

Rig Performance Analytics The Integrated Approach

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The Sultanate of Oman
18th September 2019

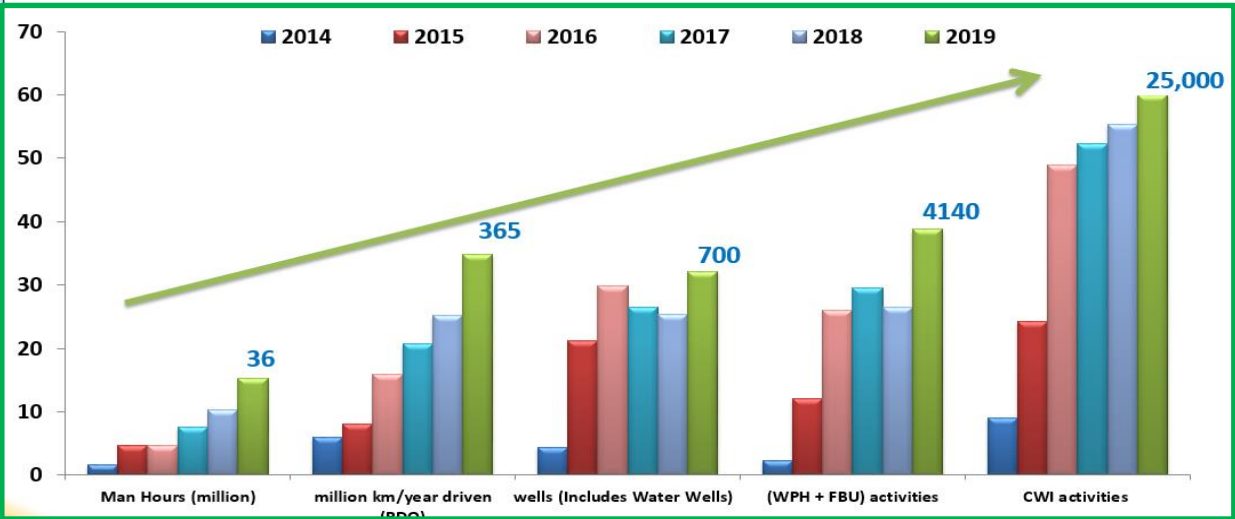
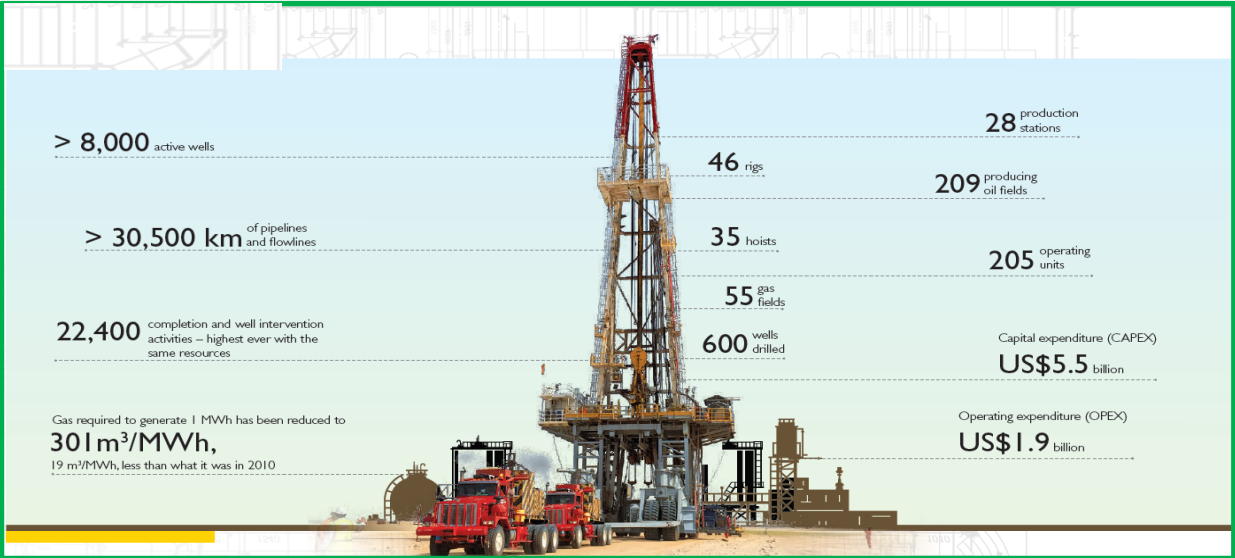
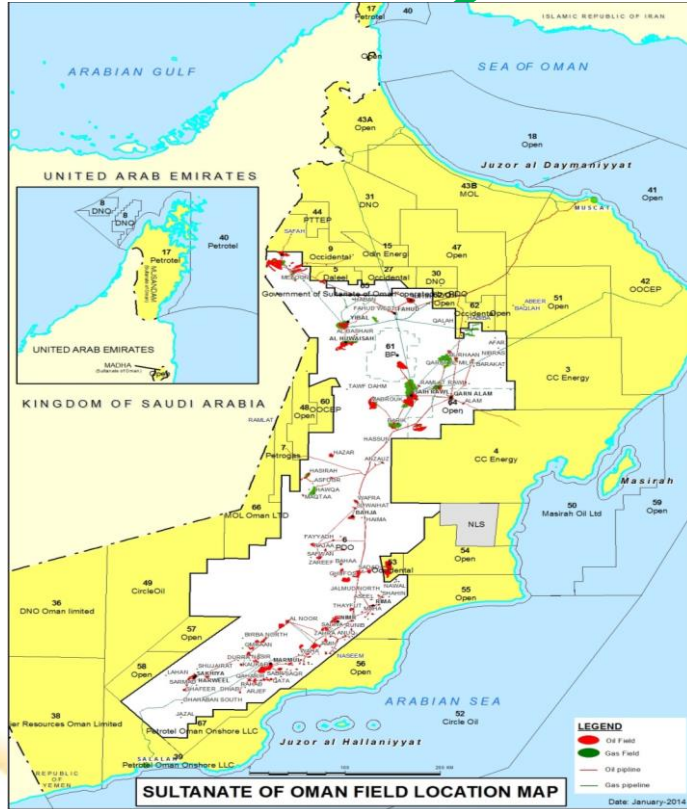
SIS Global Forum 2019



شركة تنمية نفط عُمان
Petroleum Development Oman

- PDO Operational Dimensions
- Well Engineering Digitalization Vision
- HSE & Operation Performance
- The integrated approach
- electronically Delivering the Limit (eDtL)
- RigHour in PDO, Value for Business
- Key KPIs and visualizations dashboards
- If you can measure it, you can improve it !
- Impact of Integrated Approach
- Way Forward

