

Kantori real-time fluid monitoring

Knowing drilling hydraulics at all times driving more efficient and lower cost drilling operations

Predictable, productive and profitable wells

- Kantori well construction solution platform
- Real-time fluids monitoring
- How we use real-time data
- Case histories

Baker Hughes 
Rewriting The Energy Equation™

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Kantori™

autonomous well construction solution

Customer Systems



E&P Planning applications
(petrophysical, well design,
drilling engineering etc.)

WITSML data-
stores or other
data-lakes



3rd party
monitoring
applications



3rd party
sensors &
services

E&P Enterprise Systems

Baker Hughes Systems

Kantori™ autonomous well construction solution

Kantori™ placement

Kantori™ performance

Kantori™ rig control

planning
orchestration
well engineering
center

intelligent well
planning:
engineering
applications

fluids
intelligence
DF, CF and FES
operations workspace

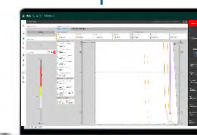
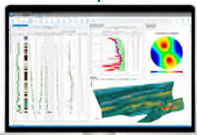
real-time fluids
monitoring
Sensor skid and
software for
continuous fluid
property monitoring

fluid apps in
Corva platform
Real-time fluid KPI
analytics

advisory
applications
physics-based
& data-driven models

automated
Control

rig control
system



Actionable insights from high-fidelity data delivers predictable, productive, and profitable wells delivered at lower risk and cost

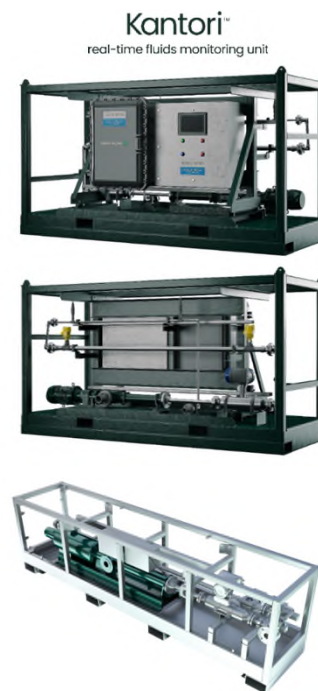
Well construction challenges

The economics of well construction is fundamental to success. Common factors influencing operational expense and return on investment are:

- Days-on-well and well costs: \$/lateral foot
- Consistent, high efficiency well construction: pad-to-pad, rig-to-rig
- Nonproductive time (NPT): Stuck pipe, hole cleaning, wellbore instability, losses, influxes, fluid properties
- Invisible-lost time (ILT): inefficient, misaligned, non-optimized drilling parameters
- Smaller, less experienced rig crews
- Increasing focus on drilling fluid logistics

Actionable insights

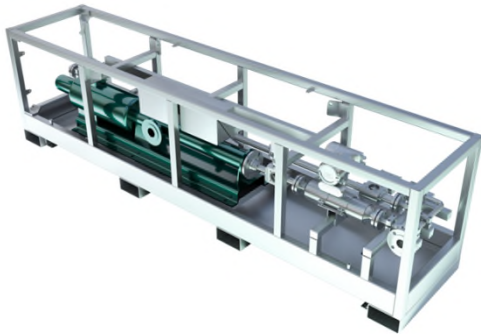
- Continuous monitoring of drilling fluids and operational parameters
- Continuous, API-equivalent measurements—beyond intermittent sampling & periodic checks
 - Optional advanced sensors—unlike basic systems
- Integrated analytics—not just data
 - Optional real-time operational support through autonomous expert data analytics and actionable insights



Kantori™ real-time fluids monitoring (RFM) unit



Dimensions	110 x 61 x 44-in (2794 x 1549 x 1118 mm)
Power Supply	pump & fan motor : 380 – 690 VAC 3-phase PLC panel & HMI : 115 – 230 VAC 1-phase
Skid weight	2,734 lb (1240 Kg)
Flange connections	Input flange : DN65 PN 16 (2½-in) Output flange : DN50 PN 16 (2-in)
Air Supply	ANSI B16.5 (2.54mm) 1-in CI 150 RF (purging only)
Water/Base oil supply	ANSI B16.5 (2.54mm) 1-in CI 150 RF (flushing only)



