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SPECIAL FOCUS: WELL CONTROL & INTERVENTION

From insight to action: Well control auditing platform reduces risk and downtime

This article examines Halliburton's data-driven approach to well control audits that use artificial intelligence (AI)-supported workflows, real-time data, and historical records to identify at-risk wells, streamline compliance, and reduce nonproductive time.

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FIG. 1. Well control specialists conduct a wellhead audit to assess the integrity and equipment condition in a mature oil and gas infrastructure.

DIGITAL TRANSFORMATION MEETS WELL INTEGRITY

As oil and gas fields mature, infrastructure degrades. This exposes wells to flow assurance challenges that increase the risk of integrity failures, such as high casing pressures, mechanical damage, and corrosion. These issues become even more complex in gas fields with elevated levels of CO_2 or H_2S, where metallurgical degradation and equipment reliability concerns must be addressed, **FIG. 1.**

At the same time, the oil and gas industry faces a digital transformation, motivated by the imperative for greater safety, efficiency and sustainability. New technologies, such as AI, automation, predictive maintenance, and advanced analytics, redefine how upstream operations are planned, executed and optimized.

Within this evolution, advanced well control software has emerged as a key catalyst for operational excellence. Data-driven, standardized assessments replace traditional, manual, and often subjective audit processes that help operators manage well control risks, strengthen compliance, and achieve measurable performance improvements.

IMPROVED PERFORMANCE THROUGH SMARTER AUDITS

Oil and gas companies face constant pressure to improve operational performance amid tighter regulations, leaner workforces, and stricter cost controls. For many years, comprehensive well control audits supported this effort through improved safety, efficiency, and overall operational discipline. Today, a

smarter, more efficient way to manage well integrity and minimize the risk of well control incidents has become a reality.

Halliburton's Boots & Coots® emergency response service risk management team collaborated with a leading national oil and gas operator to conduct a comprehensive, year-long audit of rig operations. This initiative involved extensive documentation and records review, employee interviews in operational roles, and physical condition surveys of equipment and infrastructure.

The audit team assessed whether equipment met operational requirements and also evaluated regulatory compliance and the operator's internal standards. The audit team identified significant operational risks and prioritized protective measures to manage incidents and prevent escalation. The operator credited a remarkable 200% improvement in audit scores to the audit methodology and has since launched plans to expand the program in additional operational areas.

Despite long-term success, traditional audit software revealed limitations. To address these challenges, Halliburton developed a best-practice, repository-based software solution to help operators identify specific areas for improvement and apply targeted strategies to improve safety and performance outcomes. This new capability uses real-time data and compares it with historical records to deliver actionable insights and measurable progress, FIG. 2.

The methodology incorporates hundreds of detailed evaluation criteria for key well control domains, such as well control equipment, operational specifications, safe work practices, and incident preparedness. In early field trials, the software supported non-intrusive audits and provided valuable insights without the disruption of operations.

This advanced and practical approach empowers operators to achieve measurable improvements, perform well control audits, and strengthen compliance for assets.

INDUSTRY SHIFTS TOWARD DIGITAL WELL INTEGRITY MANAGEMENT

When oil prices collapsed in 2014, companies reassessed their approach to well integrity—not only as a safety concern but as a cost-effective strategy to unlock value from current wells. This approach included wells shut in, due to integrity concerns.

This shift accelerated the adoption of digital well integrity management (WIM) systems. Exploration and production (E&P) companies standardized workflows, automated routine tasks, and strengthened risk mitigation strategies to improve operational consistency and reduce exposure.

As demand for accurate well control audit records increased, two challenges emerged: comprehensiveness and ease of retrieval. The value of a data repository depends on the accuracy of its entries, the level of post-audit detail captured from field inspections, and the timeliness of data input. Reliable data empowers operators to make informed decisions, identify trends, and improve performance.

