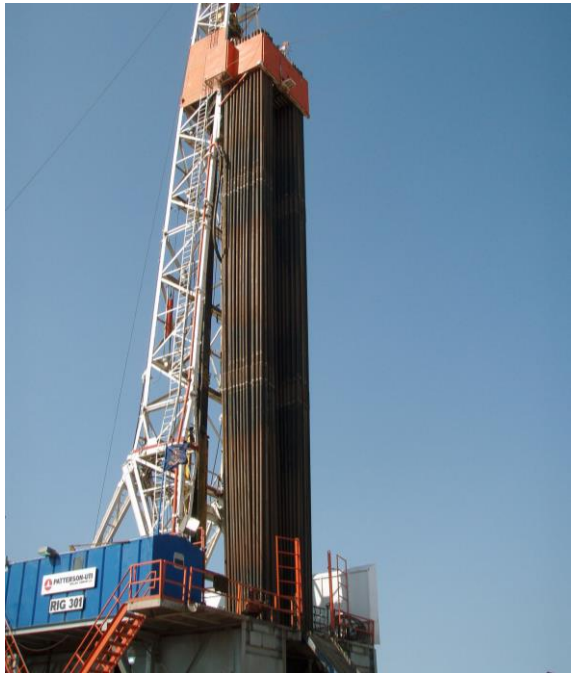
PETRONAS Drilling Automation Journey with World's First DrillOps Automate – NOVOS Integration with a 3rd Party Automation Solution

SLB DIGITAL FORUM 2022

CAN AUTOMATION IMPROVE DRILLING EFFICIENCY?

Running/Adding drill pipe is a series of repetitive activities

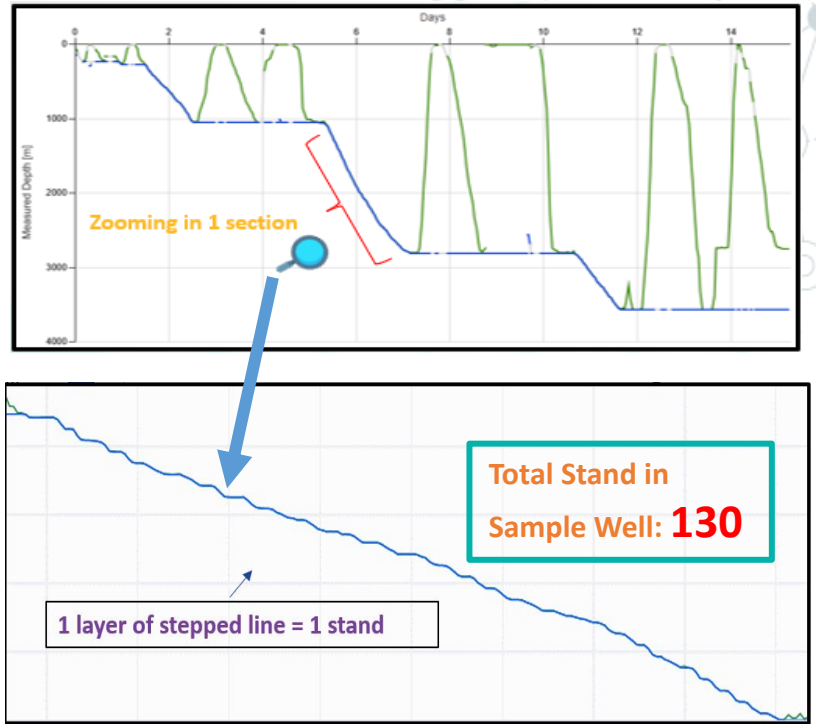


- Remove Slips
- Break circulation
- Take a survey
- Start rotation
- Zero WOB
- Tag bottom
- Drill on bottom
- Come off bottom
- Circulate off botttom
- Reciprocation
- Friction Test
- Go to connection
- Stop rotation and circulation
- Set drill pipe in slips
- Add new drill pipe

