

Delay Reason	Note	Resolution Date	Created By	Created Date
No records to display.				

Total Duration:

Problem/Resolution:

Problem (5000 char max): CBM Event: Asset Health Alert for Overtemp Alert

Action Taken (5000 char max): Replaced circuit

Work Order Docs

Equipment Class Docs

Equipment Docs

Add New Document

Select a File:

Browse...

Document Type: (Select from list.)

Comments:

Upload File

You are uploading documents for the WorkOrder Number: UWO005431

File Name	Document Type	Comments	Uploaded By	Uploaded Date
No records to display.				

0 items in 1 pages

Work Order Inventory

Edit

Master Part #	Inventory Class	Part #	Warehouse	Location	Quantity	On Hand
No records to display.						

©2017 NOV

Increasing Internal Reliability with Smart Asset IoT - 11/29/2017 | 17

NOV | Total Cost of Ownership

Division: Grant Prideco
 Cost Center/Zone: 
 District: North America
 Equipment Number: 
 From: N/A
 To: N/A
 Include Children Equipment: Yes

Equipment Details:

Equipment #: 
 Description: 
 Zone: 
 Serial Number:
 Current Operating Status: In Full Service
 Install Date/Creation Date: 1/8/2013
 Current Age In Months: 57
 Estimated Total Life In Months: 0
 Remaining Life In Months: 0



Planned Work Order:

of Work Orders: 8
 Labor Hours: 1938.30
 Labor Cost: \$28,620.00
 Additional Cost: \$372,370.41
 Parts Cost: \$0.00
 Inventory Costs: \$3,977.52

Miscellaneous:

Contacts Cost: \$0.00
 Direct Purchase Costs: \$1,569,425.12
 Direct Parts Cost: \$0.00
 Direct Third Party Costs: \$0.00

Summary:

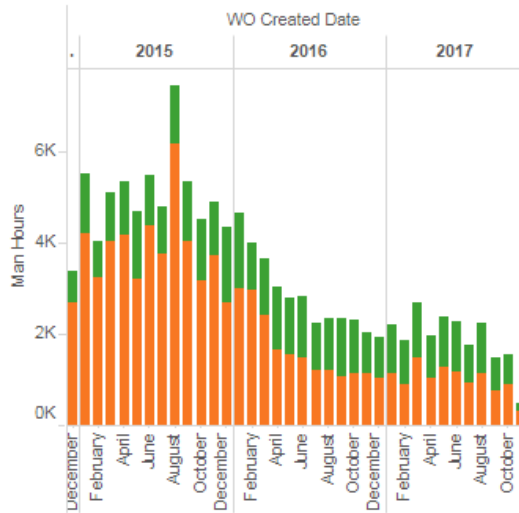
Cost Incurred So Far: \$2,208,715.71
 Average Monthly Operating Cost: \$11,215.62
 Estimated Cost Over Life: \$1,569,425.12
 Estimated Cost Over Remaining Life: N/A

Unplanned Work Order:

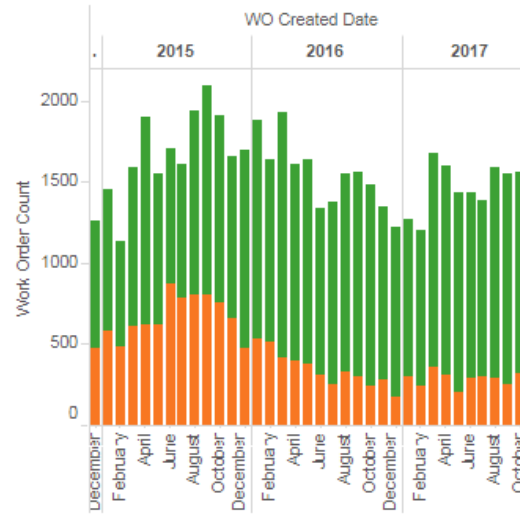
of Work Orders: 321
 Labor Hours: 2816.07
 Labor Cost: \$22,779.99
 Additional Cost: \$2,101.89
 Parts Cost: \$0.00
 Inventory Costs: \$4,957.92
 Downtime Hours: 720.26
 Downtime Costs: \$204,482.86

