BP Well Advisor Project

- Build capability to integrate real-time data with predictive tools, processes and expertise to enable the most informed operational decisions

BPWA Focus on:

- Operational Safety: Number #1 priority
- Well Construction Efficiency: Average Offshore NPT approx. 30%
- Life of Well Reliability: High rate of impairments in early well life

- Develop a standardized company wide infrastructure
- Business transformation – deployment of a solution
- Address technical challenges and organizational change
- Plan for the future
Project Vision and Technical Goals

**Project Vision:**
Build capability to integrate real time data with predictive tools, processes, and expertise to enable the most informed operational decisions

**BP Well Advisor System**
- Wells Engineer or Wells Specialist
  - Drilling
  - Completions
  - Interventions
- Analysis, Modeling, Recommended Practices

**Project Status:**
- Phase 0 - Casing Running in Deployment
- Phase 1 - Consoles 2014 Deployment
- Phase 2 - Consoles in Development

**Real Time Data**

**Recommendations**

**Driller’s Dashboard**
- Mud Logging
- MWD
- Rig Systems

**High bandwidth telemetry - Wired Pipe Deployment**

**New real time interpretation methods and processes**

**Distributed Measurements**

**Novel measurements (pressure at/near bit)**
IT Infrastructure and System Design

- Internet Web browser
- Microsoft .NET platform
- WITSML & OPC standards
- UTC time system
- Company wide approach
- Data synchronization
- Data aggregated, distributed and managed by system.
## Console Overview – Phased Development

<table>
<thead>
<tr>
<th>BPWA Console</th>
<th>Purpose</th>
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<tbody>
<tr>
<td><strong>Casing Running</strong></td>
<td>• Ensures operation runs within pre-determined safe operating windows&lt;br&gt;• Provides early warning signs of differential sticking between casing and wellbore</td>
</tr>
<tr>
<td><strong>Cementing</strong></td>
<td>• Real-time cement placement and centraliser stand-off analysis&lt;br&gt;• Verification of cement well barrier elements</td>
</tr>
<tr>
<td><strong>Pressure Testing</strong></td>
<td>• Helps assure compliance with regulations and conformance with BP standards&lt;br&gt;• Remote monitoring / more efficient pressure testing operations</td>
</tr>
<tr>
<td><strong>BOP Monitoring (NOV / GE / CAM)</strong></td>
<td>• Remote monitoring of BOP health and valves position&lt;br&gt;• BOP and control system diagnostics beyond rig site</td>
</tr>
<tr>
<td><strong>Rig Site Fluid Management</strong></td>
<td>• Early warning indicators for potential lost circulation and well control issues&lt;br&gt;• Annular pressure display to detect wellbore ballooning</td>
</tr>
<tr>
<td><strong>No Drilling Surprises</strong></td>
<td>• Displays correlation of sub-surface boundaries, zones of overpressure, and pre-drill risks&lt;br&gt;• Real-time early warning indicators of sub-surface risks</td>
</tr>
<tr>
<td><strong>Rate of Penetration</strong></td>
<td>• Improves ROP, optimizes drill-bit performance, reduces shock and vibration&lt;br&gt;• Drives a reduction in well construction costs in hard rock drilling areas</td>
</tr>
<tr>
<td><strong>Drilling Operations</strong></td>
<td>• Informs the drilling operation with real-time wellbore stability and hole cleaning information&lt;br&gt;• Assists drillers in delivering a quality hole for subsequent tubulars</td>
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<tr>
<td><strong>Tripping</strong></td>
<td>• Monitors tripping-in/out and associated reaming operations for any tubular; Includes torque, hookload, pressure and flow rate displays&lt;br&gt;• Near real-time event detection and wellbore condition monitoring</td>
</tr>
<tr>
<td><strong>Completions</strong></td>
<td>• Extends Casing Running capabilities to incorporate tubing make-up and running</td>
</tr>
<tr>
<td><strong>Remote BOP Pressure Testing</strong></td>
<td>• Combines BOP Monitoring with Pressure Testing consoles, remote monitoring</td>
</tr>
</tbody>
</table>
Deployed Consoles

