PETRONAS Drilling Automation Journey with World’s First DrillOps Automate – NOVOS Integration with a 3rd Party Automation Solution
Running/Adding drill pipe is a series of repetitive activities:

Off-bottom activities:
- Remove Slips
- Break circulation
- Take a survey
- Start rotation
- Zero WOB
- Tag bottom
- Drill on bottom
- Come off bottom
- Circulate off botttom
- Reciprocation
- Friction Test
- Go to connection

On-bottom activities
- Stop rotation and circulation
- Set drill pipe in slips
- Add new drill pipe

These Activities Accounted around 55% of Total Rig Time
PETRONAS JOURNEY INTO DRILLING AUTOMATION

Sept 21’

Field B

Installation of DrillOps Automate (Advisory Mode)

DO

DO

DO

DO

Advisory

4 Wells Campaign Deployment

16” Hole + 12.25” Hole + 8.5” Hole

Dec 21’

Feb 22’

Mar 22’

Simulator Integration Test

Transition

Field A

Apr 22’

July 22’

DrillOps Automate with NOVOS installed

23” Hole

23” Hole

16” Hole

12.25” + 8.5” Hole

16” + 12.25” + 8.5” Hole

Well 1

Well 2

Well 1 & Well 2

Well 1 & Well 2

Well 3 & 4

Field A

Well 3 & 4

16” + 12.25” + 8.5” Hole

DrillOps Advisory Mode

Hardware Reconfiguration

4 Wells Campaign Deployment

© 2022 Petroliam Nasional Berhad (PETRONAS)
CONFIGURATION SETUP

FIELD A

Driller's Cabin

- HMI
- SpeedCast Switch
- NOVOS

LER Room

- CODA
- SpeedCast Switch

D&M WITS

DrillOps In Control for On-Bottom Workflow

FIELD B

Driller's Cabin

- HMI
- SpeedCast Switch
- NOVOS

LER Room

- CODA
- SpeedCast Switch
- GSS WITS

D&M WITS

DrillOps In Automate Advisory Mode
KEY LEARNINGS FROM ADVISORY VS AUTOMATE IN CONTROL DEPLOYMENT

Similarities

Both use the same hardware set up and have the same networking requirement

Advisory require less training support then Automate in control

Differences

Performance are driller’s dependent. Recommended parameters need to applied into rig control system.

Reaction to mitigate drilling dysfunctions will also depend on driller’s reaction time.

Auto-downlink cannot be done in Advisory

KEY TAKEAWAYS

Gain has been observed during Advisory deployment however more gain observed when Automate in control mode

Advisory act as transition platform for drillers and other stakeholders before transitioning into full automation demonstrated by high adoption the beginning
**DRILLOPS AUTOMATE + NOVOS EXECUTION CHALLENGES**

### Key Challenges

- **Automation Enablement**
  - Overlapping features (i.e., Auto friction test)

- **System Integration**
  - Integrated system stability (pilot system)

- **User Adoption**
  - Driller’s confidence level
  - Ergonomics setup (additional screen for UI/HMI DO)

### Solutions

- **Workflow segregation and ownership**
- **KPI/target set by workflow**
- **System Integration test**
- **Staggered deployment level**
- **Upskilling with dedicated coach/trainer**
- **Simplified procedures tailored to each operations which continuously being improved**
• Auto ROP: ROP control by the solution apps, determined by machine learning (GPM, RPM & WOB)

<table>
<thead>
<tr>
<th>AUTO ROP</th>
<th>AUTO DOWNLINK TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>WELL 1 8.5IN PH</td>
<td>WELL 2 12.25IN</td>
</tr>
<tr>
<td>0.51</td>
<td>1</td>
</tr>
<tr>
<td>WELL 1 8.5IN HZ</td>
<td>WELL 1 8.5IN PH</td>
</tr>
<tr>
<td>6.32</td>
<td>1.58</td>
</tr>
<tr>
<td>WELL 1 8.5IN HZ</td>
<td>WELL 1 8.5IN HZ</td>
</tr>
<tr>
<td>2.25</td>
<td>2.25</td>
</tr>
</tbody>
</table>

• Total drilling efficiency gain from 10% On Bottom ROP improvement = 12 hours
• Procedure adherence when DrillOps executes the Downlink resulting in 98-99% surface correlation factor
• During downlink on bottom, the DD and Driller can monitor drilling performance without needing to focus on adjusting the flow and RPM for Downlink
• The improvement is credited to the machine learning capability of DrillOps when more well data gathered

• Auto downlink: survey downlinking (GPM/RPM) and survey acceptance automatically controlled by DrillOps
DRILLOPS AUTOMATE + NOVOS EXECUTION CHALLENGES

Successful Key Features

- **Extremely high user adoption rate**
- **100% successful downlink execution**
- **Excellent adoption progress steep learning curve for the drillers on usage**
- **Simplified workflow resulting in human error avoidance**
- **Increased on-bottom Drilling Performance Efficiency & Consistency**

Key Features for Enhancement

- **Better integration between DrillOps and Rig Automation Platform i.e., NOVOS**
- **Expand features and capabilities especially on downhole protection workflows**
THANK YOU