Planned vs. Unplanned Maintenance

Planned vs. Unplanned Work Order Hours



Planned vs Unplanned Work Order Count



Cost Center

(All)

Zone

(All)

Criticality

(All)

Company Doing Work

(All)

Start Date

12/1/2014

End Date

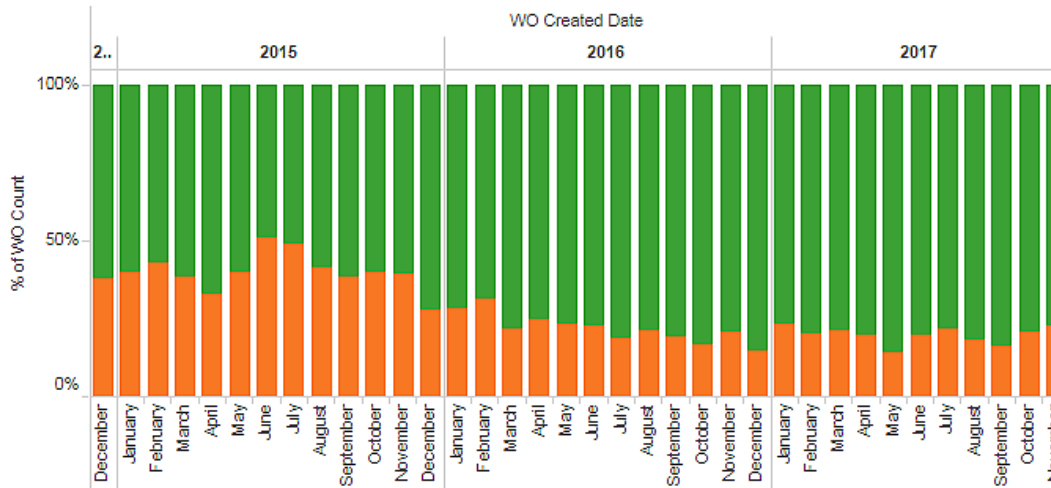
11/14/2017

WO Type

Planned

Unplanned

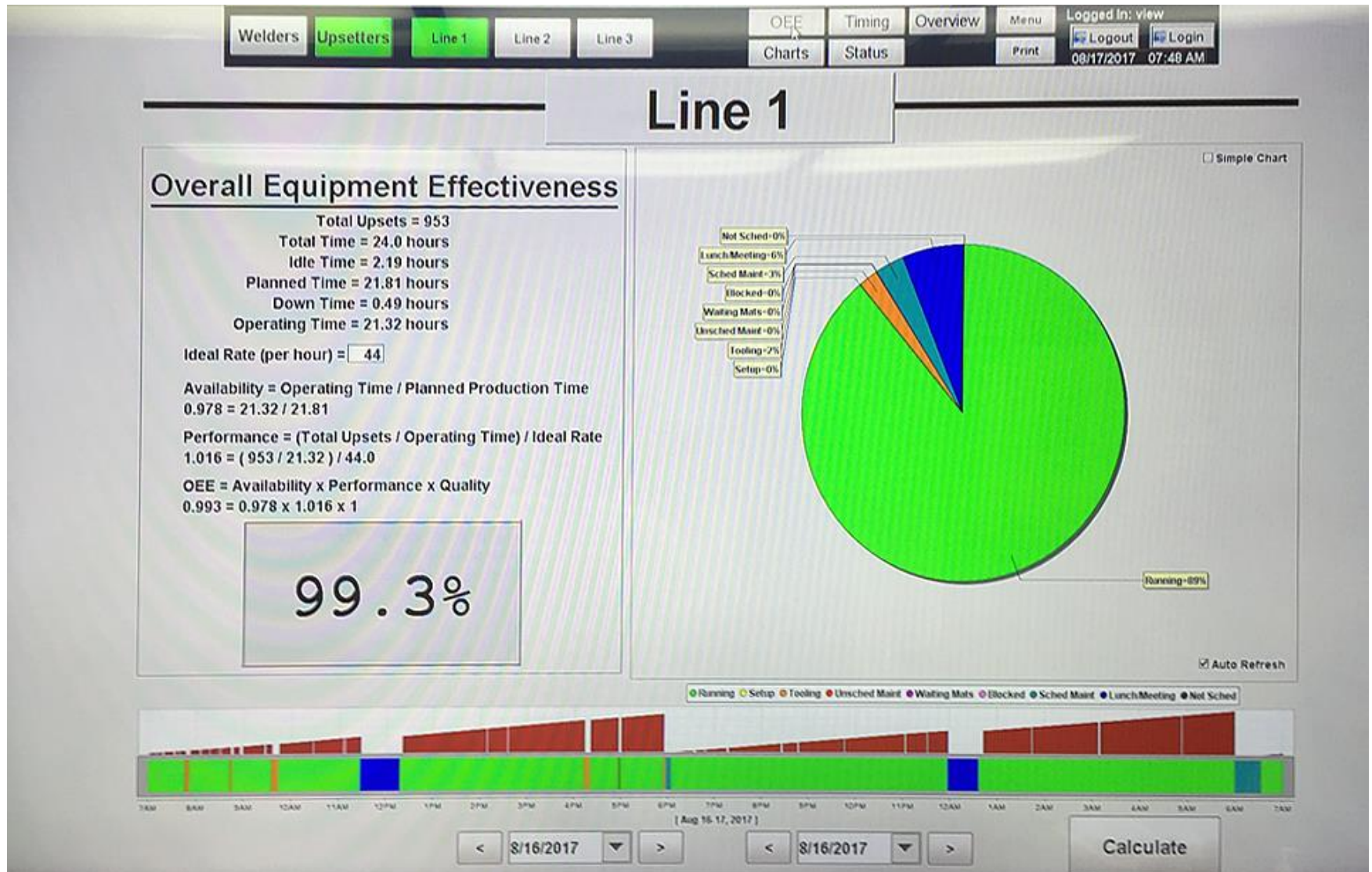
% Planned vs Unplanned



Undo Redo Revert Refresh Pause

Share Download

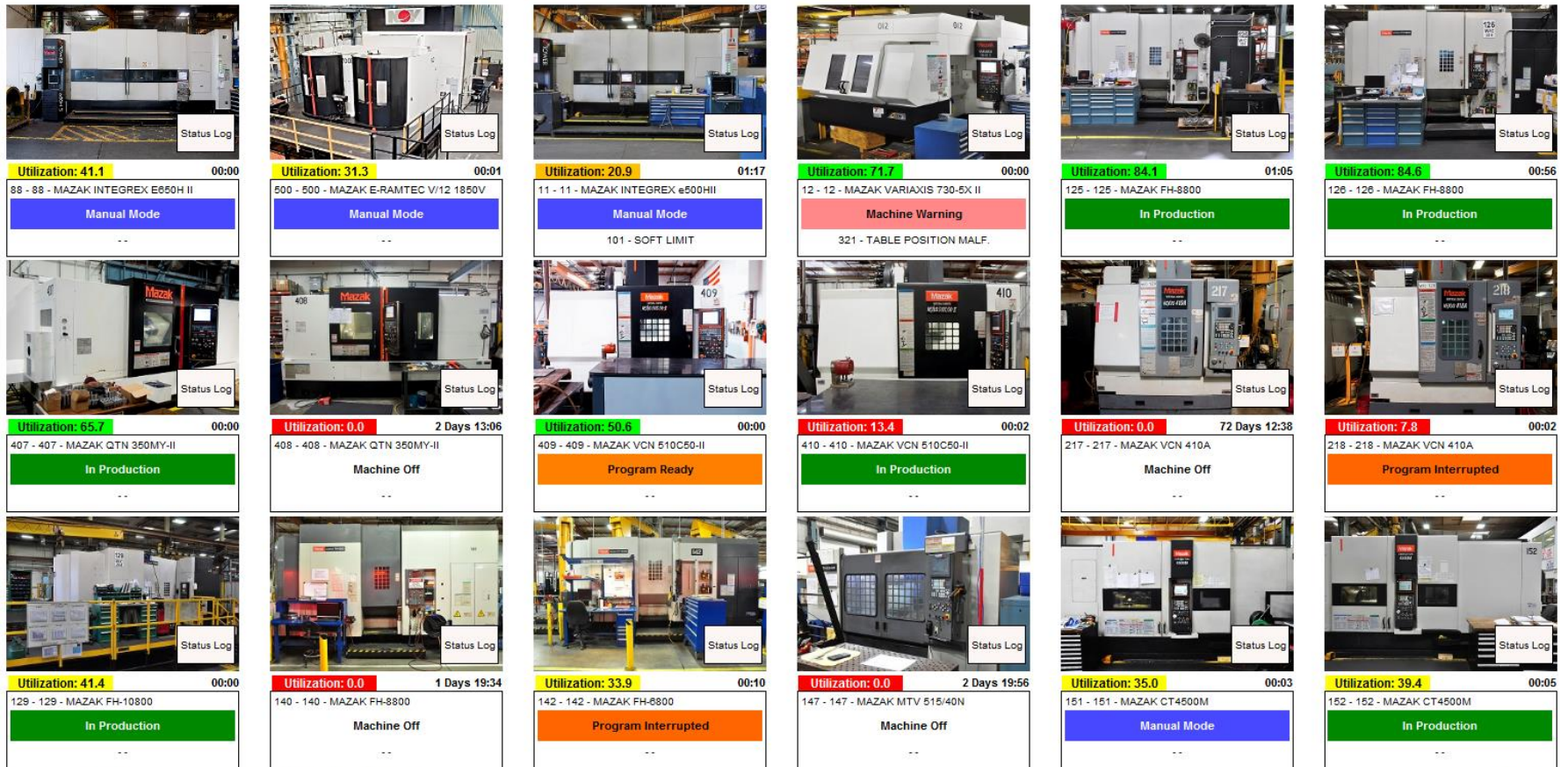
OEE



