



Maximo Auto Work Orders

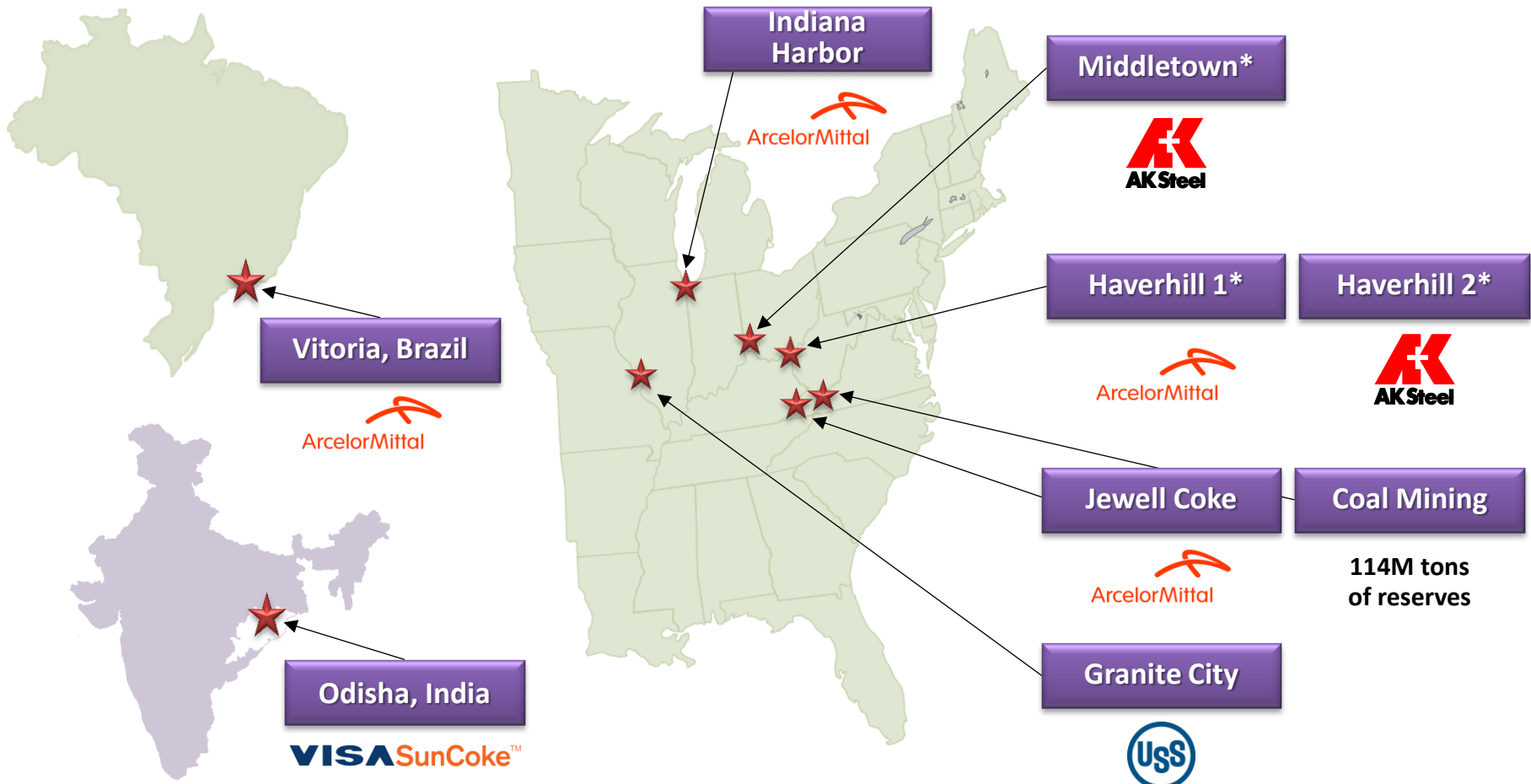
Using PI as the data source

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- Introduction to SunCoke
- Case 1: Auto-Generated PM based on Equipment Runtime
 - Project Overview / Goals
 - Data Flow
 - Maximo Meter and Metered PM Review
 - Project Review
 - Learnings
- Case 2: Event based Auto-Generated Work Orders
 - Project Goals
 - Technical Concepts
 - Using PI as the decision maker
 - Project Review
- Key Differences Between Case 1 and Case 2