Casing Running

- Provides early warning signs of onset of differential sticking between casing and wellbore
- Hookloads monitored against planned drag curves
- Running speeds monitored against planned trip schedule
- Ensures operation runs within safeguards

Cementing

- Real-time cement placement and centraliser stand-off analysis
- Cementing operations visible to rig and onshore engineers
- Verification of cement well barrier elements
Consoles to be Deployed in 2014

Pressure Testing
- Helps assure compliance with regulations and conformance with BP standards
- More efficient pressure testing operations
- Remote monitoring of pressure testing from onshore

BOP Monitoring
- BOP control system diagnostics beyond rig site
- Simplifies complex diagnostic information
- Remote monitoring of BOP health and valves position
Consoles to be Deployed in 2014

Rig-Site Fluid Mgt.

- Early warning indicators for potential lost circulation and well control issues
- Annular pressure display to detect wellbore ballooning

No Drilling Surprises

- Displays correlation of sub-surface boundaries, zones of overpressure, and pre-drill risks
- Real-time early warning indicators of sub-surface risks
- Summarizes operational observations, annotations, and events
Consoles in Development

Rate of Penetration (ROP)
- Deliver improvements and consistency in drilling performance
- Drive a reduction in well construction costs in hard rock drilling areas
- Improve ROP, optimize drill-bit performance, reduce shock and vibration

Drilling Operations
- Inform the drilling operation with real-time wellbore stability and hole cleaning information
- Help the operations teams understand the drilling envelope
- Assist the driller in delivering a quality hole for subsequent tubular running operations

Tripping
- Extend functionality of Casing Running console to BHA assemblies
- Monitor tripping-in and out and associated reaming operations for any tubular
- Provide near real-time event detection and wellbore condition monitoring
Casing Running console

**Highlights:**

- Real-time monitoring of casing, liner and completions running operations
- Early warning indicators that help reduce stuck pipe incidents and mud losses

**Features**

- Automated Drag Chart
- Detection of Static Friction
- Trip Schedule vs. actual running speeds
- ‘Zone’ providing warning indicators of hookload (high & low), magnitude of static friction, running speed & hookload variance
- Hookload Signature showing calculated values of interest
**Casing Running console Deployment**

**Console Run Frequency**

BPWA CRc – Run Frequency (31 Aug 14)

- Total Number of Runs = 273
- Stuck Tubular Incidents = 0
- Total Runs (Trouble Time) = 20
- Total Runs (Trouble Free) = 253

**Total Runs by Region**

BPWA CRc – Total Runs by Region (31 Aug 14)

- AGT: 157
- North Sea: 51
- GoM: 39
- Trinidad: 20
- Angola: 6

**Console Total Runs**

BPWA CRc – Total Runs by Rig (31 Aug 14)

- Total Number of Runs = 273

**Key Messages**

- Technology deployed on 26 offshore rigs
- > 250 runs monitored live to date
- > 550km of tubulars run
- No stuck tubular incidents have occurred
- 8 runs where console was used to make an intervention or significantly influence an outcome
Project Challenges

- Oil company management of large complex software projects
  - product conceptualisation
  - establishing right scope early
  - change control
- Complexity in certain technical areas
  - understanding strengths and weaknesses of real-time data
  - need to focus on simple solutions first
- Right blend of deep technical specialists with operational experience
  - needed for optimum product development
- Energizing engineers to make change
  - diverse community involved in well construction
- Global deployment challenging
  - not just about software but also about the business solution
  - organisational change
Future Opportunities

• Move from Advisory system to Automation
• Deep embedment of technology in planning and operations
• Big data – more data, extract more value
• Predictive analytics – smarter analysis of data
• Advanced sensors – improved clarity of operations
• Real-time monitoring of along string measurements
• Excellence in operational decision making