Orange - Mazak FCA750PY-N3B



Orange Overview



Operating States Legend:

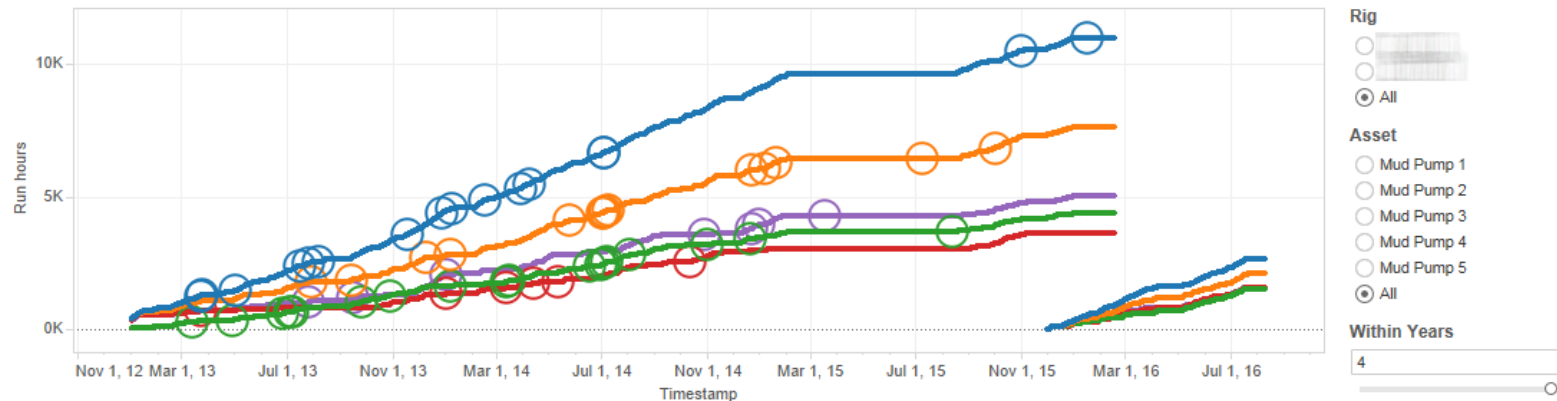
Production	Reduced Production	Maintenance	Program Interrupted	Break
Setup / Manual	Machine Problem	Idle / Undefined	Program Ready	Machine Off

