



# Leveraging PI Asset Framework and PI Event Frames to Achieve Operational Excellence in Offshore Drilling

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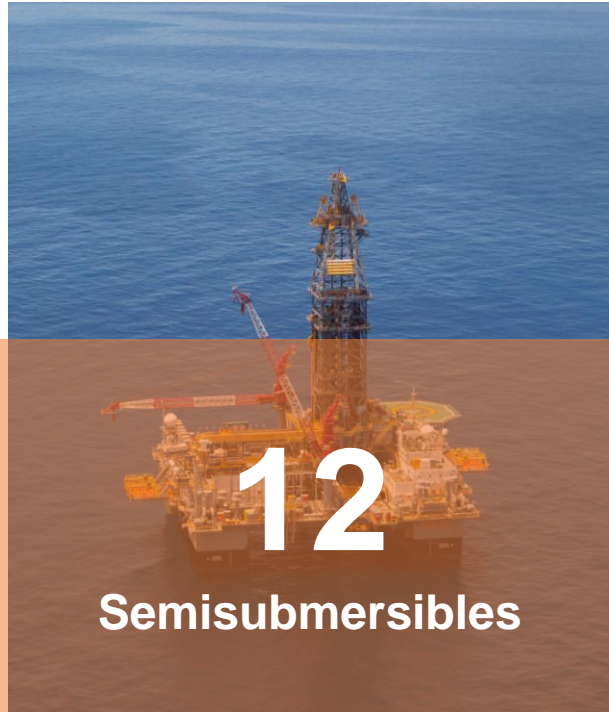
# Agenda

- About Ensco
- The Ensco Predictive Intelligence Center (EPIC)
- PI System Overview
- Benefits of using Event Frames
- Use Cases
  - Operational Performance
  - Equipment Test
  - Anomaly Detection
- Best Practices/Lessons Learned
- Summary
- Q&A

# World's largest offshore fleet



Drillships



Semisubmersibles



Premium Jackups

# About Ensco

- Operations span six continents
- Drilling experience in virtually every major offshore basin
- Headquarters in London and corporate office in Houston
- More than 40 patent filings since 2015

# The Ensco Predictive Intelligence Center

- Ensco's operation and condition monitoring tool.
- Ensco's business case is looking for bottom line results by:
  - Provide early warning of asset degradation
  - Determine the Remaining Useful Life of an asset
  - Reduce costs by optimizing asset selection and maintenance activities
  - Increase revenue capture by limiting unplanned downtime

Doing the right work at the right time  
based on the health of our assets

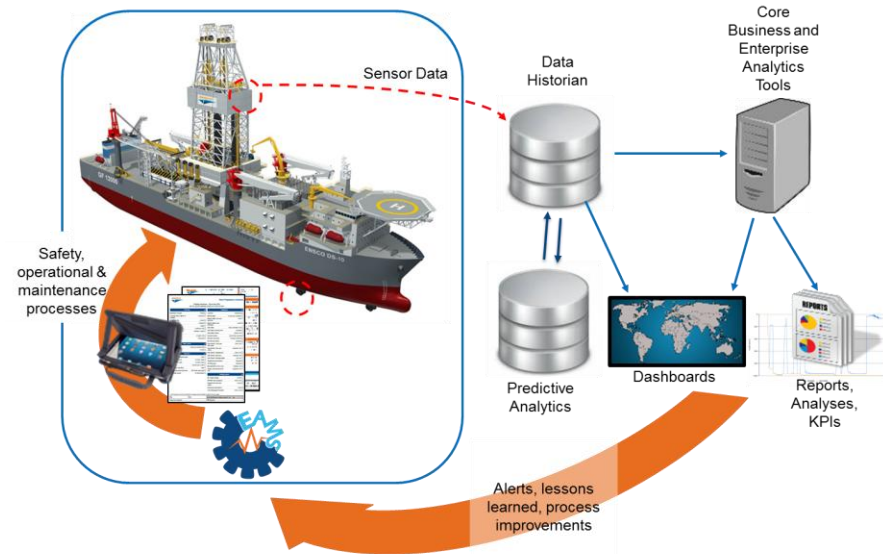
thereby,

increasing operational uptime and  
decreasing lifecycle costs



# The Ensco Predictive Intelligence Center

- PI System collects control system and sensor data on board our rigs and streams it back to shore in real time
- Static Data is also collected from corporate databases and reports, also stored on PI linked in PI AF using tables and RDBMS Interface
- Data is processed in Asset Framework, using Asset Analytics
- A Machine Learning Engine works on top of PI System consuming its data and writing back its results as additional tags
- PI System uses these outputs combined with sensor data and Asset Analytics calculations to generate Event Frames as well as Notifications