Off-bottom activities: When the drill bit is not engaged with formation

On-bottom activities

Off-bottom activities



These Activities Accounted around **55%** of Total Rig Time

DRILLOPS AUTOMATE + NOVOS SETUP

RIG CONTROL SYSTEM

Process-automation Platform

NOVOS™

OPTIMIZATION

PROTECTON

DrillOps

Schlumberger

Mud Pumps

Top Drive

Draw works

Driller's Cabin Interface

NOVOS

Driller

DrillOps

Performance Well Data for Benchmarking

Remote Support

NO

SLB

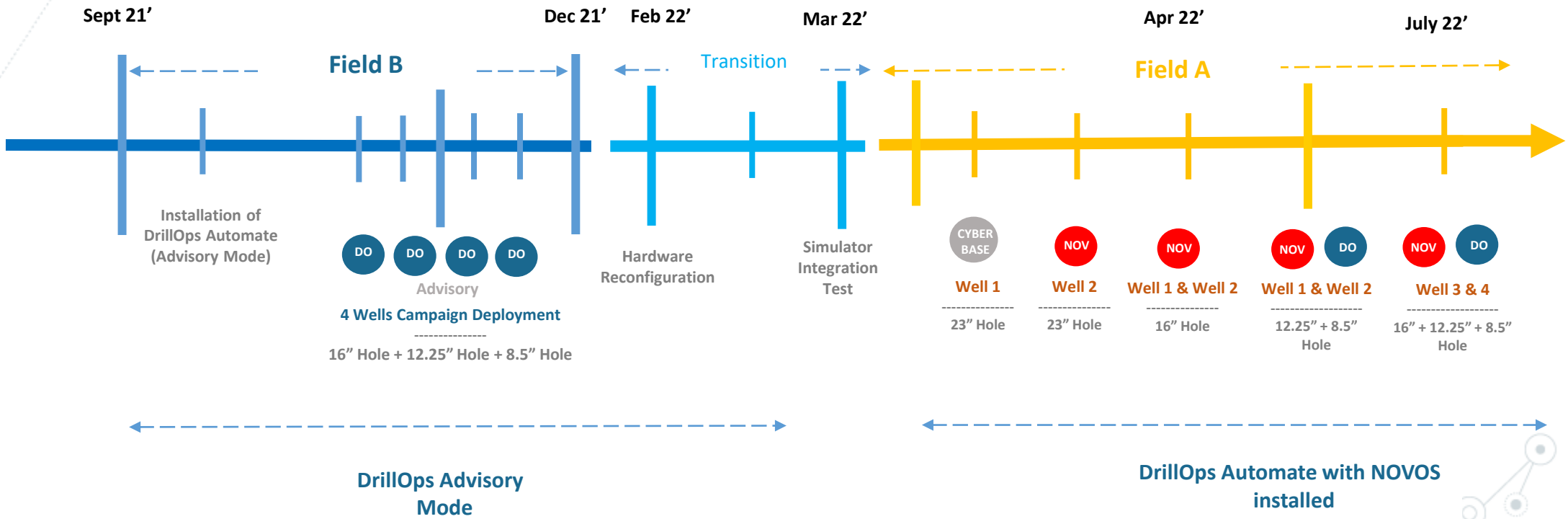
Rig Server

DrillOps

DrillOps-NOVOS Automation Driver

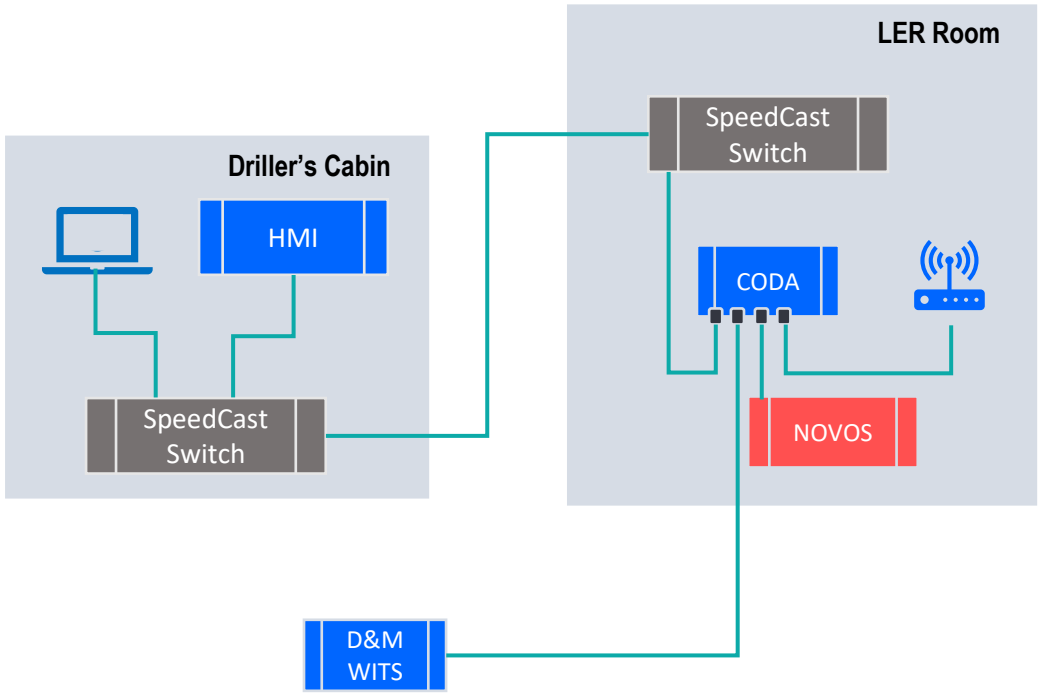