PDO Operational Dimensions



8500+ Employees

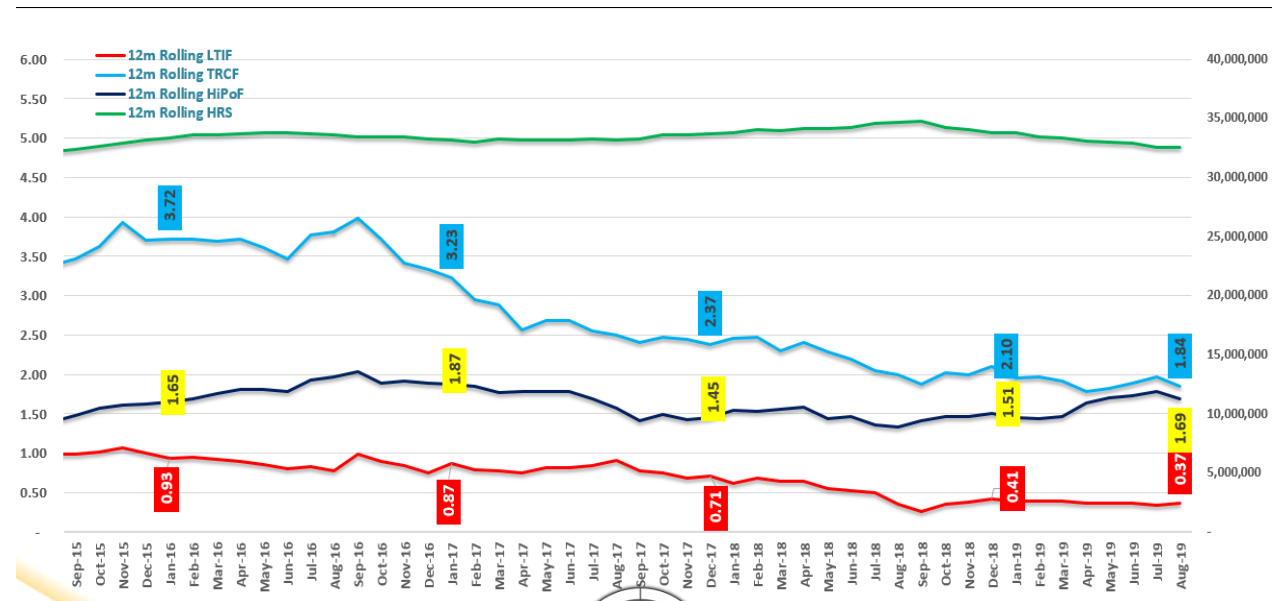
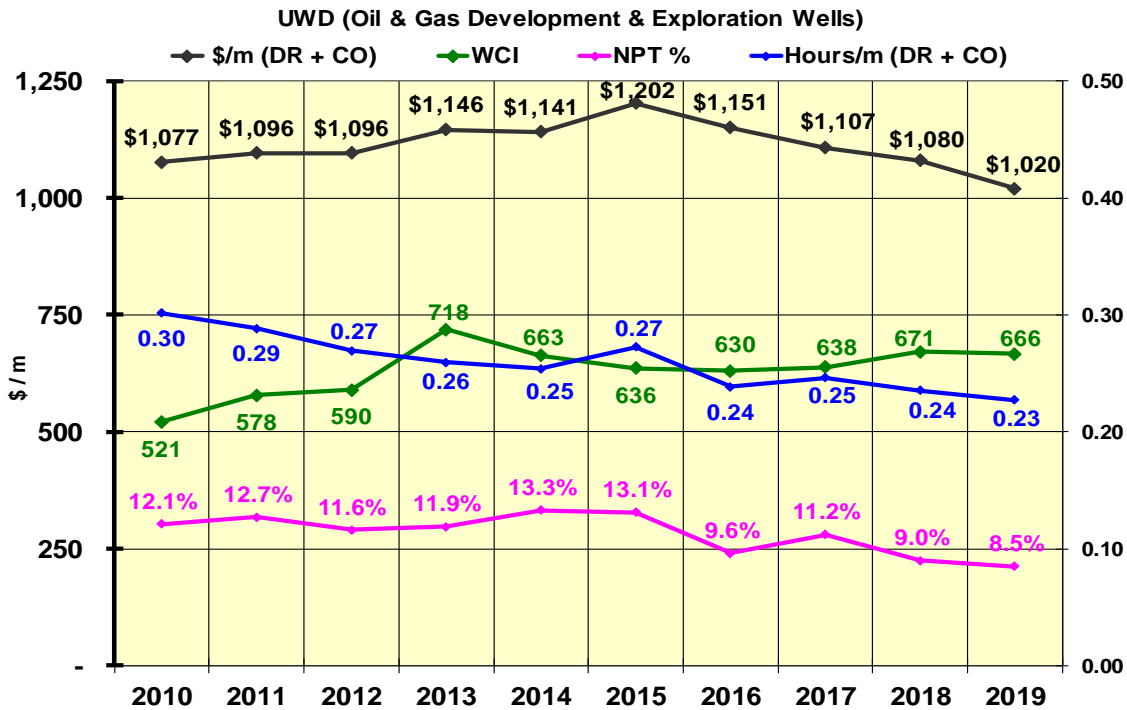
70+ Nationalities

70000+ Contractor

4 Women Directors

By 2030 We will **Safely Deliver our Wells at HALF the Current E2E Delivery **Time** and **Lifecycle Cost** while *Maximizing Well Availability* and the *Value of our People and Technology* and *creating a Self Assuring mindset***

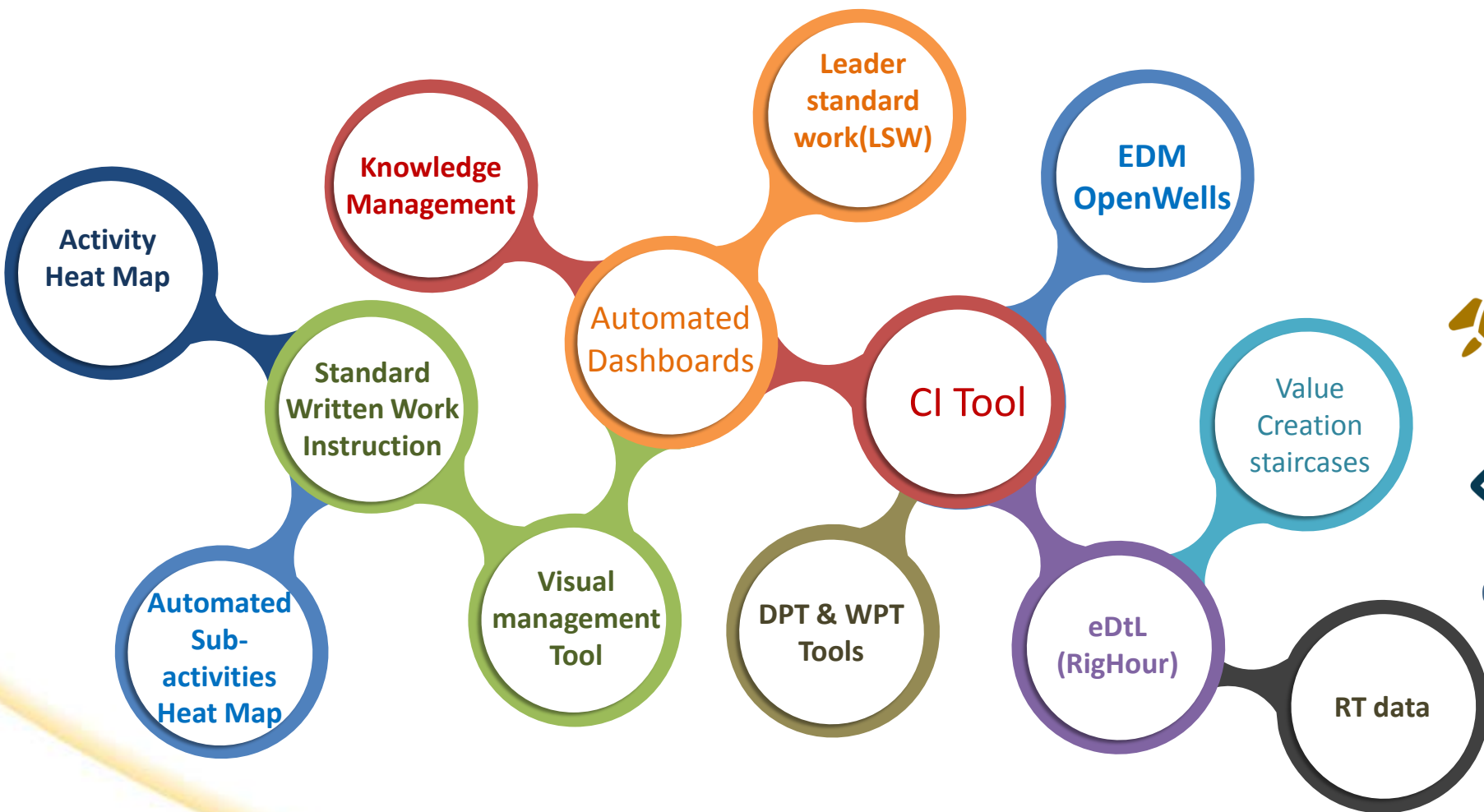
Well Engineering HSE & Operation Performance