# Ensco's PI System Overview

13

Rigs

1.5

Years

+900K

Tags

+15K

Elements

+40K

Analysis

+3M

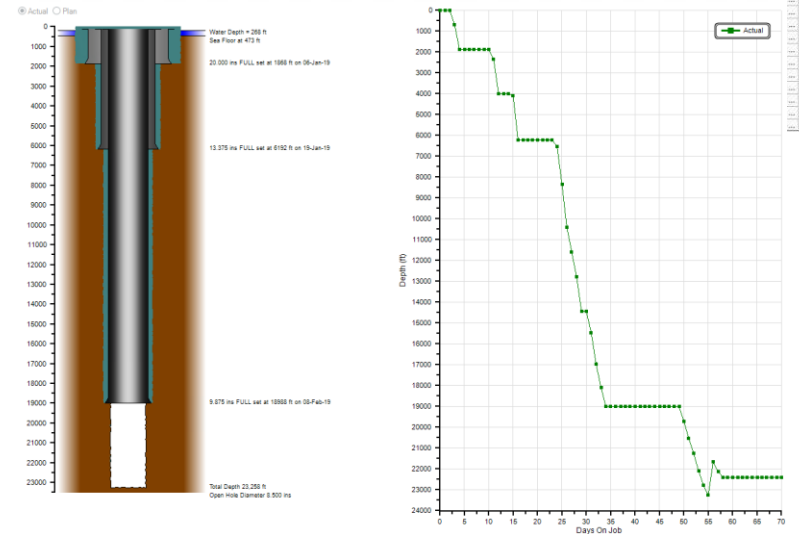
Event Frames



# Why Event Frames?

- Offshore Drilling is an event based business.
- Storing data in events helps to compare and find patterns
- Asset Cycles are better understood when stored in events
- Event Frames to store data of Critical Asset testing can be a powerful tool
- Event Frames enable the use of PI Notifications

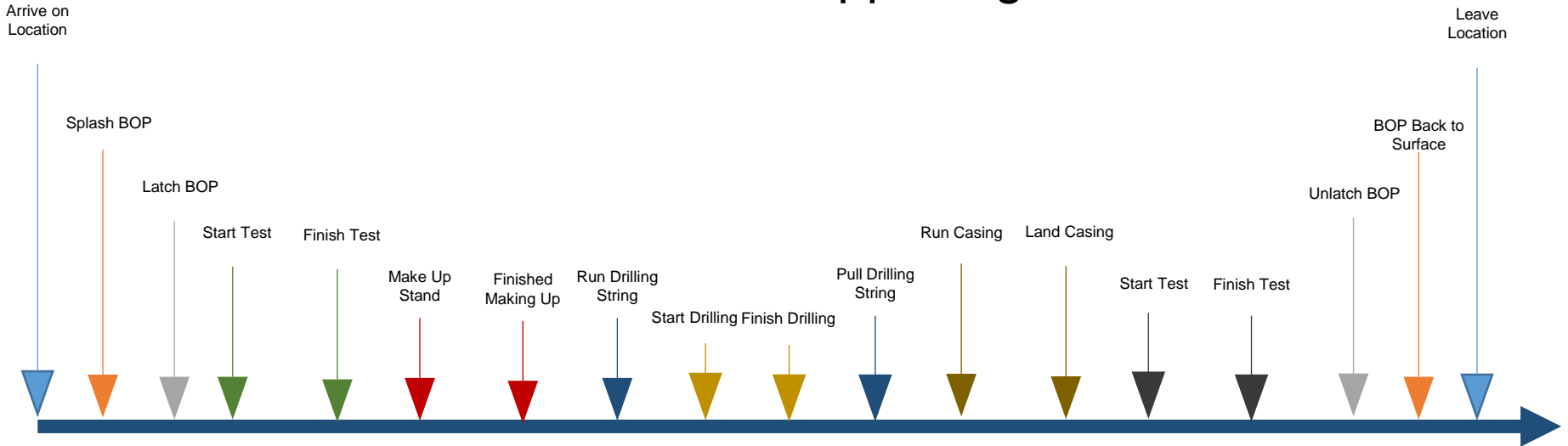
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11687	147:8:46:47.264	11/8/2013 12:00:00 AM	4/9/2014 9:46:47.265 AM	4/9/2014 9:46:47.265 AM	DS-8	3/26/2018 4:15:36.847 PM	9/30/2018 6:23:45.152...	