Fluid Properties	Dual DP rheology	Real-time rheology with in-situ LCM and particles
		Uptime without plugging or flushing
		Minimum moving parts
		Low maintenance
	Density sensor	Early density fluctuation tracking
		Fluid density monitoring to ensure hydrostatic pressure in the well
	<i>Optional OWR sensor</i>	Potential sagging tracking
		Solids build-up monitoring to optimize dilution
		Solids control efficiency
		Fluid composition monitoring and maintenance before issues arise
		Displacement monitoring for slop reduction
Design	Durable design	Minimum maintenance and downtime Zone 1 and 2 rated (ATEX/IECEX)
Logistics	Transportation	Frame-mounted skid unit for simple access
Installation	Simple fluid connections	Plug-and-play connectors for shorter rig-up time
		Fluid feed line aligned with rigs capabilities
Connectivity	Communication	Data security
		Universal data communication protocols

Actionable insights from high-fidelity fluid data delivers predictable, productive, and profitable wells delivered at lower risk and cost

Real-time fluids monitoring

- Universal deployment— supports conventional and unconventional drilling
- Optimized for high-efficiency, fast-paced drilling environments
- Supports extended-reach and narrow-margin drilling
- Reliable in extreme conditions, including HP/HT and fractured formations, for improved wellbore stability
- Enables remote-supported operations— vs. rig-bound systems

Solution & Benefits

- Real-time fluids monitoring providing API equivalent data reports into and out of the wellbore
- Compare planned versus actual fluid performance as conditions change
- Detect early indicators of wellbore and fluid-related risks
- Real-time operational support through autonomous expert data analytics and actionable insights
- Ensure operational efficiency and wellbore integrity

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real-time fluids monitoring unit



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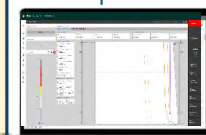
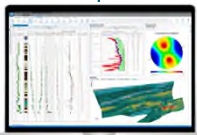
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Kantori Apps integration into CORVA

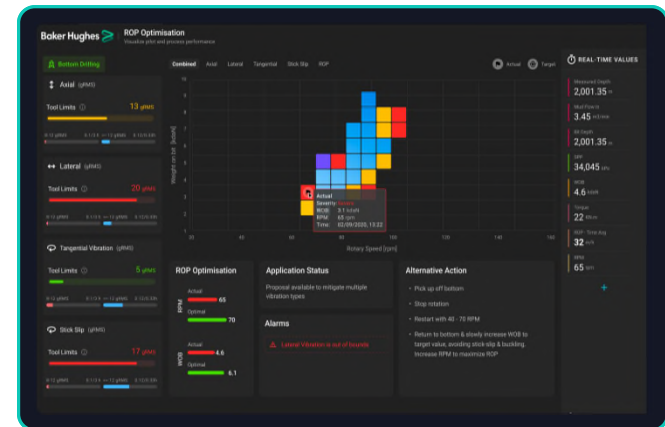
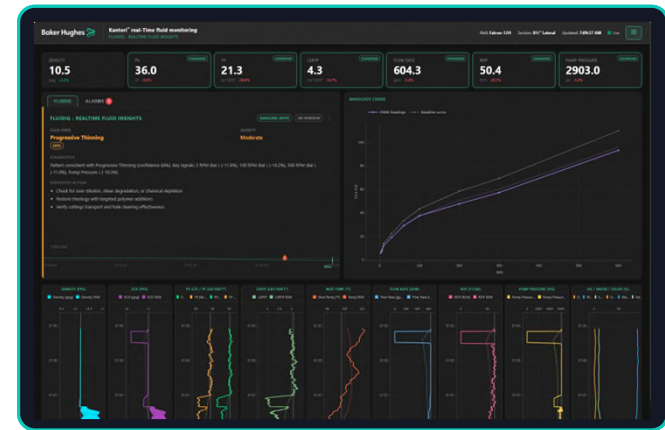
Kantori integrates downhole, rig, and third-party sensor data through WITSML into a unified platform connected to remote operations centers. It enables real-time analytics, drilling automation, and optimization through a closed-loop control system, leveraging a broad ecosystem of applications—including customer-specific solutions—to deliver a combined hardware and software approach for improved operational performance.

Kantori real-time fluid monitor app powered by Corva™

Realtime fluid monitor app powered by Corva, analyzes real-time fluid data to detect anomalies and potential dysfunctions during drilling operations. It provides automated diagnostics, early warnings, and actionable alerts, enabling operators to quickly identify issues and take corrective actions to maintain optimal well performance and reduce operational risk.

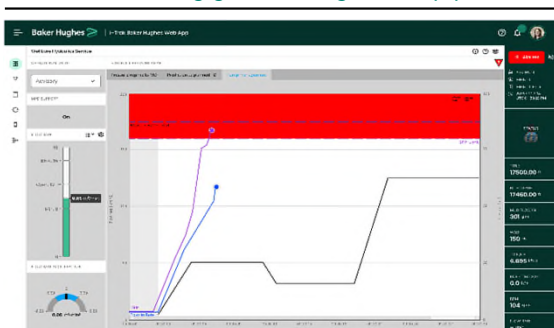
Kantori optimization powered by Corva™

Drilling parameter and hydraulics optimization app hosted in Corva platform using data from Kantori RFM and rig sensors.