Our cokemaking operations are strategically located in proximity to our customers' integrated steelmaking facilities



*65% owned by SXCP

- May 2009 - Maximo Project is approved
- October 2009 – implementation of v7.1.1.5 at first coke manufacturing plant.
- June 2010 - implementation at last coke manufacturing plant
- August 2010 – implementation at corporate office
- June 2012 – upgrade to O&G v7.1 industry solution
- August 2012 – implementation at coal mining operations
- April 2013 – upgrade to Maximo v7.5 / O&G v7.5

- https://www.youtube.com/watch?v=_rIQxXp2lQg

- What:
 - Automate Maximo Procedures
 - Utilize process information
 - Integrate data source (PI) into Maximo
- Why:
 - Improve Maximo record consistency and accuracy
 - Decrease delay and variability in record creation
 - Allow intelligent creation of Maximo records
 - Improve PM efficiency using live run time values
 - Reduce administrative effort adding work orders
 - Fill in repetitive information, automate location, etc
 - Increase value in historical data
 - Less dependent on individual people, reduce variability of data
 - Within site and across fleet

- **Project Team**
 - Reliability Engineer
 - Maximo Administrator
 - PI Administrator and Contractor
 - Production and Maintenance Coordinator
- **Goal: Generates PM work orders based on machine run hours**
 - No PM Work orders for idle machines
 - Ideal for redundant machinery
- **Eliminates unnecessary maintenance**
 - Although the meter is continuous, the cycle is reset to the current meter reading when the PM is complete

Instrument Data

- Instrument Information
 - Equipment Runtime for Crusher 1 and 2
- Data goes to OPC server from PLC/DCS


Data Repository


- PI queries OPC for meter data
- Stores runtime information
- Sends meter reading to Web Service


Maximo


- Web Service between PI and Maximo
 - Sends Meter info to Maximo
- Maximo creates PM if criteria is met


- Set up a meter
- Add the meter to a location
- Determine Meter Type, Reading Type, Unit of Measure

Meter: 

Meter Type: 

* Reading Type: 

Domain: 

Unit of Measure: 

- Key fields when adding a meter to a location
 - Use Last Work Order's Start Date to Calculate Next Due Date
 - Generate Work Order Based on Meter Reading
 - Frequency
 - Generate Work Order Ahead By

Work Order Generation Information

Use Last Work Order's Start Date to Calculate Next Due Date? Generate Work Order Based on Meter Readings (Do Not Estimate)?

Generate Work Order When Meter Frequency is Reached?

Time Based Frequency | Meter Based Frequency

Meter Based Frequency Filter > 1 - 1 of 1 Download

Meter	Description	Frequency	Units to Go	Generate WO Ahead By	Alert Lead
CRUSH1T-HR	Hourly Meter for Crusher 1-JS	1,350.00	988.00	350.00	

Details

* Meter: CRUSH1T-HR >> Hourly Meter for Crusher 1-JS Average Units/Day: -23.32


Frequency: 1,350.00 Rollover:

Alert Lead:

Generate WO Ahead By: 350.00

Crusher Meter based PM's

- Grease Feeders 400 hrs.
- Precision Grease Crusher Bearings 720 hrs.
- Inspect Breaker Plates 2200 hrs.
- Inspect Coupling 2200 hrs.
- Change Motor Bearing Oil 2200 hrs.
- Clean/Overhaul Motor 17000 hrs.