# Why Event Frames?

Because Offshore Well construction is a combination of several event frames happening over time



# Benefits of Event Frames

What was my Rig's...

Drilling Performance in the previous Well?

Safety Record in the previous well?

Downtime Hours in the previous well?



# Use Cases

- Blowout Preventer Run

## Background

- Running a Blowout Preventer on an offshore drilling Rig is a very important operation that involves several risks
- Rig Personnel, Office and Client need to be informed during the operation

## Solution

- Create physics based model that detects when the BOP is splashed and initiate the event frame
- Using PI Notifications, alert relevant personnel that the BOP run has begun
- Create physics based model that detects when the BOP lands and the event has finished

## Results

- The recorded Event Frame stores the data of the BOP run
- Proven high performance can lead to revenue bonuses.
- The notification alleviates managers from constantly calling the rig asking for statuses

# Use Cases

- Asset Tests

## Background

- Well Control equipment needs to be tested periodically
- For maintenance purposes cycles need to be counted and segregated between different categories
- Pressure curves, flow rates and times need to be recorded

## Solution

- Create physics based model that detects when the test starts and record the variables of interest
- Create physics based model that detect the test ends
- Created logic to segregate between cycle categories

## Results

- Event Frames can alert us on the degradation of the closing cycle and the potential root cause
- Data stored can assist with operational decisions as well as defining maintenance tasks required after the well is completed

# Use Cases

- Asset Tests

**ENSCO**

**DS-10 BOP Information**  
ACTIVE POD

**BOP 1**  
Status: Offline  
Location: Offline  
Subsea Hours: 4,783.63  
LMRP # in Use: 1

**BOP 2**  
Status: Online  
Location: Subsea  
Subsea Hours: 505.41  
LMRP # in Use: 2

**Active POD**  
Can #1 Temp: 54.07 °F  
Can #2 Temp: 53.29 °F  
Can #1 Humidity: 23.43 %  
Can #2 Humidity: 0.00 %

**Event Log**

Event Name	Start Time	End Time	Duration	
Pump #3 Running	2018-05-11 15:57:57.775	3/11/2019 3:57:01 PM	3/11/2019 3:58:23 PM	28.027s
Pump #3 Running	2018-05-11 14:58:55.158	3/11/2019 2:58:55 PM	3/11/2019 2:57:33 PM	37.005s
Pump #3 Running	2018-05-11 14:08:38.411	3/11/2019 2:08:38 PM	3/11/2019 2:01:14 PM	35.012h
Pump #3 Running	2018-05-11 12:02:19.131	3/11/2019 12:02:19 PM	3/11/2019 12:02:04 PM	35.042s
Pump #3 Running	2018-05-11 11:22:24.803	3/11/2019 11:22:24 AM	3/11/2019 11:24:02 AM	38.004s
Pump #2 Running	2018-05-10 18:38:18.083	3/11/2019 10:38:18 AM	3/11/2019 10:38:39 AM	18.005s
Pump #1 Running	2018-05-10 18:38:01.802	3/11/2019 10:38:01 AM	3/11/2019 10:38:32 AM	31.001s
Pump #3 Running	2018-05-11 10:58:58.987	3/11/2019 10:58:58 AM	3/11/2019 10:58:52 AM	18.000s

**Main Page**  
EDS10 BOP 2  
Subsea

Time On Current Status: 526.55 h  
Accumulated Surface Hours

**Statuses**  
Choke/Kill Stabs: Green  
Blue Lower Female Sec. Cylinder: Green  
FSC Accumulators: Green  
Yellow Lower Female Sec. Cylinder: Green  
Acoustic Accumulators: Green  
Shear Accumulators: Green  
Orientation Pins: Green