DrillOps Software Infrastructure

PETRONAS JOURNEY INTO DRILLING AUTOMATION



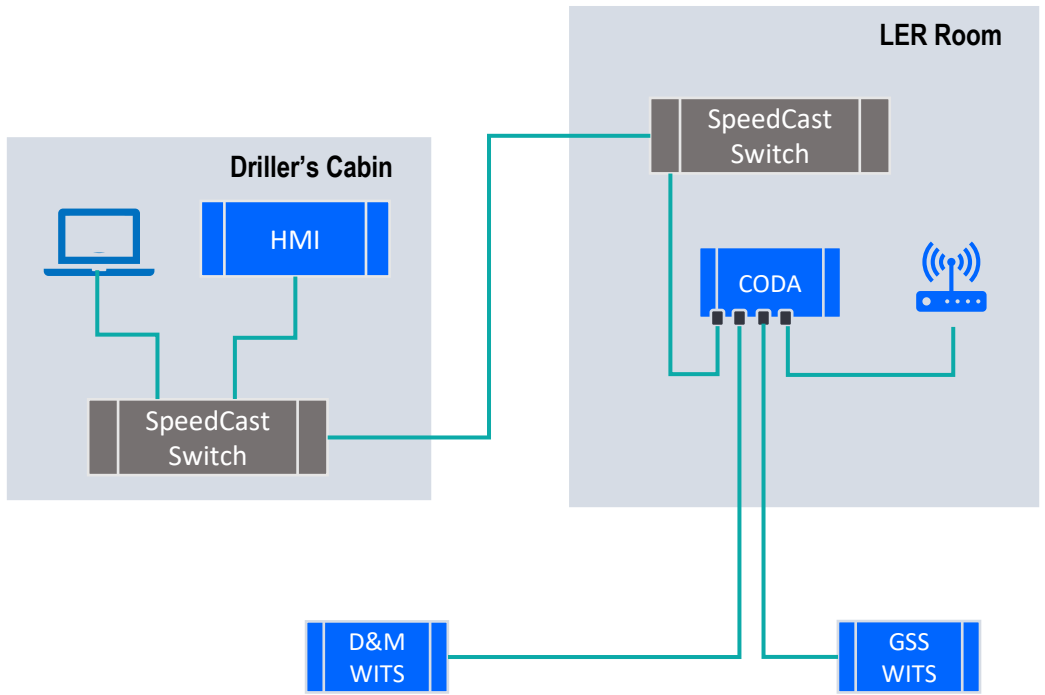
CONFIGURATION SETUP

FIELD A



DrillOps In Control for On-Bottom Workflow

FIELD B



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

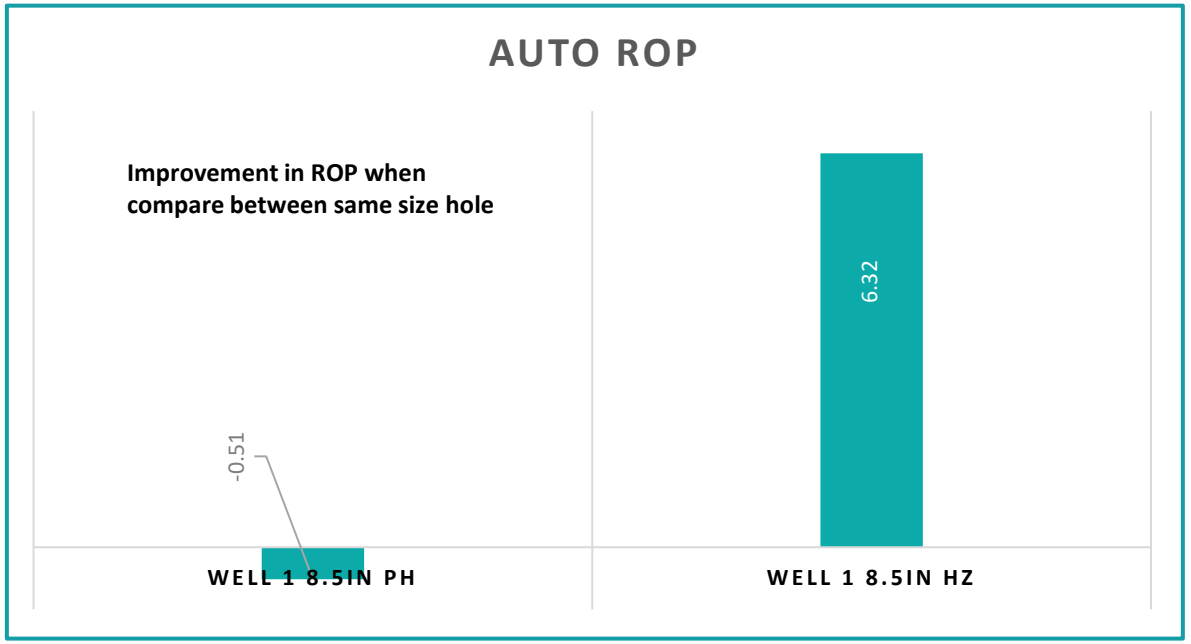
Staggered deployment level

Upskilling with dedicated coach/trainer

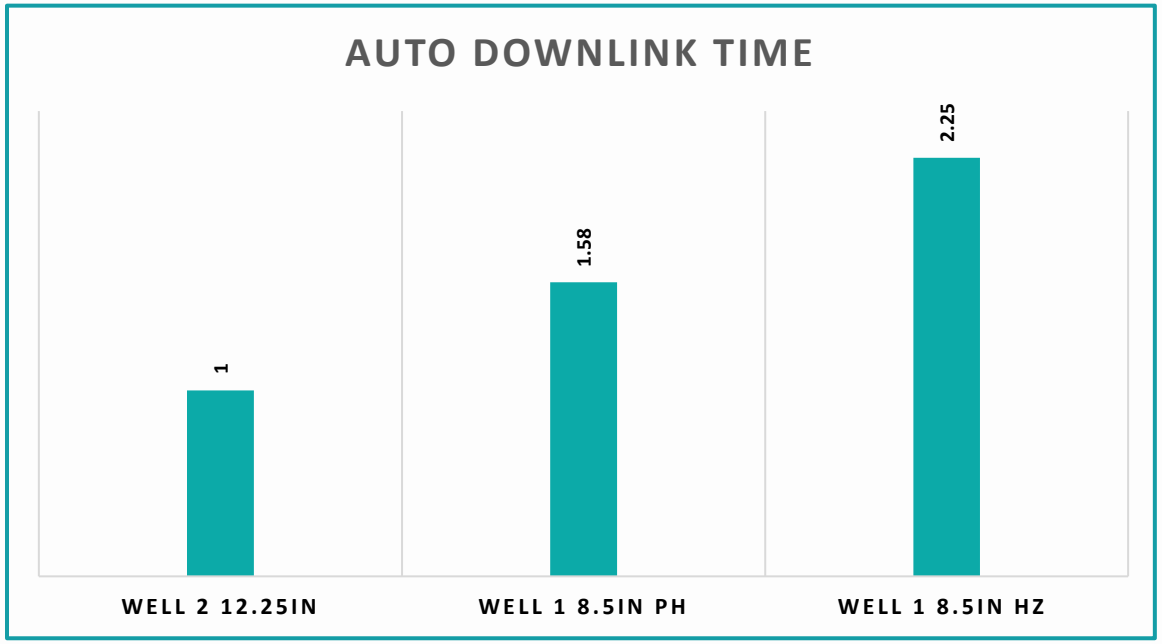
Simplified procedures tailored to each operations which continuously being improved

HIGHLIGHTS

- **Auto ROP : ROP control by the solution apps, determined by machine learning (GPM, RPM & WOB)**



- **Auto downlink : survey downlinking (GPM/RPM) and survey acceptance automictically controlled by DrillOps**

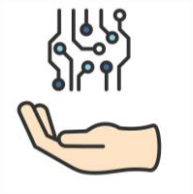


- **Total drilling efficiency gain from 10% On Bottom ROP improvement = 12 hours**
- **Procedure adherence when DrillOps executes the Downlink resulting in 98-99% surface correlation factor**
- **During downlink on bottom, the DD and Driller can monitor drilling performance without needing to focus on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

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