PM 	Description	Location	Location Description
8668	GREASE CRUSHER FEEDER #1	FD-26-07	FEEDER _z #1
8669	GREASE CRUSHER FEEDER #2	FD-26-08	FEEDER _z #2
8670	GREASE CRUSHER BEARINGS #2	CU-2302	COAL CRUSHER #2
8671	GREASE CRUSHER BEARINGS #1	CU-2301	COAL CRUSHER #1
8672	INSPECT CRUSHER #1 & QTRLY CHECKS	CU-2301	COAL CRUSHER #1
8673	INSPECT CRUSHER #2 & QTRLY CHECKS	CU-2302	COAL CRUSHER #2
8674	CLEAN AND INSPECT CRUSHER MOTOR #1	MT-23-01	MOTOR, AC, CRUSHER #1
8675	CLEAN AND INSPECT CRUSHER MOTOR #2	MT-23-02	MOTOR, AC, CRUSHER #2

Select Records

- PMs were created and work orders were generated in the QA area of Maximo.
 - No redundant work orders were generated while a previous work order was still outstanding.
 - Test procedure put together before testing
- Meters can be managed and reset if necessary
 - A meter may need to be reset if the machine is replaced or overhauled
- Lead time – intended to provide sufficient advanced notice to complete PM on time
 - Minimum lead time – 1 week
 - Lead time not to exceed 50% of PM cycle time
 - 400 hour PM, lead time <200 hours

- The operating hours recorded by Maximo was not being updated.
 - The PLC was rebooted and reinitialized the counters
 - The values passing through the system to the Maximo server were less than the values recorded by Maximo therefore, Maximo did not update.
 - Update the counters in the PLC
 - Maximo retains the most recent reading from the PLC. Update the reset PLC counters by the amount recorded in Maximo plus the current value of the counters.

- What:
 - Automate Work Order entry into Maximo
 - Utilize process/status information to identify failures
 - Integrate data source (PI) into Maximo to create work orders
- Why:
 - Improve work order creation consistency
 - Time to identify failure / input work order
 - Data input into work order
 - Failure status
 - Decrease work order entry delay
 - Reduce administrative effort adding work orders
 - Fill in repetitive information, automate location, etc
 - Increase value in historical data
 - Less dependent on individuals people, reduce variability of data
 - Within site and across fleet

PI to Maximo Connection (Overview)

Instrument Data

- Instrument Information
 - Thermocouple Temperature
 - Equipment Runtime
- Potential for failure logic to reside in DCS/PLC

Data Repository

- PI
- Stores information
- Also capable of logical analysis / failure recognition
- Queries Maximo for current work orders

Maximo

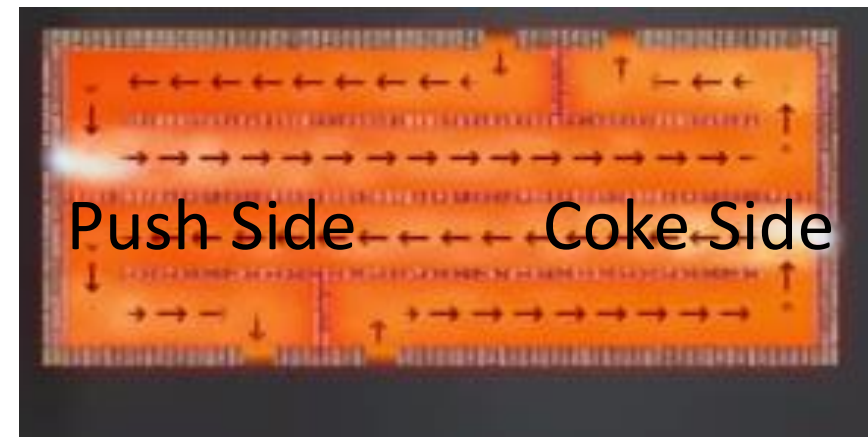
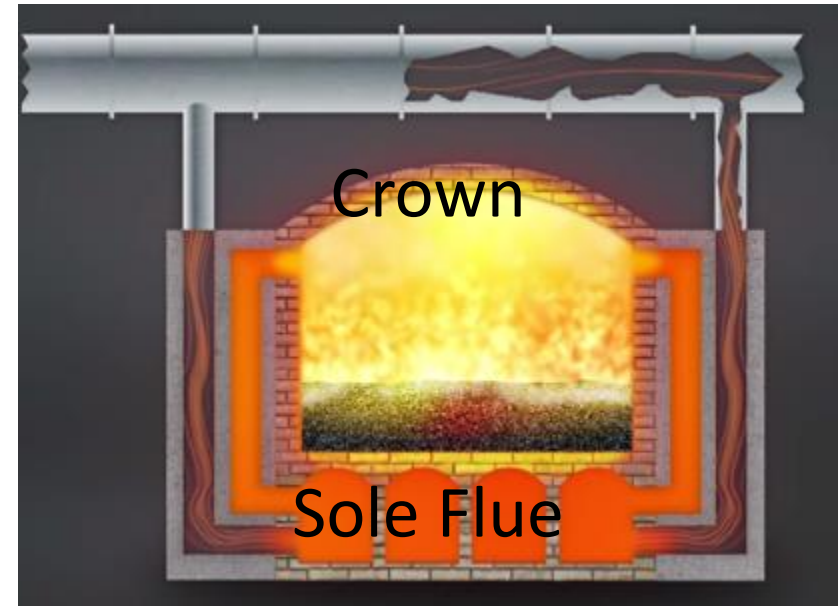
- Web Service between PI and Maximo
- Maximo creates work orders as requested by Data Repository