**Event Log**

Event Name	Start Time	End Time	Duration
EXT / CHG / ARM			
RET / DIS / OMP			
BLK / ISO			

**Main Well**  
Well Depth: 11,800 ft  
Well Cylch: 0.0 ft

**Wellbore Temperature 1**  
32.0 °F

**Wellbore Pressure 1**  
0.0 psi

**BLUE SUBSEA FLOWMETER TOTALIZER GALLONS**  
0 gal

**YELLOW SUBSEA FLOWMETER TOTALIZER GALLONS**  
0 gal

**SURFACE FLOWMETER TOTALIZER GALLONS**  
0 gal

# Use Cases

- Anomaly and Early Failure Detection

## Background

- Normal equipment alarms are triggered when equipment has already reached a functional failure and an action must be taken
- Critical equipment that experiences these events can put us in a downtime situation (loss of revenue)
- Crews may only band aid the issue in order to get off of downtime

## Solution

- Create machine learning models with digital twins and run in parallel with the asset real time
- Trigger an Event Frame when the asset starts to deviate from its twin, but before alarms are triggered.
- Event Frame triggers a service request in the maintenance system

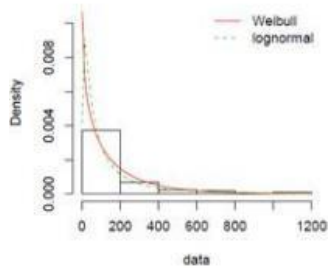
## Results

- Early identification of problems allows for proper planning and scheduling of work
- This results in reduced mean time to repair and avoidance of operational downtime

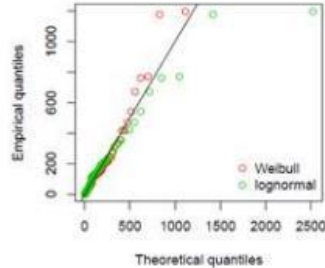
# Use Cases

- Anomaly and Early Failure Detection

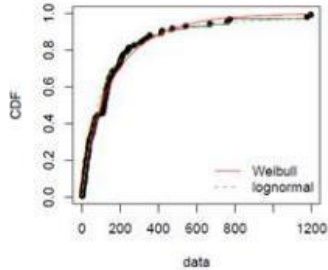
Histogram and theoretical densities



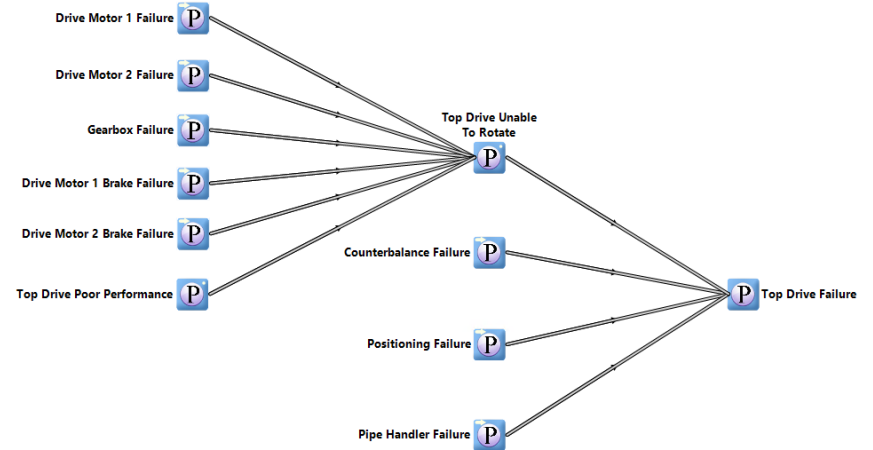
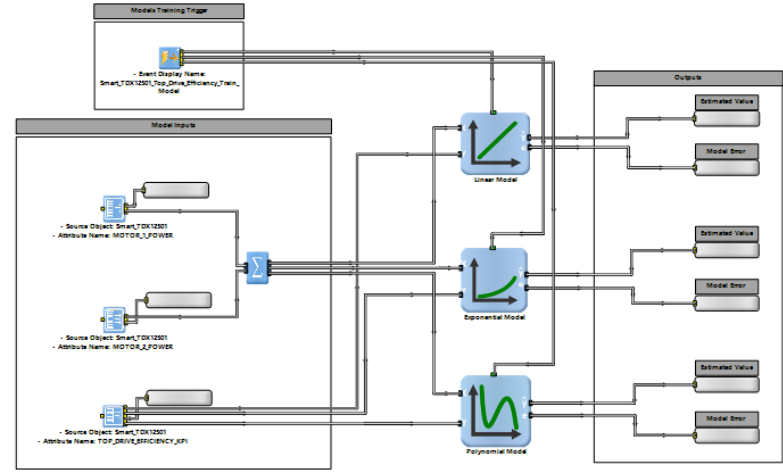
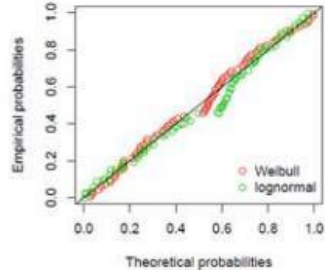
Q-Q plot