Achieved the best ever cost/meter, through very efficient operation with an improvement of 4% time to drill a meter and lowest NPT record of 8.5%.

- FLS Academy
- IHTIMAM
- Journey Management center
- Safety Support Center
- HSE in Contract
- Assurance





Create competition at all levels in Wells: Team; units, contractor and crew



Embed GtP concept into day to day activity and performance improvements



Create a self-monitoring culture



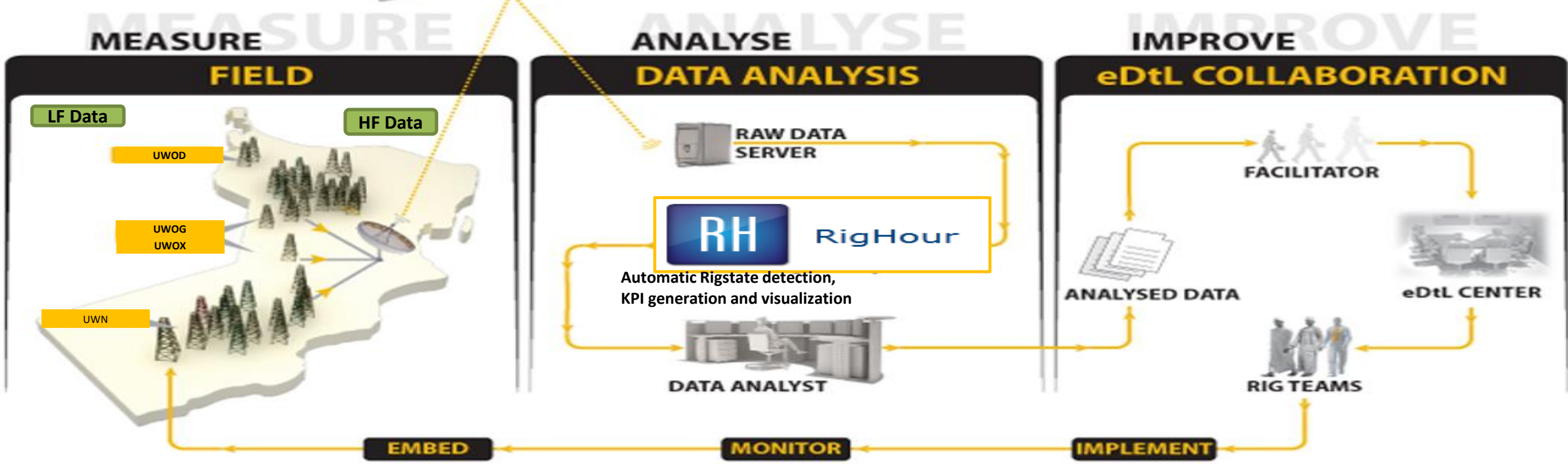
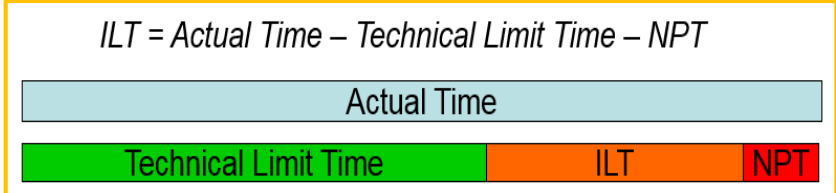
Data Quality check

electronically Delivering the Limit (eDtL)

eDtL is an automated electronic method of automatically detecting and analysing time based rig activities based on actual historical data

