



ADVANCED WELL ENGINEERING REAL-TIME ADVISORY

The drilling industry faces challenges when it comes to implementing physics-based decisions in real-time, resulting in missed opportunities to improve drilling performance and maximize value. Helmerich & Payne's Advanced Well Engineering Real-Time Advisory service bridges the gap and helps deliver the highest possible value throughout the entire well cycle.

That's why H&P assigns experienced drilling engineering advisors to evaluate well deficiencies and identify major pain points that can be improved. By integrating with your existing workflow and focusing on areas not already covered, the Advanced Well Engineering (AWE) team works with you to solve problems and improve performance.

In addition, the AWE Remote Operating Center (ROC) can provide 24/7 rig coverage, further enhancing your operations. The drilling engineering advisor and AWE ROC collaborate and engineer innovative solutions to overcome operational challenges and unlock new opportunities for success.

ROLES & RESPONSIBILITIES

Drilling Engineering Advisor (DEA)

- Main focal point for the customer, serving as the project manager
- Performs tailored engineering analysis that the DEA identifies and prioritizes with the customer
- Focuses on stabilizing well time consistencies
- Performs in-depth root cause analysis with actionable recommendations
- Performs pre-analysis for any well execution design changes
- All work performed by the DEA is enabled by DrillScan® Digital Solutions, our highly sophisticated drilling optimization software designed to improve accuracy, quality, and efficiency

Remote Operating Center (ROC)

- 24/7 monitoring by experienced engineers with varying disciplines from directional drillers, to mud engineers, and drilling engineers
- Tailored Scope of Work to the customer:
 - Torque & Drag
 - Hydraulics
 - Vibration Modal Analysis
 - ROP/MSE Optimization
 - Zeroing Practices
 - Drilling Practices
- Utilizes DrillScan Digital Solution's real-time application (LiveScan™ software) to tie in all streaming data sources, coupling this data with elite physics-based models to interpret results and provide actionable recommendations

DELIVERABLES

Pre/Post Analysis Reports	<ul style="list-style-type: none"> ▶ Focus on design or re-design projects ▶ Utilize limiter re-design approach ▶ Unbiased QC service provider recommendations
Root Cause Analysis Reports	<ul style="list-style-type: none"> ▶ Diagnose a problem to figure out the root cause ▶ Produce recommendations for action ▶ Determine how to setup preventative measures within current ecosystem

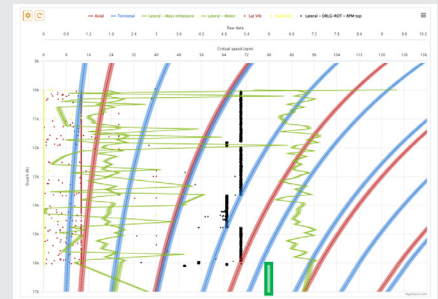
TARGET FORMATION	WELL SECTION	HOLE SIZE	CHALLENGE	ACTION PLAN	ROOT CAUSE	RECOMMENDATION	ESTIMATED TIME (Business Days)
All	Intermediate I	8 3/4"	Loss of ROP @ 8,650	Post-run analysis on multiple wells to get optimal parameters Roadmap creations Flow rate optimization			~ 4 days
All	Intermediate I	8 3/4"	Bit trips @ 9,900' due to PR	Bit forensics analysis Drilling roadmap analysis			~ 3 days
All	Intermediate II / Production	8 3/4" / 6 3/4"	Unable to make Curve Build Rates	Analyze data BHA design review Drilling parameter utilized			~ 8 days
Wolfcamp A	Production	6 3/4"	Lateral ROP Improvement	Post-run analysis on multiple wells to get optimal parameters Roadmap creations Flow rate optimization DOC evaluation			~ 8 days
Wolfcamp A	Production	6 3/4"	DLS peaks of almost 10 deg/100ft	Evaluate BHA design Lateral review will be required prior			~ 5 days
Wolfcamp C	Production	6 3/4"	(Reduce Formation Push Impact)	Identify casing running issues from Drilling BHA POOH Perform deeper casing running T&D			~ 6 days
Wolfcamp C	Production	6 3/4"	Unable to get casing to bottom	Pinpoint the main contributing factor as to how to eliminate wiper trips Lateral review T&D for DP Drilling practices			~ 10 days
Wolfcamp A	Production	6 3/4"	Performing wiper trips to ensure hole is clean prior to running casing	Look into reducing flow rates Conduct step tests with various flow-rates (maybe check the offset)			~ 4 days