- Project Team
 - Reliability Engineer
 - SAP Administrator
 - PI Administrator and Contractor
 - Production and Maintenance Coordinator
- Use existing data in PI to automated work order creation for failed thermocouples
- Demonstration of Event Based Work Order Creations in Maximo for SunCoke

- Thermocouples are used to record temperature levels in high temperature areas
- High temperatures can damage refractory by weakening or melting the material
- Low temperatures can damage refractory through cracking if temperature change is too quick or severe
- Oven temperature is also critical in understanding and optimizing the process of Coking Coal
- Thermocouples have a high failure rate due to the hot and corrosive environment they experience

Case 2: Thermocouple Information

- High Temperature Thermocouples in a hot and corrosive environment
- 3 per oven
 - 1 in center of Crown
 - 1 on each side of Sole Flue
- SunCoke Sites range from 100 Ovens to 268 Ovens
 - 300 to 804 Thermocouples per site
- Critical for process control and for asset protection
 - High Temperatures can damage refractory
 - Quick decrease in temperature can cause cracking to refractory
- Oven has no moving parts, but is our highest value asset



DCS

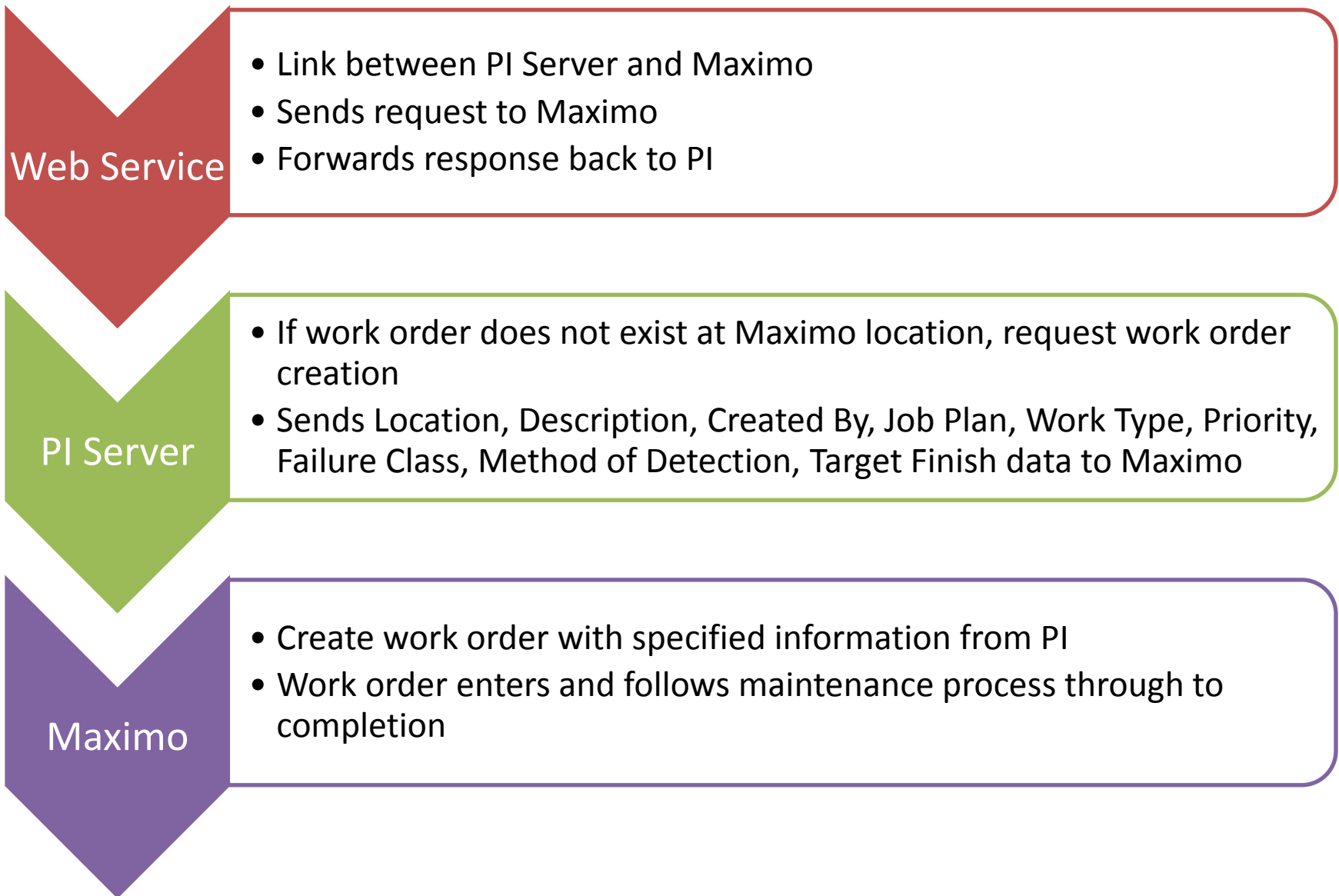
- Constant reading of TC temperature
- Failed TC - DCS tag value read as 'Equip Failure'