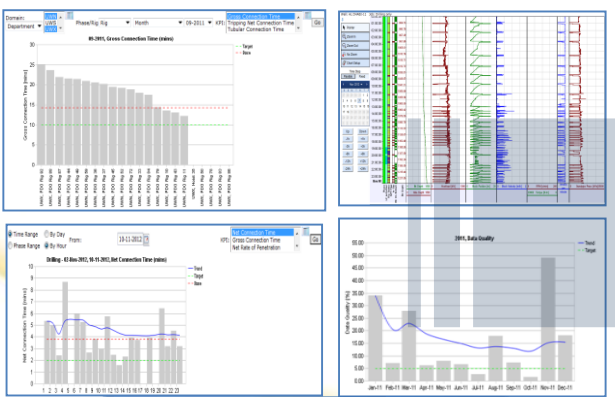
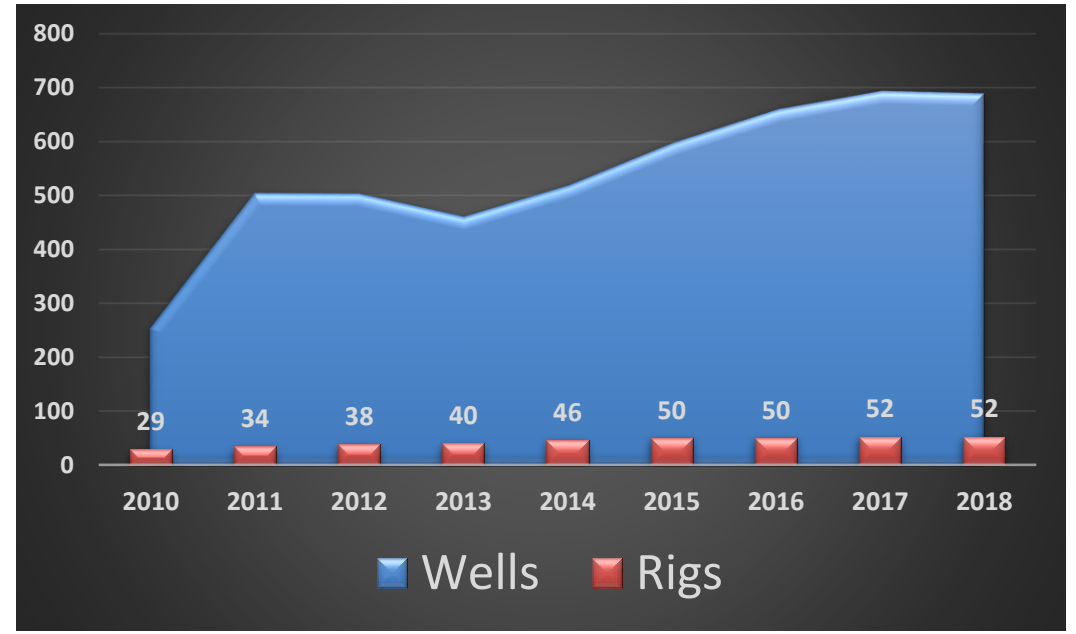
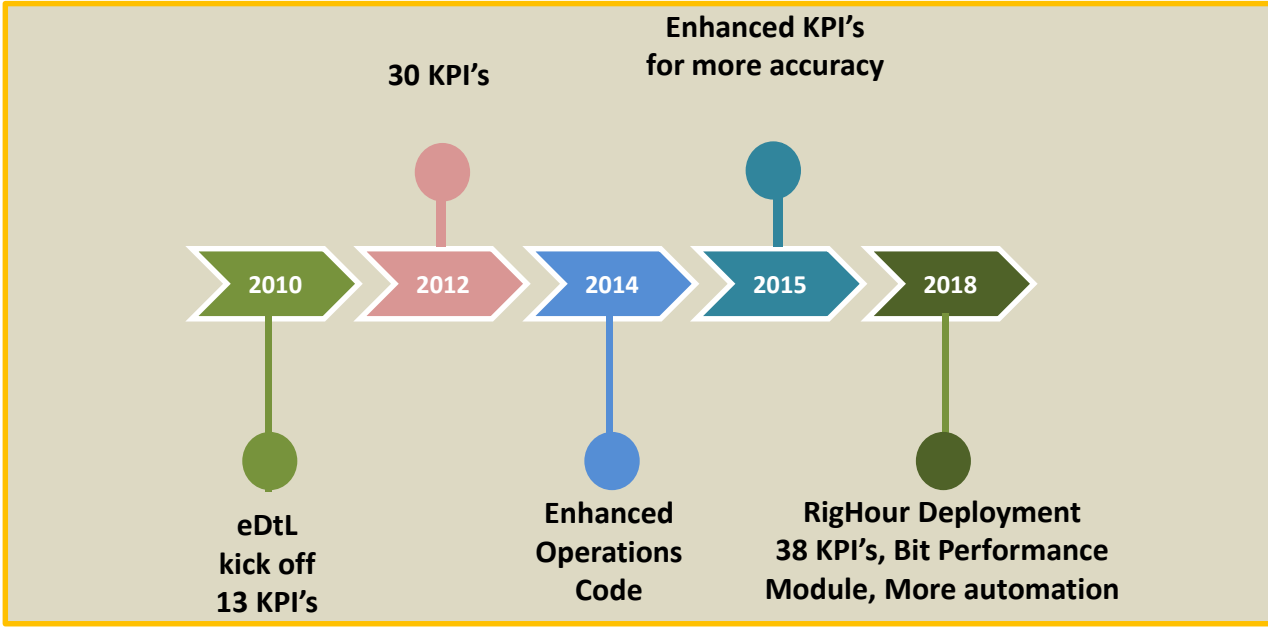
Objective