Current Shift
Utilization: 34.0 %

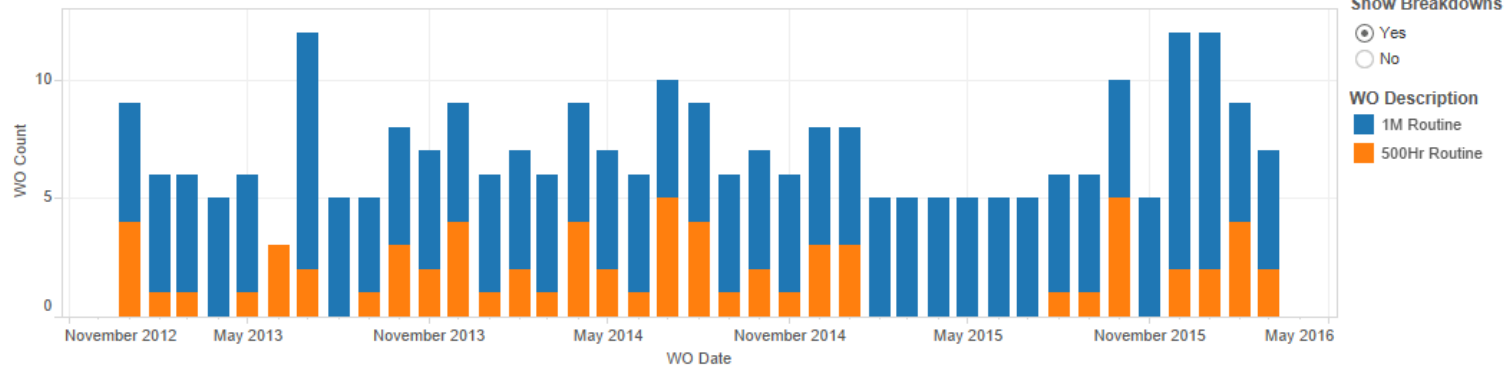


Day-Driven vs. Usage-Driven Maintenance Study

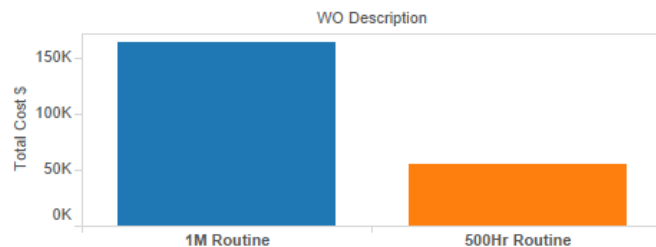
Mud Pump Maintenance Savings



1M vs 500Hr Routine Maintenance



1M vs 500Hr Maintenance Cost

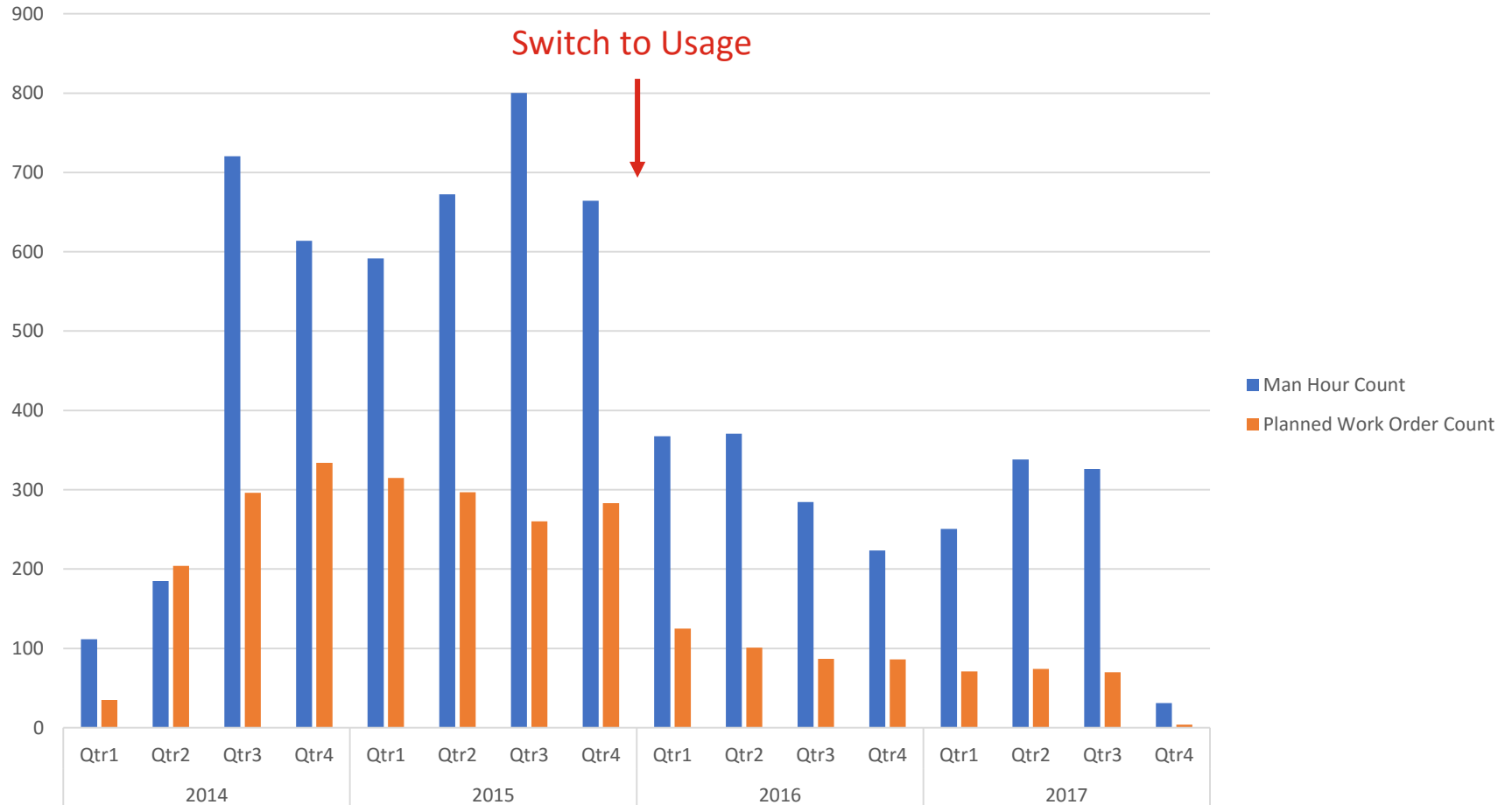


Savings from 1M to 500Hr

66.18%

\$108,000

Day-Driven vs. Usage-Driven Maintenance



Lessons Learned

- Prepare your machines for IoT now (e.g. network ports or wireless networks)
- Always get your corporate network security team involved whenever you connect equipment to your company network
- Develop/Buy/Rent computerized maintenance management system (CMMS) to log maintenance and failure data
- Perform FMECAs on your most critical equipment
- Try to store any type of data from your machines that you can get; for new machine purchases, check whether they support MTConnect for easy data access
- Switch to usage-driven maintenance
- Never Settle!

Lessons Learned

- Uptime and reliability is fun
- Plants want to be cool
- Technology exists
- Show them the money!!!
- We have no more excuses:

Insert Your Company Here



JUST DO IT

Questions?