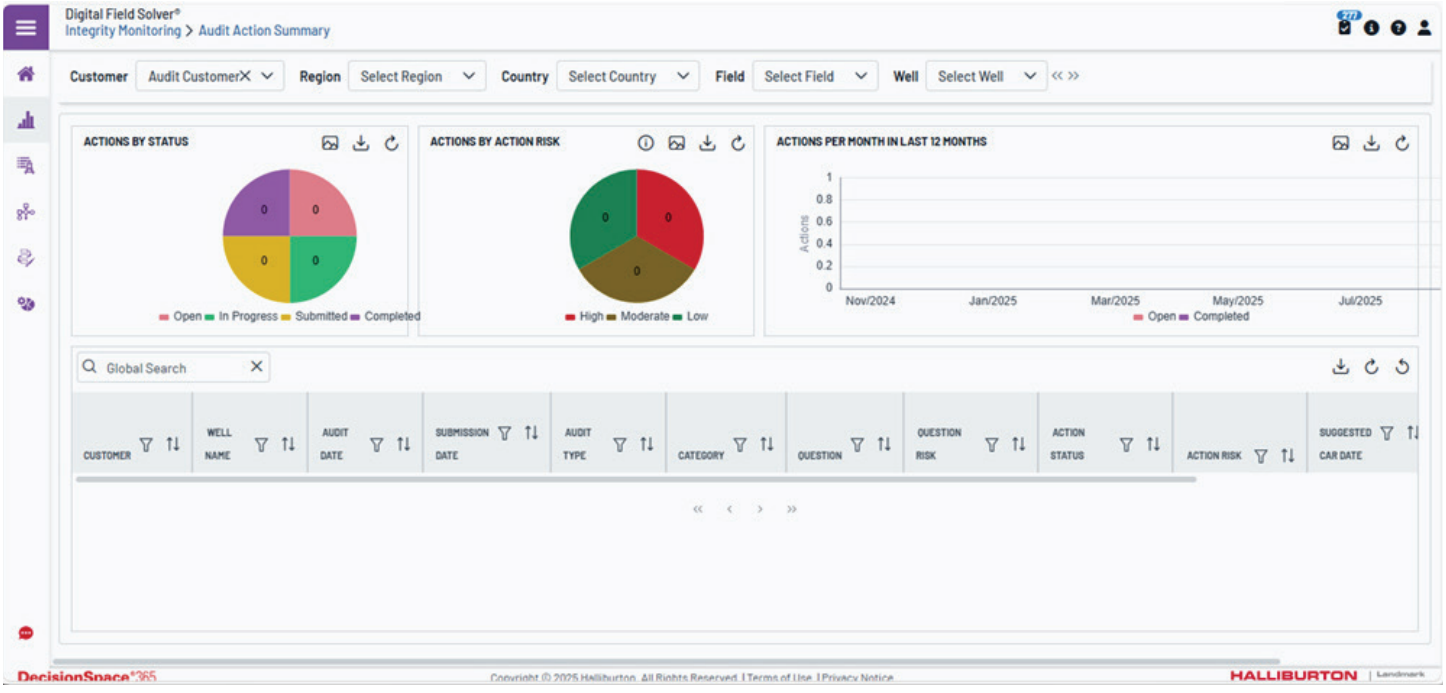

FIG. 2. The KPI dashboard displays audit status distribution, risk rankings, and monthly audit trends over the past year.

Accurate field data also facilitate actionable conclusions, supports regulatory compliance, and improves operational efficiency. To meet these demands, operators require the system to support contextualization and perform complex queries, trend analyses, and go deeper into specific operational questions. Contributions from industry professionals and well control specialists inform the content's technical depth and field relevance.

No two oil fields are the same, and neither are their well integrity management requirements. When software cannot adapt to the specific context of an operation, it often causes E&P companies to work around its limitations, which can hinder innovation and reduce user adoption.

Effective well integrity management software must operate in a diverse technological environment that includes a wide range of data sources, systems, and operational modes. As E&P companies evolve, so do their operational requirements, data streams, and integration expectations. Software that cannot adapt to those demands becomes a liability, adds complexity to system architecture, and increases total cost of ownership.

Halliburton's Landmark DecisionSpace® Digital Field Solver® optimization and decision-making system for oil and gas production addresses these challenges with an open, interoperable foundation. Built on the Open Subsurface Data Universe™ (OSDU), it connects to a broad ecosystem of data sources, such as real-time sensors, historical databases, and third-party applications. It supports dynamic workflows, visualization, and analytics. Halliburton designed the system to adapt and scale with the business. The system helps eliminate the requirement for companies to add additional tools, which reduces complexity, accelerates deployment, and improves long-term value.

The system helps avoid these limitations with configurable solutions aligned with each company's business processes and IT environment. This flexibility supports more effective integrity management within assets.

Landmark's development of advanced software solutions for the oil and gas sector, combined with deep knowledge of well control issues and solutions, reflects a collaboration between Landmark's innovators and Boots & Coots professionals, who help shape well control principles and best practices.