Performance improvement by reducing Non Productive and Invisible Lost Time

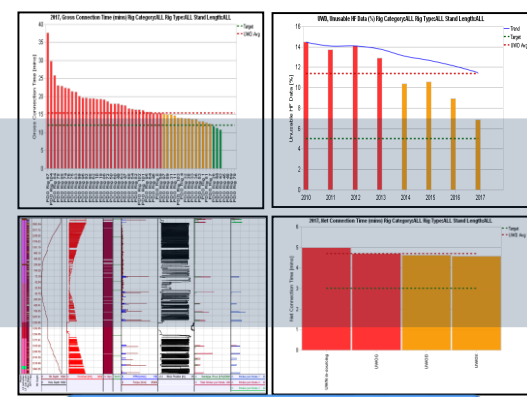


OPPORTUNITIES

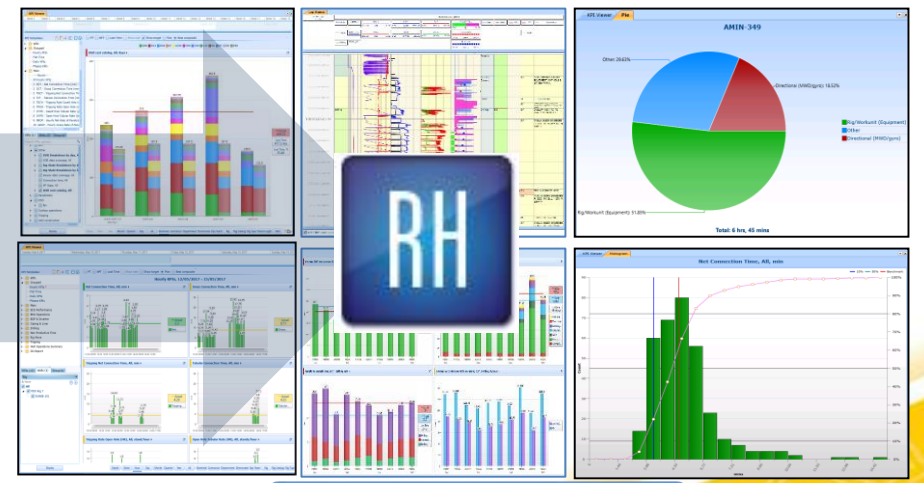




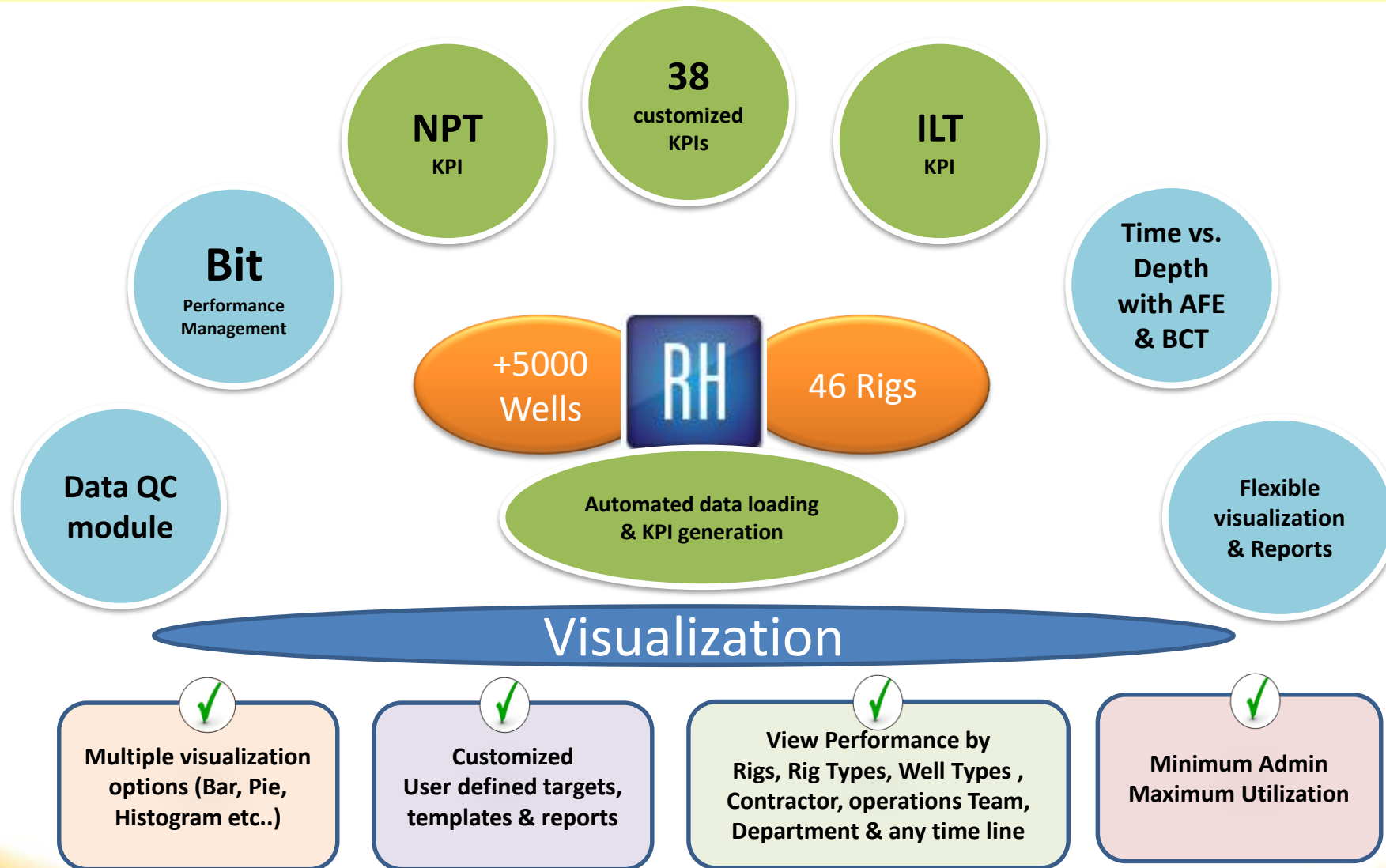
Osprey Operations Manager 2010

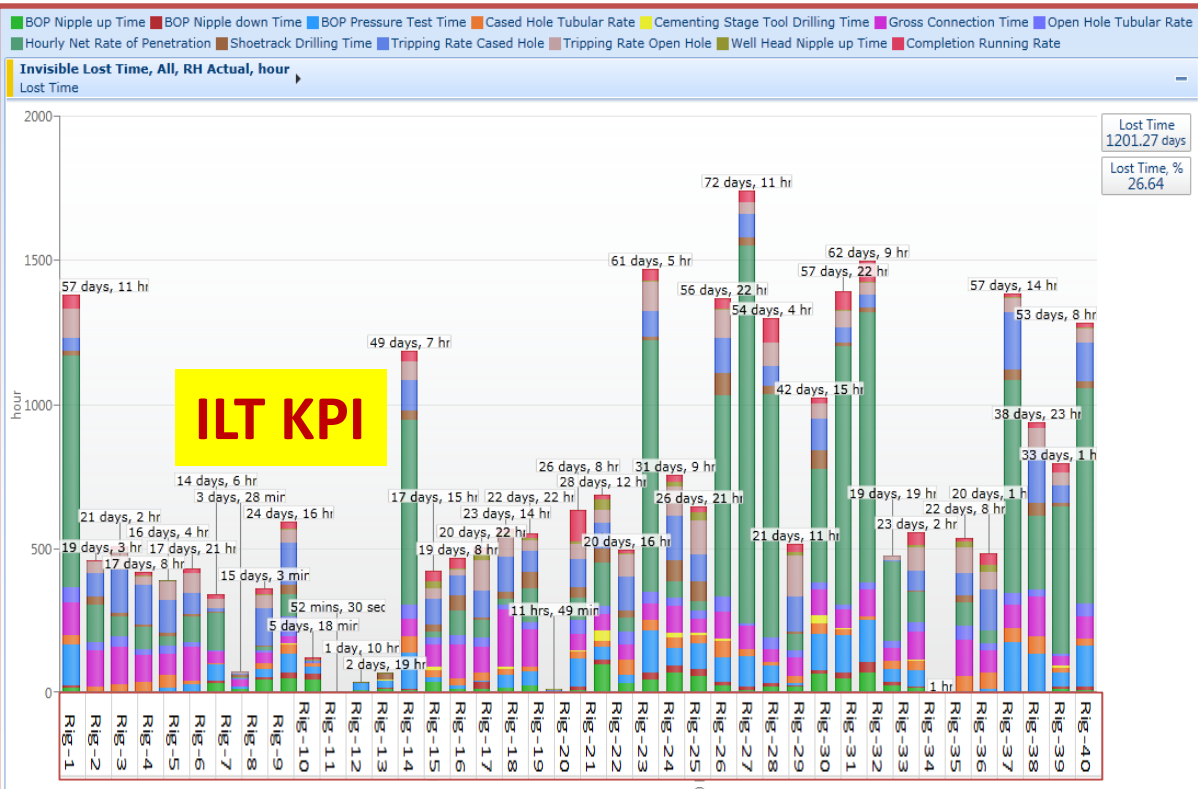


Osprey Operations Manager 2015



RigHour 2018

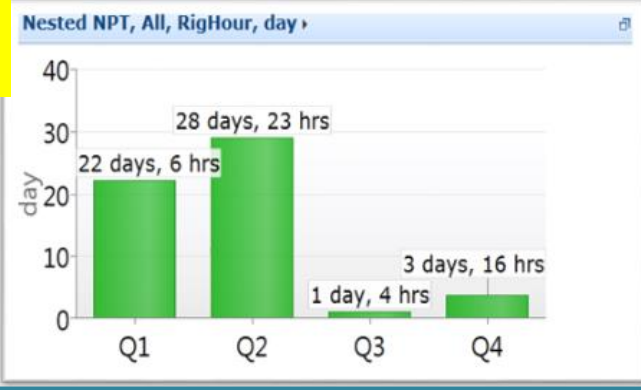
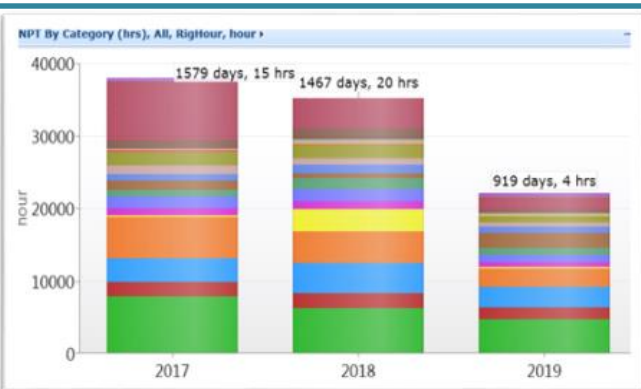