Empirical and theoretical CDFs



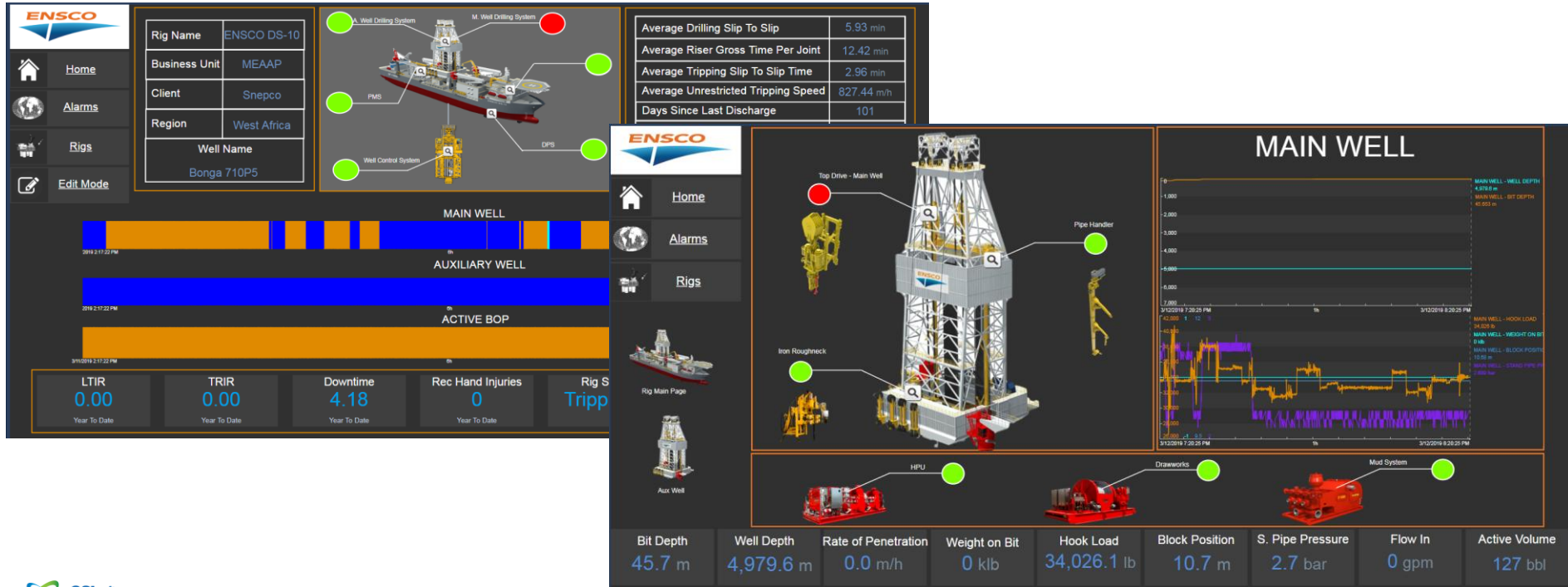
P-P plot





# Use Cases

- Anomaly and Early Failure Detection



# Use Cases

- Anomaly and Early Failure Detection



# Lessons Learned

- Define standards first.
  - Data quality
  - AF hierarchy
  - Asset Analytics
- Keep Calculations Efficient
  - Watch your Analysis service
  - Watch your lagging and skipping
  - Computing resources



The screenshot shows the E120 EPIC Health Monitoring software interface. It includes a dashboard with asset health indicators for Jack and Tank, a detailed analysis table for PI-to-PI, and a list of managed assets with their status and location.