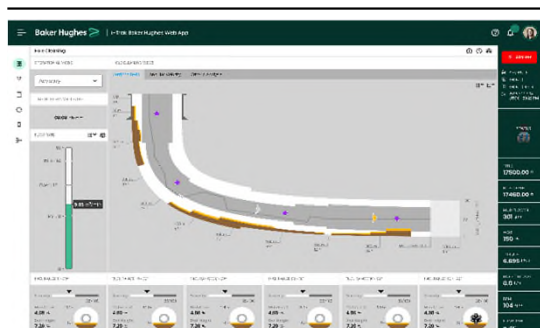


Kantori™ performance advisory applications underpinned by physics-based and data-driven models with modern, rig- and cloud-based visualizations

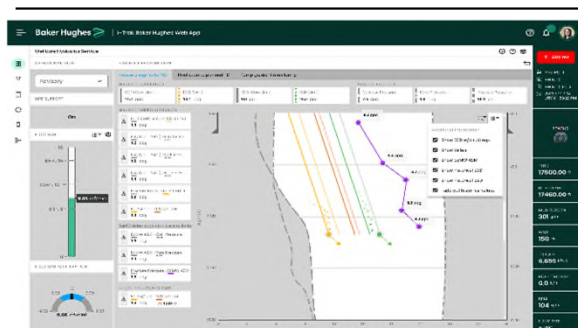
Borehole Pressure – automatic pump-ramp up control including gel breaking and fill pipe.



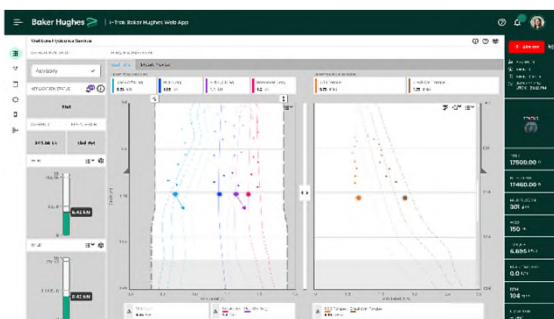
Hole Cleaning – predicted time-to-clean wellbore, ASM visualization, pack-off protection coming Q4.



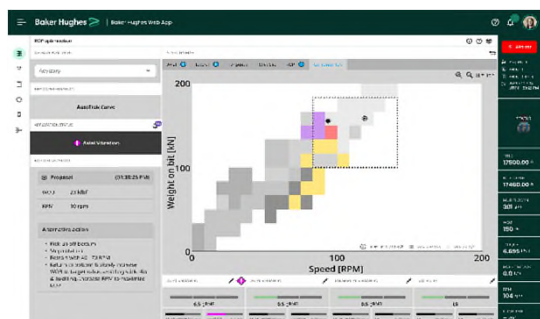
Borehole Pressure – max flow protection, along-string ECD visualization, wired-pipe ASM visualization.



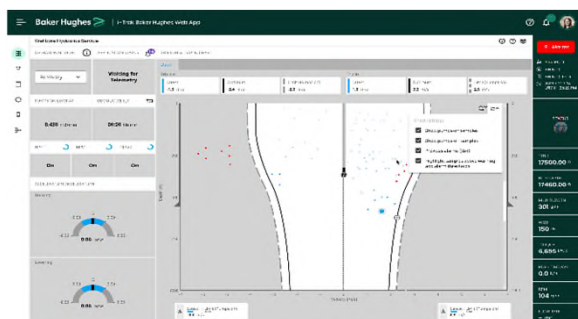
Torque & Drag – Overpull and over-torque protection, pipe stretch supplied for NOVOS.



ROP Optimization – WOB & RPM control for VSS mitigation and ROP optimization.



Tripping Advisor: velocity and acceleration constraint control during all off-bottom operations.