One KPI to know lost time from various activities

ILT KPI report is made of lost time calculated from 13 selected KPI's (ILT does not contain NPT) & Rig move)

ILT can be viewed by Rig, contractor, department, phase, and any time duration



NPT by %, days, Category and Sub categories

Nested NPT KPI to track invisible NPT (Normally ignored, but sometimes have significant cost impact)

NPT can be viewed by Rig, contractor, department, phase, and any time duration

Active Well Status

| Rig-1 | Rig-2 | Rig-3 | Rig-4 |
|---|---|---|---|
| <p>Total NPT: 12.25 hours</p> <p>Well Name: THULELAT-219 Block Position: 12m Phase: C09 Bit Depth: 185m Rig Type: Kelly/Light Hole Depth: 1,841m</p> <p>Stationary</p> <p>Updated On: 25/08/2019 05:17:35 AM</p> | <p>Total NPT: 16.75 hours</p> <p>Well Name: THAMOUD-37 Block Position: 12m Phase: D09 Bit Depth: 185m Rig Type: Kelly/Light Hole Depth: 1,841m</p> <p>Stationary</p> <p>Updated On: 25/08/2019 05:17:35 AM</p> | <p>Total NPT: 27 hours</p> <p>Well Name: TIBR-10 Block Position: 3m Phase: D09 Bit Depth: 2,415m Rig Type: Top/Medium Hole Depth: 3,080m</p> <p>Pump</p> <p>Updated On: 25/08/2019 05:41:55 AM</p> | <p>Total NPT: 61.75 hours</p> <p>Well Name: QARN ALAM-136 Block Position: 22m Phase: IC Bit Depth: 582m Rig Type: Top/Medium Hole Depth: 1,452m</p> <p>In Slips</p> <p>Updated On: 25/08/2019 05:33:35 AM</p> |
| Rig-5 | Rig-6 | Rig-7 | Rig-8 |
| <p>Total NPT: 5 hours</p> <p>Well Name: RASHEEQ-2 Block Position: 10m Phase: D09 Bit Depth: 143m Rig Type: Top/Medium Hole Depth: 1,126m</p> <p>In Slips</p> <p>Updated On: 25/08/2019 05:36:30 AM</p> | <p>Total NPT: 196 hours</p> <p>Well Name: MARMUL-986 Block Position: 11m Phase: D09 Bit Depth: 1,023m Rig Type: Kelly/Light Hole Depth: 1,026m</p> <p>Rotate, Pump</p> <p>Updated On: 25/08/2019 05:19:35 AM</p> | <p>Total NPT: 5 hours</p> <p>Well Name: AL BURJ-131 Block Position: 2m Phase: D17 Bit Depth: 40m Rig Type: Top/Light Hole Depth: 3,215m</p> <p>In Slips</p> <p>Updated On: 25/08/2019 05:40:50 AM</p> | <p>Total NPT: 5 hours</p> <p>Well Name: AMIN-404 Block Position: 17m Phase: D09 Bit Depth: 4,962m Rig Type: Top/Heavy Hole Depth: 4,963m</p> <p>In Slips</p> <p>Updated On: 24/08/2019 08:00:00 AM</p> |
| Rig-9 | Rig-10 | Rig-11 | Rig-12 |
| <p>Total NPT: 5 hours</p> <p>Well Name: MISBAH-16 Block Position: 27m Phase: C09 Bit Depth: 4,087m Rig Type: Top/Light Hole Depth: 4,087m</p> <p>Rotary Drill</p> <p>Updated On: 20/08/2019 09:31:35 AM</p> | <p>Total NPT: 5 hours</p> <p>Well Name: MABROUK NE-10 Block Position: 27m Phase: D09 Bit Depth: 4,087m Rig Type: Top/Heavy Hole Depth: 4,087m</p> <p>Rotary Drill</p> <p>Updated On: 20/08/2019 09:31:35 AM</p> | <p>Total NPT: 5 hours</p> <p>Well Name: SAIH RAWL-513 Block Position: 2m Phase: ACID Bit Depth: 40m Rig Type: Top/Light Hole Depth: 3,215m</p> <p>In Slips</p> <p>Updated On: 25/08/2019 05:40:50 AM</p> | <p>Total NPT: 5 hours</p> <p>Well Name: SAIH NIHAYDA-107 Block Position: 17m Phase: C06 Bit Depth: 4,962m Rig Type: Top/Heavy Hole Depth: 4,963m</p> <p>In Slips</p> <p>Updated On: 24/08/2019 08:00:00 AM</p> |

Status view of rig operations

Rig list can be customizable for user preference

Shows basic rig & well information

Highlights rigs with NPT, and displays Total NPT

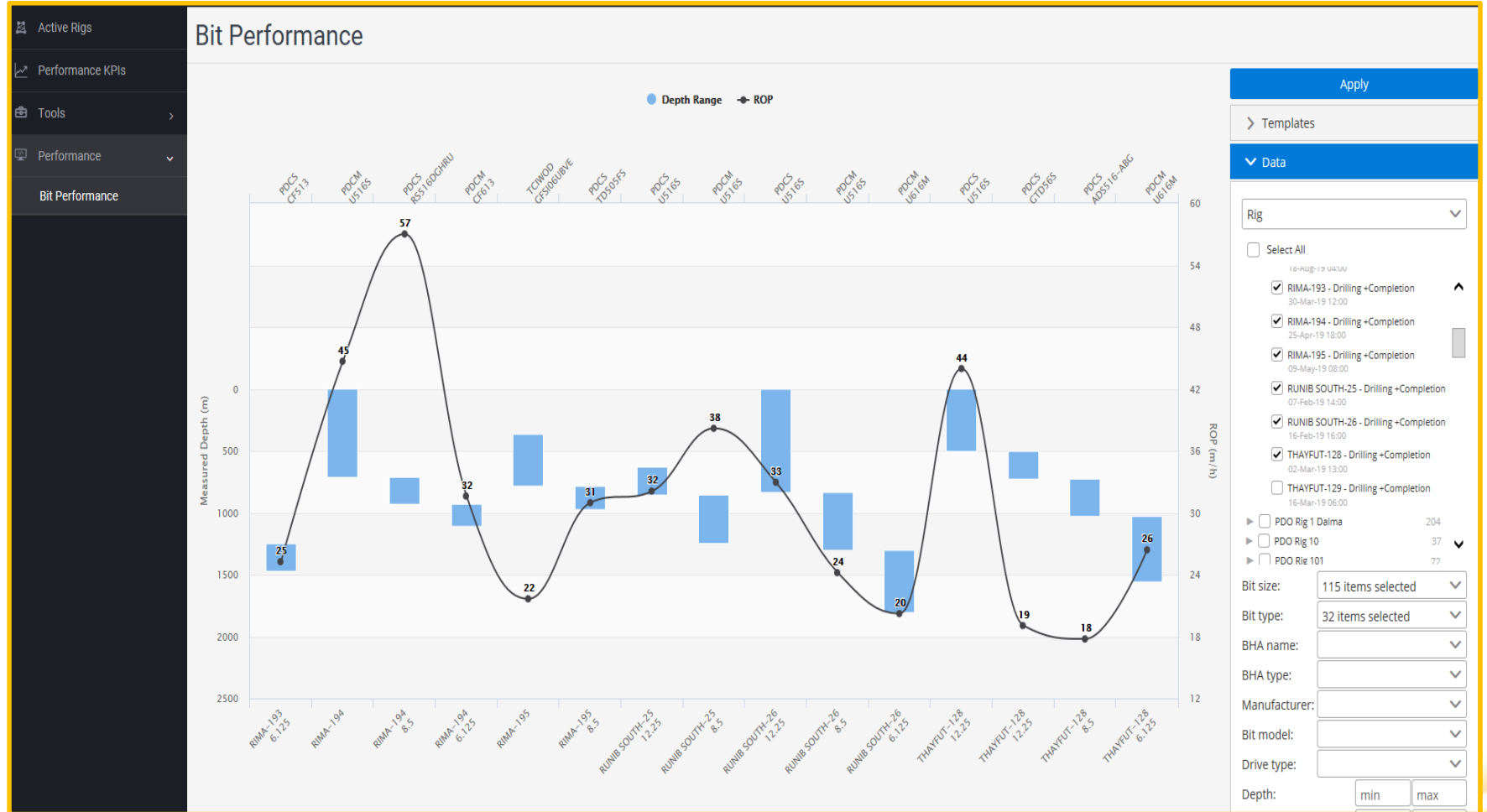
Bit Performance management module built for the first time