Sample Project Prioritization Charter between DEA and Customer Drilling Team

AWE ROC

12 HR Reports	Drillstring Report
Pre-Casing Report	Observation Report

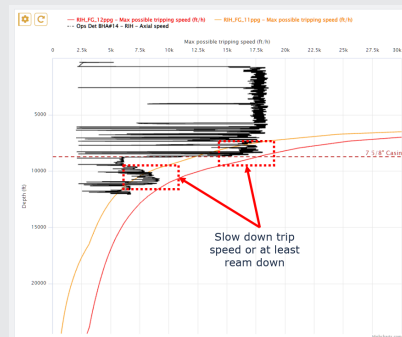
Vibration Roadmap



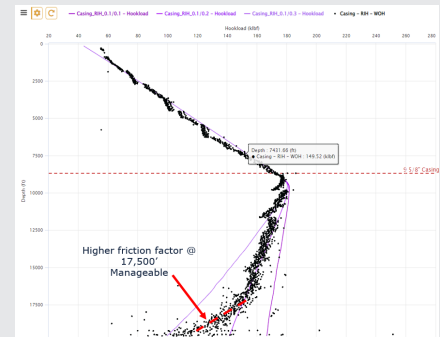
Torque & Drag



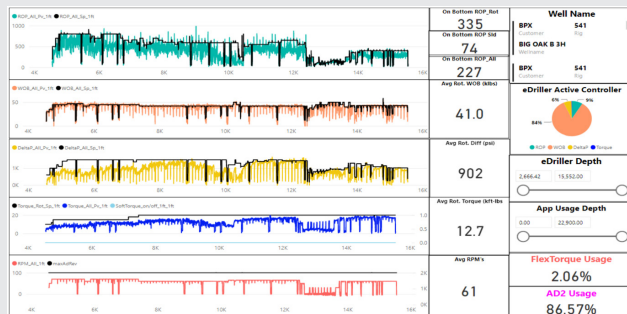
RIH Surge - Trip Speed Limitations



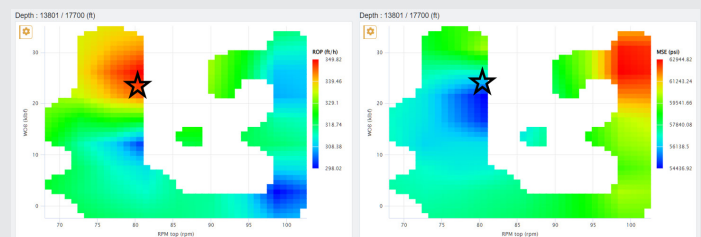
Drag



Offset Well Parameter RoadMap



ROP / MSE Optimization

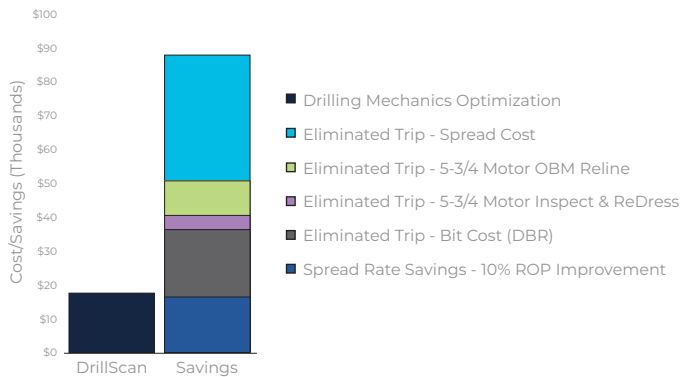


Sample 12HR Report Snap Shots

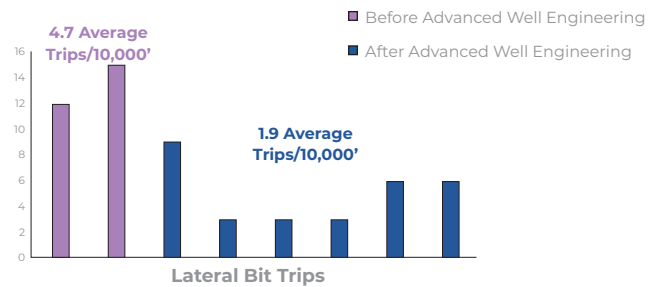
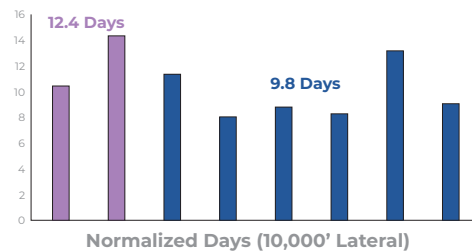
QUANTITATIVE PERFORMANCE VALUE METRICS:					
METRICS	UNIT	MODULE IN USE	BENCHMARK	STRATEGY	SAVINGS CATEGORY
On-Bottom Rotating ROP	Ft/hr	ROP Optimizer Torque & Drag Vibration Modal Analysis ECD Management	Offset Wells (5km Radius) with equivalent tool package	Higher ROP	Time Cost Saving
On-Bottom Sliding ROP	Ft/hr	Torque & Drag Vibration Modal Analysis BHA Pre-Analysis	Offset Wells (5km Radius) with equivalent tool package	Higher ROP	Time Cost Saving
Bit Trips	Count	ROP Optimizer Torque & Drag Vibration Modal Analysis	Offset Wells in Field	Extend Bit Life	Time Cost Saving Tool Cost Saving
Additional Trips (wiper / reaming / clean out)	Count	Torque & Drag Hydraulics	Offset Wells in Field	Evaluate hole condition while drilling	Time Cost Saving