This collaborative approach helps deliver a platform with strong technical foundations and practical field applications. It reflects current challenges, standards and innovations in well control integrity. Industry professionals and well control specialists contribute knowledge, operational insight, and the latest advancements to create content that reflects operational realities, regulatory compliance, and safety requirements. These resources are invaluable for professionals who seek actionable guidance, preemptive solutions, and workflow optimization in the management of well integrity in the upstream lifecycle.

FIG. 3. Close-up inspection of wellhead equipment in the course of a Boots & Coots well control audit.

INTEGRATED DIGITAL SOLUTION FOR WELL INTEGRITY AUDITS

The Boots & Coots well control auditing platform software is an integrated digital solution developed with Landmark to support proactive well integrity management. Embedded in the system, WIM provides a view of the full integrity management cycle.

Landmark delivers the platform through its iEnergy® software, a hybrid cloud environment that supports the deployment, integration, and management of cloud-based E&P applications. This includes digital WIM solutions, which facilitate seamless connectivity between field operations and enterprise systems.

At the core of the platform is an audit engine that identifies "at-risk" wells through systematic audits. The system pinpoints wells that require immediate intervention, remedial action, or corrective measures to well control equipment. With early identification of issues, the platform helps prevent production losses and nonproductive time, which supports proactive integrity management through prompt execution of scheduled or urgent remediation, **FIG. 3.**

This proactive approach improves plans, reduces risk, and

optimizes resource allocation. The application gives customers visibility into asset integrity and supports organized, preventive maintenance and a replacement for reactive, ad hoc interventions. As a result, operators can better schedule resources and reduce operational risk.

INTERACTIVE TOOLS IDENTIFY AND MITIGATE HIGH-RISK WELLS

Well integrity status is visualized through a traffic-light, risk-ranking system that consolidates maintenance history, audit outcomes, customizable operator criteria, and user-defined parameters to provide an immediate appraisal of each well's condition. The interactive dashboard facilitates intelligent resource allocation with real-time risk stratification, FIG. 4. This allows customers to prioritize remedial actions where they are most required.

Key audit results are categorized by high, medium or low risk. When users click on a well, detailed information is displayed, such as a summary of site observations and operations, well type, coordinates, and visual documentation. The dashboard also displays the latest audit report, with audit type, date, and the auditor who completed it. Additional resources such as schematics, layouts, risk assessments, and gas dispersion analysis are available for review.

AUDIT INSIGHTS TO OPERATIONAL CONTROL

Operators can view open audit actions, assign corrective tasks to designated teams, route feedback to a specific email address, set due dates, and sort actions by date, risk level, or status. The interface is customizable to meet daily operational requirements.

When it comes to wellhead configuration, users can rebuild the last known setup of the audited well with Halliburton's parts library. If no wellhead data are available, the system displays the current blowout preventer or Christmas Tree configuration. A centralized database provides streamlined access to historical data, to help ensure that each well's operational and audit history is available for analysis and decision-making. Reports follow industry standards and can be tailored with custom features to support consistent documentation of audit results and corrective action tracking. The system automates report distribution and monitors compliance until all actions are resolved.

A scheduled integrity management program applied throughout the E&P lifecycle allows operators to detect critical well issues early and reduce the risk of failures and unplanned rig downtime. High-quality data and reliable repositories support regulatory compliance and facilitate continuous improvement and strategic asset planning.

On-demand, standards-based reports summarize the well history, audit findings, and operational status. The system distributes reports and tracks the resolution status of all corrective actions.