Identify the best performing bit based on formation type

Evaluate Bits model, types and contractor products

Enable bit selection for future wells based on historical data

Helps ROP vs. Bit field study



Customized Time vs. Depth curve

Time vs. depth curve plots AFE Plan, WCC Plan, Best Composite Time and Actual

View current well progress against plan

Historical drilling performance analysis of well types, helps planning for the upcoming wells

Together with Bit Performance KPI, the selection of materials is simplified



Improve Data Quality Using RigHour

Duplicate Row Issues

Filters

Well Name

Table Name

Duplicate Entry

| Reported Date | Table Name | Well Guid | Well Name | Details |
|--------------------|--------------|-----------|------------------|--|
| 02/08/2017 5:11 AM | pdo2rh_NPT N | Q8tEPR1cd | AL HUWAISSAH-199 | 15.10.2012 15:45:00, 15.10.2012 17:15:00 |
| 20/09/2017 9:32 AM | pdo2rh_NPT N | VXkrA6gtr | AL HUWAISSAH-231 | 18.09.2017 09:30:00, 18.09.2017 11:00:00 |

Gaps LF

Filters

Borehole Name

Rig Name

Missing reports entry

| Rig Name | On Location Date | Off Location Date | Borehole Name | Start Date | End Date | Duration Hour | Duration Min |
|-----------|-------------------|-------------------|---------------|-------------------|-------------------|---------------|--------------|
| PDO Rig 1 | 25/04/16 09:00:00 | 06/05/16 00:00:00 | AMIN-326 | 04/05/16 09:00:00 | 04/05/16 09:30:00 | 0.5 | 30 |
| PDO Rig 1 | 08/04/17 06:00:00 | 21/04/17 02:00:00 | AMIN-348 | 18/04/17 23:45:00 | 19/04/17 00:00:00 | 0.25 | 15 |

Data Issues

Filters

Rig Name

Borehole Name

Data Type


Issue Type

Incorrect reporting

| Rig Name | Borehole Name | Data Type | Issue Type | Prev End Date | Start Date | End Date | Next Start Date |
|-----------|---------------|--------------|--------------|---------------------|--------------------|---------------------|--------------------|
| PDO Rig 1 | AMIN-349 | NPT Interval | intersection | 30/04/2017 11:00 AM | 30/04/2017 2:45 PM | 30/04/2017 12:30 PM | 30/04/2017 9:00 AM |

| Rig Name | Borehole Name | Data Type | Issue Type | Prev End Date | Start Date | End Date | Next Start Date |
|------------------|----------------|-----------------|---------------------------|---------------------|---------------------|---------------------|---------------------|
| PDO Rig 58 Dalma | ZALUVAH-83 | Casing Interval | zero or negative duration | 23/07/2011 12:30 PM | 10/08/2011 12:00 AM | 12/08/2011 8:00 PM | |
| PDO Rig 36 | MALAAH-35 | Casing Interval | zero or negative duration | 13/04/2012 6:30 PM | 17/04/2012 8:36 PM | 18/04/2012 8:35 AM | 23/04/2012 3:00 AM |
| PDO Rig 44 | MUSALLIM-141 | Casing Interval | zero or negative duration | 17/06/2011 6:00 AM | 21/06/2010 3:30 AM | 22/06/2011 6:30 AM | |
| PDO Rig 72 Dalma | FAHUO-472 | Casing Interval | zero or negative duration | 29/05/2029 10:00 AM | 29/05/2010 12:00 AM | 01/06/2010 11:30 PM | |
| PDO Rig 99 Dalma | LEKHWAIR-848 | Casing Interval | zero or negative duration | 27/11/2019 8:00 AM | 27/11/2016 6:15 PM | 02/12/2016 12:00 AM | |
| PDO Rig 80 | | | | | | 04/2019 10:30 PM | |
| PDO Rig 81 | | | | | | 02/2019 8:00 PM | |
| PDO Rig 104 | SAQR NE-24 | BHA Interval | zero or negative duration | 11/01/2019 12:45 PM | 11/01/2019 12:45 PM | 11/01/2019 12:45 PM | 14/01/2019 3:00 AM |
| PDO Rig 103 | ANIN-389 | BHA Interval | zero or negative duration | 01/11/2018 1:45 PM | 01/11/2018 1:45 PM | 01/11/2018 1:45 PM | |
| PDO Rig 38 | WADI HAKA-6 | Time Breakdown | zero or negative duration | 15/05/2018 9:15 AM | 15/05/2018 9:15 AM | 15/05/2018 9:15 AM | 15/05/2018 10:00 AM |
| PDO Rig 38 | WADI HAKA-6 | Time Breakdown | zero or negative duration | 15/05/2018 12:00 AM | 15/05/2018 12:00 AM | 15/05/2018 12:00 AM | 15/05/2018 12:30 AM |
| PDO Rig 103 | KARIM WEST-221 | BHA Interval | zero or negative duration | 13/02/2018 11:00 PM | 13/02/2018 11:00 PM | 13/02/2018 11:00 PM | 16/02/2018 11:00 PM |
| PDO Rig 104 | AMAL SOUTH-28 | BHA Interval | zero or negative duration | 15/11/2017 1:00 AM | 17/11/2017 12:30 AM | 17/11/2017 12:30 AM | 17/11/2017 1:00 AM |