OPC Server

- Provides connection to allow query of DCS tags

PI Server

- Queries and stores TC status
- When status is 'Equip Failure'
 - Queries Maximo to determine if Work order exists

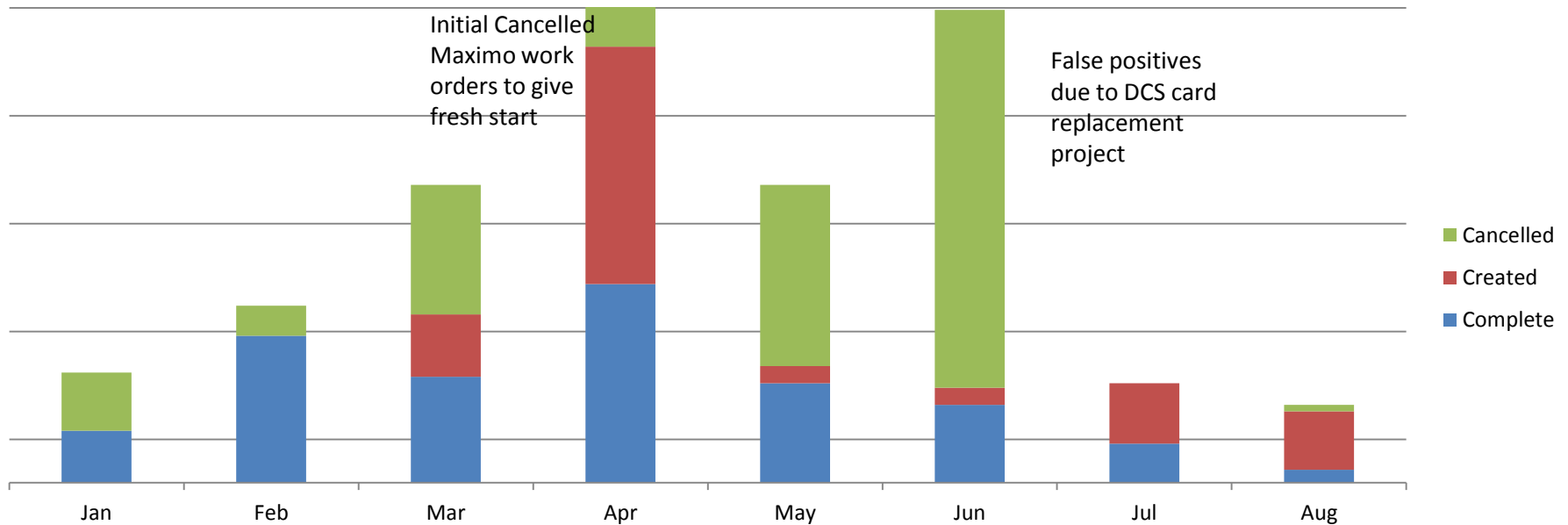


- Identify Potential PI data
 - Analyzed potential PI data to determine accuracy in creating failures
 - Was able to piggy-back off previous efforts to identify failures and send PI email notifications
 - Note: Using existing information was valuable, but need to properly vet differences in data and impact on outcome
 - Specified PI notification creation logic (TC < 1500 degrees or value reads 'Equip Fail')
- Test PI Notification settings
 - Set up notification logic as an email notification
 - All failures the system recognized caused an email notification
 - Set up inbox filter to automatically archive emails
 - Downloaded all emails into excel and formatted into excel table
 - Analyzed email information to recognize initial work order creation time, filter out duplicate work orders
 - Used PI Excel tool to verify creation date/time was a valid failure state in the PI data

- Test PI Notification
 - Multiple records created for same location due to intermittent failures
- Set up PI to Maximo Interface
 - Done concurrently with PI Notification testing
 - 3rd party contractor set up the Web Service / PI-Maximo communication
- Set up Maximo Work Order Values
 - Defined desired behavior for Maximo fields and added to PI reference table
- Test in Maximo QA server
 - Created a couple PI automated work order locations to test behavior
 - Used bad actors to ensure multiple failures during test period
 - Verified that duplicate PI email notifications were sent, but only the first event created a Maximo work order
 - Confirmation that the Maximo query/PI logic worked as desired
 - Verified all data going to work order was as expected from PI
 - Verified via work order creation date/time and PI tool that work orders were created for actual TC failures
 - Added remaining TC's to the PI system

- IT and IHO approval to implement
- Move from Test to Production Maximo Server
 - Moved the Web service to point to Maximo Production instead of Maximo QA
 - Tracked all work orders created by the PI Auto system, and removed associated work orders for TC's already in system