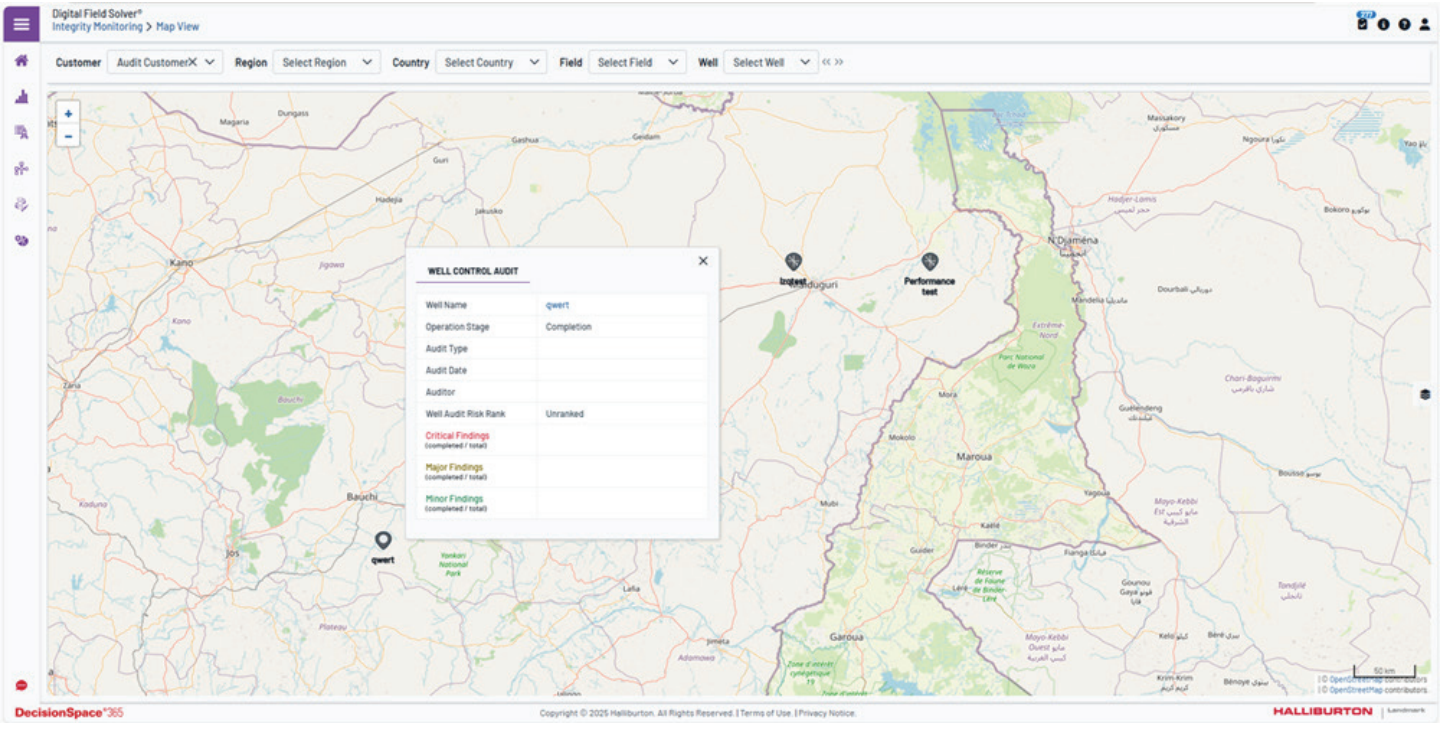

FIG. 4. Interactive map view of the well integrity monitoring platform shows real-time audit risk rankings, operational stage, and site-specific data.

CENTRALIZED DATA AND CONTINUOUS COMPLIANCE FROM DRILLING TO ABANDONMENT

A scheduled maintenance program throughout the E&P lifecycle of a well plays a crucial role in the prevention of well integrity failures. This approach identifies and addresses potential issues before they escalate into wellhead failure or unplanned rig downtime. Regular maintenance helps keep wells in optimal condition throughout their lifecycle stages, from drilling and completion, production, intervention, and eventual abandonment, to support operational reliability and asset value.

Accurate field data collection helps organizations create efficiencies with resource allocation and prioritize interventions, based on condition assessments rather than reactive decisions. Prompt, high-quality data support regulatory compliance and reporting requirements and also inform continuous improvement through root-cause analysis.

A centralized data repository improves operational plans with accessible well histories. It supports preventive scheduling and prompt remediation, reduces the frequency and severity of workovers and shutdowns, lowers operational risks, and improves asset management.

This approach transforms WIM from reactive troubleshooting to a predictive, proactive framework. Real-time data visibility, standardized workflows, automated reports, and compliance tracking equip operators to protect well performance, extend asset life, and maintain continuous production. This digital solution gives operators the ability to resolve root causes with precision, improve maintenance outcomes, and preserve asset value throughout the upstream lifecycle—to turn insight into decisive action. **WO**

ANDY CUTHBERT holds an MPhil in geology from the University of London and has more than four decades of experience in the oil and gas industry. He joined Halliburton Boots & Coots in 2013 and manages a team focused on engineering solutions for relief well construction. Mr. Cuthbert has held leadership roles in measurement/logging-while-drilling, directional drilling, multilateral completions, and project management. He holds 24 patents and has written more than 30 papers and articles.

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