Kantori real-time fluids monitoring strengthens digital twin accuracy, improves cuttings transport prediction, and enables more stable wellbore pressures

CHALLENGES

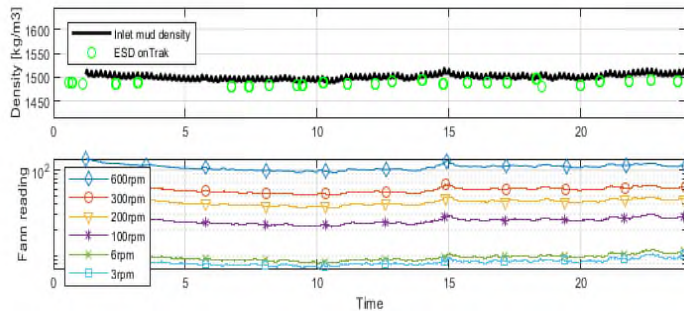
- An operator in North Sea was challenged by rapidly shifting downhole conditions that were not reflected quickly enough in existing hydraulics workflows.
- Pressure spikes and transient events during circulation and pump transitions created recurring operational risks.
- Decision-making lagged because operational limits (ECD, surge/swab, pressure ramps) were not updated in real time.
- Invisible lost time accumulated as drilling teams reacted to events instead of predicting and preventing them.

SOLUTION

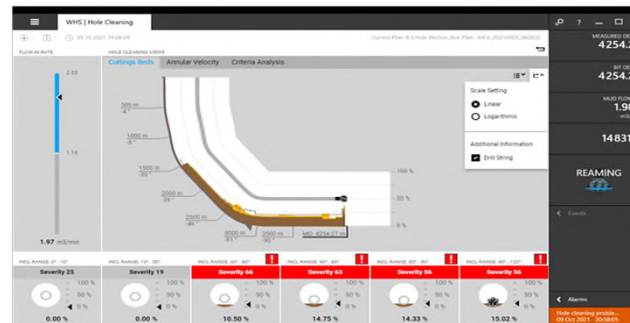
- [Kantori™ real-time fluids monitoring service](#) was deployed to feed the real-time fluid data to the optimization software to simulate the accurate and continuous ECD, surge/swab limits and hole cleaning.
- Fully integrated with a transient hole cleaning engine, the precise hole cleaning parameters were used to reduce the ILT.
- Advanced algorithms identified emerging downhole risks early and provided proactive recommendations before conditions escalated.
- Updated hydraulics envelopes and operating limits were automatically shared with advisory applications and the rig's control ecosystem via OPC UA.

RESULTS

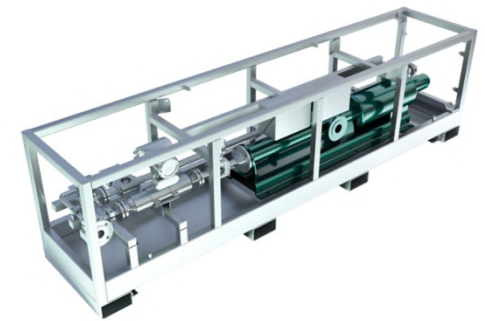
- **10 to 20%** tighter correlation to measured ECD/ESD compared with steady-state or traditional hydraulics models.
- Simulated cuttings return matched measured skip weights within **4%**, confirming mass-balance accuracy of the transient model.
- Real-time fluid measurements significantly improved model accuracy, outperforming simulations that used low-resolution manual.



Real-time fluids monitoring measurements



Transient hole cleaning service



Kantori real-time fluids monitoring enables rapid barite SAG detection to avoid hours of NPT

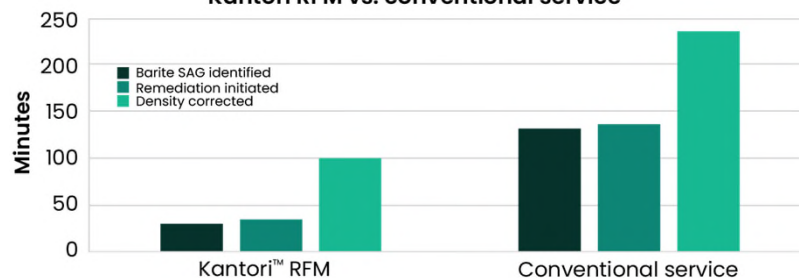
CHALLENGES

- A major operator in the North Sea faced serious barite sagging challenges while drilling with an invert emulsion fluid (IEF) system
- The IEF system was evaluated against many risks—barite sagging included—prior to the final fluid program
- Due to extreme high temperatures and pressures downhole the IEF could not withstand prolonged static conditions even though the IEF rheology remained in-spec during dynamic conditions
- The operator asked Baker Hughes to develop an early warning solution to identify onset of barite sagging enabling rig crew and the Remote Operations Center early risk detection, prompt remediation, avoidance of stuck pipe and other, more serious NPT.