 - Gave system a fresh start with PI Auto Work orders

IHO 2014 TC Status




Example of PI data for failed TC





Work Order Created

- Description, Location, Asset, Attachment, Work Type shown below

List	Work Order	Plans	Assignments	Related Records	Actuals	Safety Plan	Log
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Work Order: 419064 • Push Thermocouple needs inspected/repaired 

Location: TE-B46-01 >> THERMOCOUPLE, TYPE B, PUSHER SIDE 

Asset: 45548 >> THERMOCOUPLE, TYPE B, PUSHER SIDE 

Parent WO: >>

Failure Reporting	Specifications	Details	Regulations
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Site: IH

Class: WORKORDEF

Work Type: CM 

GL Account: 769-164-2160-70075-00000 

Attachments 

Status: COMP

Status Date: 7/21/14 9:49 AM

Inherit Status Changes?

- Careful of repurposing data
 - Many of the implementations we are looking at doing are based on some manual system already in use today
 - This data can be very close to ready for PI – Maximo implementation
 - Careful to recognize assumptions that were made to make the data work in a manual type process
 - Identify areas of ambiguity or potential improvements that can be made
 - Example: IHO TC data was originally set up for emails, and was set up to try to limit the sheer number of emails
 - This became obsolete with the Maximo Query PI made
- Work closely with Maintenance personnel who will use the data
 - To be a success they have to find value in the work, where possible tailor the data to fit their needs

- Case 1 allows Maximo to be the intelligence behind the system
 - PI simply feeds a run time value sent from a counter in the DCS/PLC to Maximo
 - Maximo makes the decisions
 - Is an active work order already created for this PM?
 - If no active work order should a new work order be created?
 - What is the target completion for the new work order?
 - All work order information determined by the PM set up in Maximo
- Case 2 leaves the intelligence in the DCS/PLC or within PI to make decisions
 - Maximo simply accepts data from PI through the Web Service
 - PI and/or the automation makes the choice on whether or not to create a work order
 - PI stores all the data that will feed into the Work Order and send to Maximo via We Service

- Questions?