Casing Running Time	Hours	Torque & Drag Hydraulics ECD Management Surge & Swab	Offset Wells in Field	Evaluate hole condition while drilling	Time Cost Saving
NPT (Drillstring Mech Stuck Pipe)	Count	Torque & Drag Hydraulics	Offset Wells in Field	Monitor Hole Condition	Time Cost Saving Tool Cost Saving
NPT (Tool Failure)	Count	ROP Optimizer Forced Vibrations Vibration Modal Analysis	Offset Wells in Field	Reduce Vibrational effects	Time Cost Saving Tool Cost Saving
NPT (Directional Drilling)	Count	Forced Vibrations Pre BHA-Analysis	Offset Wells in Field	Optimize Directional Behaviors	Time Cost Saving Tool Cost Saving
NPT (Well Control)	Count	Surge & Swab ECD Management	Offset Wells in Field	Gradually Optimize trip speeds with refined PP & FG windows	Time Cost Saving HSE

DRILLING ENGINEERING ADVISORY PROJECT SUCCESSES:

- For a two-mile lateral, **10% improvement in rotating ROP** and **elimination of a single trip yields an estimated net savings of \$70,000**



- In depth analysis of each run identified root cause of failures, providing elimination opportunities through design changes
- Identification and elimination of dysfunction extends BHA runs
- Even applying conservative assumptions, value delivered is clear



CONTACT US

For more information contact an H&P sales representative today or contact us through our website at helmerichpayne.com/contact.

It's time to follow through on your drilling performance potential.