Name	Value
Analysis Service Statistics	15/30/18 8:00:00 AM
Analysis Service Status	OK
Analysis Service Version	1.0.0
Analysis Service Path	C:\Program Files\EpicSoft\EpicSoft\AnalysisService\AnalysisService.exe
Analysis Service PID	1536
Analysis Service Parent PID	1536
Analysis Service Parent Name	AnalysisService
Analysis Service Parent Path	C:\Program Files\EpicSoft\EpicSoft\AnalysisService\AnalysisService.exe
Analysis Service Parent PID	1536
Analysis Service Parent Name	AnalysisService
Analysis Service Parent Path	C:\Program Files\EpicSoft\EpicSoft\AnalysisService\AnalysisService.exe
Analysis Service Parent PID	1536
Analysis Service Parent Name	AnalysisService
Analysis Service Parent Path	C:\Program Files\EpicSoft\EpicSoft\AnalysisService\AnalysisService.exe

# ENSCO

## Leveraging PI Asset Framework and PI Event Frames to Achieve Operational Excellence in Offshore Drilling



### CHALLENGE

How can Ensco reduce maintenance and overhaul cost and also reduce unplanned downtime

- Early identification of needed repairs
- Scheduling maintenance work around operational requirements

### SOLUTION

Implement the EPIC system which included use of the PI System

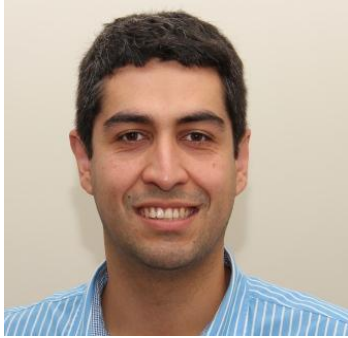
- Integrated PI System to predictive analytics system and the Maintenance System
- Capture important data using PI Event Frames
- Trigger notifications when warranted

### RESULTS

Efficiencies created within daily operations

- Removal of manual tasks
- Data helps to identify and repair true root cause problems
- Reduction of mean time to repair

# Speaker Information



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# Questions?

Please wait for  
the **microphone**

State your  
**name & company**



# Please remember

TO DOWNLOAD  
APP, SEARCH  
OSISOFT



謝謝 KEA LEBOHA  
 TAPADH LEIBH 고맙습니다  
 БАЯРЛАЛАА MISAOTRA ANAO  
 DZIĘKUJĘ CI NGIYABONGA TEŞEKKÜR EDERIM GRACIES OBRIGADO شكرا SALAMAT  
 DANKON TANK TAPADH LEAT  
 KÖSZÖNÖM DANKIE TERIMA KASIH GRACIES  
 СПАСИБО  
 ПАКМЕТ СІЗГЕ  
 GO RAIBH MAITH AGAT  
 БЛАГОДАРЯ GRACIAS MAHADSANID  
 ТИ БЛАГОДАРАМ  
 TAK DANKE MAHANSANID  
 RAHMAT MERCI  
 HATUR NUHUN  
 GRAZZI ПАККА ПЕР PAXMAT САГА  
 CẢM ƠN BẠN  
 WAZVIITA  
 FALEMINDERIT  
 ありがとうございました  
 SIPAS JI WERE TERIMA KASIH  
 UA TSAUG RAU KOJ  
 ТИ БЛАГОДАРАМ СИПОС  
 MULȚUMESC  
 HVALA FAAFETAI  
 ESKERRIK ASKO  
 HVALA ХВАЛА ВАМ  
 TEŞEKKÜR EDERIM  
 GRAZIE  
 DI OU MÈSI  
 ĎAKUJEM  
 MATUR NUWUN