SOLUTION

- Baker Hughes proposed its **Kantori™ fluids intelligence service** utilizing the **Kantori™ real-time fluids monitoring (RFM) unit** for continuous monitoring of fluid and drilling parameters combined with automated analysis and real-time, expert technical support.
- The RFM unit automatically detects the slightest mud weight trends with greater speed and precision than is possible using manual methods..
- These measurements are automatically analyzed and transmitted to remote Baker Hughes fluids experts tasked with actively monitoring the fluid properties and other key drilling parameters.
- Once verified, the data are used to engineer any necessary adjustments to the fluid system.

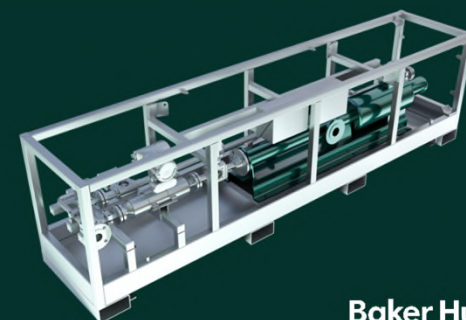
Barite SAG identification and remediation
Kantori RFM vs. conventional service



The Kantori real-time fluids monitoring unit identified barite SAG within 30 minutes of its first occurrence. This allowed the drilling team to take corrective actions and eliminate the issue faster than the SAG problem could be identified using conventional services.

RESULTS

- The real-time monitoring and automated analysis provided by **Kantori™ fluids intelligence service** identified variations in mud weight faster – from every six hours to **less than 1 min** – giving the onshore team an early indication of barite sagging.
- Reduced time to identify barite SAG.
- Minimized NPT by avoiding string plugging and long circulation times.
- Aided remote operations to maintain specified mud weight and avoid additional barite sagging.

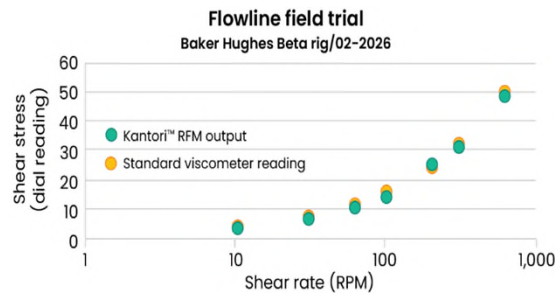


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The Kantori RFM unit delivers continuous, high-accuracy rheology where low-viscosity fluids challenge conventional systems

CHALLENGES

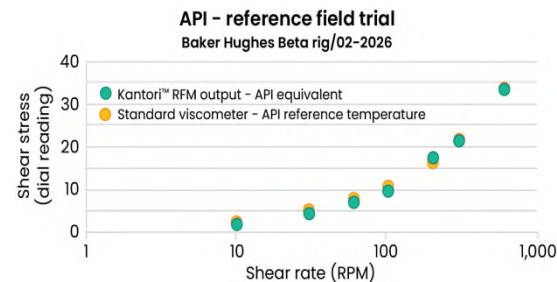
- In restrictive, narrow-margin, or slimhole drilling environments, some operations require low-density, low-viscosity fluids.
- Thin fluids significantly challenge in-line fluid monitoring devices, especially in achieving accurate rheology measurements across the full range of API-referenced shear rates.
- Accurate rheology values are critical for precise, consistent wellbore hydraulics analytics, ensuring wellbore integrity in narrow-margin environments and effective hole cleaning in slimhole settings to prevent tool failure and pack-offs.



Data for a low-viscosity, water-based drilling fluid show a direct comparison of rheology measurements at flowline temperature (22°C/71.6°F) between the Kantori™ RFM unit and a standard laboratory viscometer.

SOLUTION

- Baker Hughes trialed its **Kantori™ real-time fluids monitoring (RFM)** unit with a thin, water-based drilling fluid at its Beta Rig in Celle, Germany.
- The Kantori RFM unit demonstrated **high accuracy, precision, and reliability** in challenging measurement conditions, including low-viscosity, low-density fluids in narrow-margin, slimhole, and coiled-tubing drilling operations:
 - Drilled 8.5-in. hole section
 - KCl-polymer drilling fluid
 - 1.23 specific gravity (SG)
 - Plastic viscosity (PV) = 15
 - Yield point (YP) = 12



Data for a low-viscosity, water-based drilling fluid show a direct comparison of rheology measurements at API-reference temperature (49°C/120.2°F) between the Kantori™ RFM unit and a standard laboratory viscometer.

RESULTS

- The trial proved the Kantori RFM unit's high accuracy and precision in measuring very low-viscosity fluid over 14 days.
- The Kantori RFM unit accurately tracked variations and engineered changes in fluid rheology critical to wellbore hydraulics.
- Real-time data accuracy and precision were independently verified by three fluid engineers using API-standard measurements.





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