Zero or Negative duration



Simplify QC of DDR data

Better Data Quality = Better performance visibility

Filters

Rig Name

Borehole Name

Data Type

Issue Type

Intersection of activity time

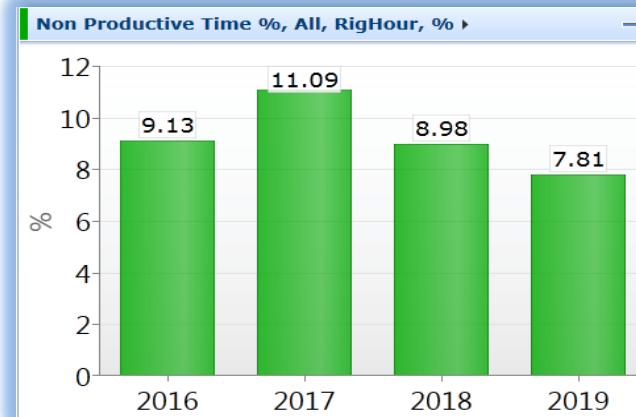
| Rig Name | Borehole Name | Data Type | Issue Type | Prev End Date | Start Date | End Date | Next Start Date |
|------------|---------------|---------------------|--------------|---------------|------------|----------|-----------------|
| PDO Rig 43 | MUSALLIM-295 | Casing/BHA Interval | intersection | | | | |

| Name | Data Type | Issue Type | Prev End Date | Start Date | End Date | Next Start Date |
|------|---------------------|--------------|---------------|-------------|-------------|-----------------|
| -295 | Event | intersection | 08/Jan/2017 | 07/Jan/2017 | 19/Jan/2017 | 19/Jan/2017 |
| -295 | Casing/BHA Interval | intersection | 14/Jan/2017 | 13/Jan/2017 | 17/Jan/2017 | 17/Jan/2017 |
| -295 | Casing/BHA Interval | intersection | 13/Jan/2017 | 13/Jan/2017 | 14/Jan/2017 | 13/Jan/2017 |

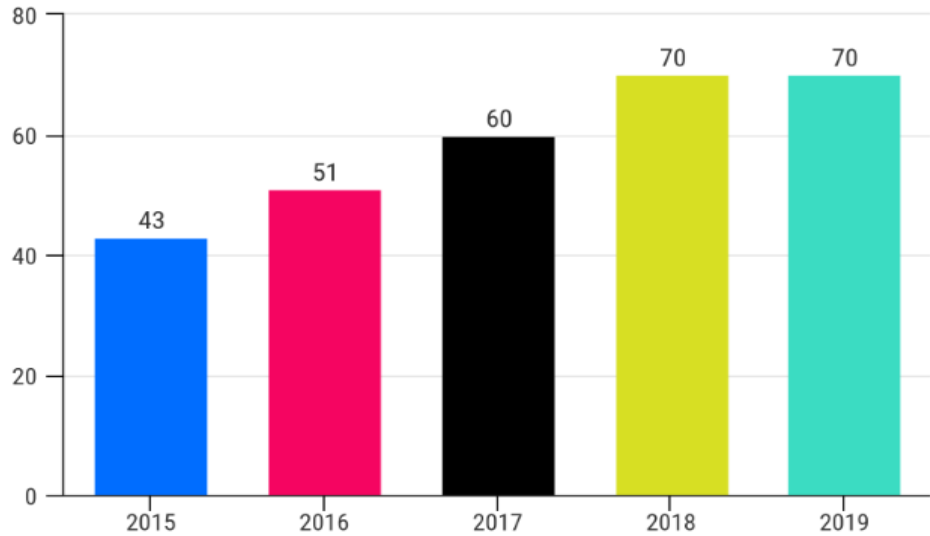
If you can measure it, you can improve it !

| # | Activity type (Baseline) | Activity per Year | Time Saved Assumption | Annual Saving Potential (days) |
|---|-----------------------------|-------------------|-----------------------|--------------------------------|
| 1 | Gross Connection (14 min) | 55,000 | 1 min | 38 |
| 2 | Nipple Up BOP (4.5 hrs) | 935 | 30 min | 19.5 |
| 3 | Pressure Test BOP (3.5 hrs) | 1,300 | 30 min | 27 |
| 4 | Rig Move (3 days) | 500 | 1 day | 45 |
| 5 | NPT (10%) | | 1% | 160 |

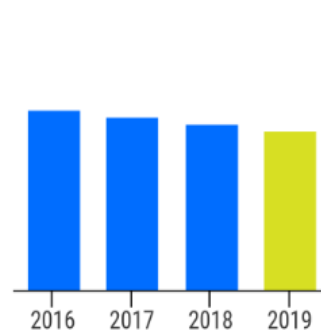
Estimated Saving Opportunity = 290 days with minimum improvement
Assumptions: above calculation based on 45 units & 355 working days/unit



Top Quartile Wells (%)



Achieved the highest Top Quartile Percentage:70%,



cost per meter

Best \$/m ever and 5% better than 2018 performance



10% Drop in NPT% Compared to 2018

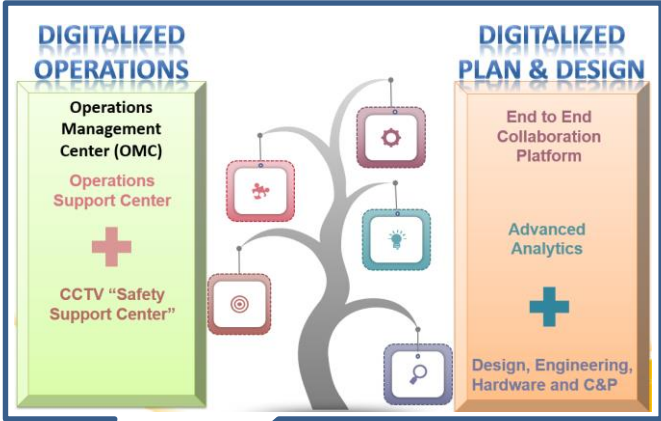
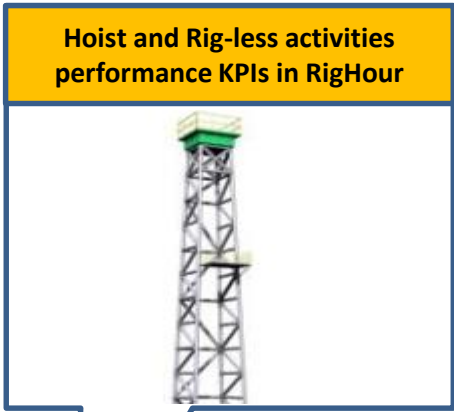
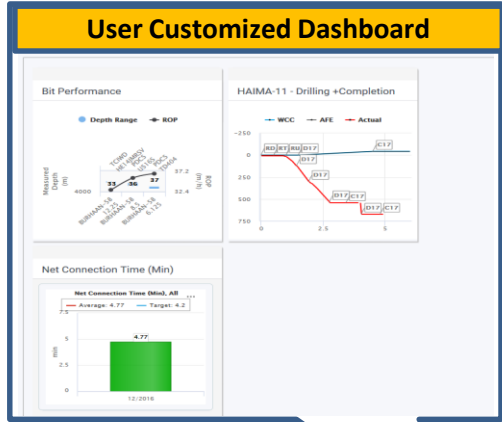
8.5% of NPT

Lowest ever overall NPT% in PDO Wells history



hour per meter

4% improvement YTD in Drilling efficiency (Hr./m) compared to 2018



Fully Automated Performance Management in the Operations Management Center (OMC)



감사합니다 Natick
Grazie Danke Ευχαριστίες Dalu
Thank You Köszönöm
Tack
Спасибо شكرا جزيلا Gracias
谢谢 Merci Seé
ありがとう

Obrigado

