Driving Operational Efficiency With Intelligent Asset Management

Optimizing upstream production and maximizing return on investment with comprehensive, timely, and high-quality information
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Introduction

Global demand for oil and gas continues to increase, and exploration and production (E&P) companies are investing heavily, drilling in deeper waters and taking on greater financial and operational risks in an effort to increase supply, lower operating costs, and increase the rate of discovery for natural resources. The industry faces several challenges, including price instability, an aging technology infrastructure, a declining experienced workforce, and regulatory requirements, aside from the increasingly complex nature of their operations.

Compared to other industries, deep-water drilling operations are not only complex but also prohibitively expensive with significant upfront investments in exploration, equipment, and facilities that can span for years. While drilling, total daily operating costs can run as high as $1.5 million, and once in production, a single hour of downtime can amount to a loss of $500,000 or more. Another factor in this total estimate is the leasing of rigs, which can cost hundreds of thousands of dollars per day before labor and maintenance—making it critical to ensure equipment uptime and reliability while balancing safety and maintenance needs.

To meet these challenges, oil and gas companies utilize some of the most advanced and innovative technologies on the market. They have made steady progress in improving their operations with automation software capabilities such as data collection, monitoring, and visualization for localized subsystems, though many have yet to extend these capabilities at the enterprise level for maximized operational efficiency. There are key improvement opportunities for managing asset information more holistically to avoid unnecessary safety and regulatory risks, and to drive optimized production and enhanced return on investment.

This white paper discusses advanced technologies for managing asset information that can help deepwater-drilling companies leverage timely, accurate, and comprehensive information and gain insight into their operations with a holistic approach. There are key software capabilities that play a vital role in improving operational efficiency and optimizing the capacity of existing assets—enabling E&P companies to gain a competitive advantage in today’s challenging market.

The nature of deep-water drilling requires extremely sophisticated equipment that can operate in offshore waters thousands of feet deep and produce underground fluids such as brine, crude oil and natural gas. An offshore oil platform, which can weigh millions of pounds, must operate in the harshest circumstances with high environmental, personal safety, and financial risks.

Trends and challenges in oil and gas offshore drilling

In addition to growing worldwide demand for oil and gas resources, stakeholders expect return on investment to match best-in-class returns for long-term investments. Therefore, to meet increasing demand pressures and capitalize on profitability potential, oil and gas companies are moving drilling operations farther and farther offshore, and into increasingly deeper waters as near-shore drilling areas and shallow fossil fuel reserves have become exhausted.

For example, there are drilling rigs that have drilled more than 35,000 feet (or more than six miles), and have operated in up to 10,000 feet of water. The combination of human and technology challenges due to exploration in these harsh, remote locations drives the need to manage assets intelligently for increased reliability, operational efficiency, and safety—both for the environment and for personnel.

To operate in such conditions, the stakes are high, and therefore companies utilize some of the most innovative and advanced technologies available. However, there are a number of inherent challenges that may hinder companies from truly optimizing their asset information and leveraging data analysis for improvements across the operations:

- **Incomplete asset information due to disparate systems**
  Deep-water drilling is an asset-intensive operation, yet most companies have disparate systems and applications with endless volumes of data at the subsystem, system, and enterprise levels, whereby information is compartmentalized and may only satisfy the requirements of localized operations. A company’s subsystems on the offshore rigs and onshore systems may not communicate with each other or enable a holistic view to enable coordinated decision making.
For instance, typical maintenance is done on a fixed schedule; many times consideration may not be given to actual usage or performance data to understand whether a particular system requires maintenance sooner or later than a prescribed period. There may also not be a unifying record of maintenance schedules and performance records for similar equipment to schedule parts ordering, sequencing and/or delivery to optimize parts inventory and availability to simultaneously minimize downtime and working capital outlays.

Without system interconnectivity, operators and managers are not easily able to collect and access information, drill down to identify areas for improvement, or apply causal analysis to drive process improvements. Such information could support better decision making to increase production throughput without adding equipment or people while also reducing downtime costs.

- **Inconsistent asset information and lack of a single view**
Disparate systems result in information not only being kept separate and isolated, but also leaves managers and other decision makers without access to accurate and reliable information from all sources at all times. Each group has its own copy of the data needed to do its function, and they may make changes based on individual updates, but rarely are the changes shared, leading to multiple “versions of the truth.”

Inaccurate or out-of-context information can result in counter-productive results, redundancies, and missed opportunities for increased productivity, profitability, and operational flexibility. It can hinder coordinated efforts around aspects such as enhanced recovery, asset availability, and optimal asset utilization, and make it difficult to monitor and manage environmental factors—critical to increasing operational efficiency. The lack of contextualized information can also impede optimized decision making during emergencies to continue safe operations, thus increasing personnel and environmental safety risk.

- **Inaccessible asset information increases risk, drives inconsistent work processes**
The unavailability of asset information can lead to improper actions to the small subset of alarms that signal critical issues, which can increase a company’s liability exposure and costs. Operators today are inundated with more alarms and warnings than ever before, and they often do not have the ability to efficiently prioritize the most critical ones and respond in the best manner with consistent, standardized procedures.

Furthermore, many drilling operators and managers have acquired deep expertise, built over years of experience, but there is no mechanism in place to capture and share this knowledge to guide new or less experienced operators. The expected “brain drain” that could occur when the most knowledgeable and experienced employees either leave or retire increases the likelihood of inconsistent procedures and unreliable responses to issues.

The imperative for intelligent asset management
How can oil and gas companies leverage their asset-related information to ensure that they have consistent access to comprehensive, high-quality information, which improves asset optimization and reliability, process consistency, and profitability?

Companies need to deploy a flexible and holistic strategy for intelligent asset management, one that can help them move from a reactive to a predictive approach. There’s a vital need to bring together and transform critical data from various systems and disparate assets—from off shore systems to onshore systems—into actionable intelligence.

Advanced software capabilities, as discussed in the next section, play a key role in providing a holistic, intelligent asset management approach that enables companies to leverage increased visibility, contextualization, and insight for informed decision-making across the operation—driving optimized operational efficiency and maximized profitability.
Critical software capabilities

- **Information aggregation** helps provide a consolidated view of information from disparate systems and increases cross-functional process visibility at the asset level. The ability to bring together information is the foundation for users to gain understanding into critical process parameters with relevance to the physical, operational, and/or functional context to help drive reduced downtime and asset efficiency at the local, unit, or platform level.

Increased operational visibility allows enterprise personnel to access performance-based views at the fleet level, drill ship subsystems level or asset details. Similarly, operational personnel may view key functions on the platform with the ability to quickly drill down to specific areas and/or functions using physical context such as location, process context such as material flows, or other contextual models relevant to the operation.

Respective stakeholders across the operations like financial analysts at the enterprise level can set up KPIs that relate real-time drilling progress to contractual payment schedules. Similarly, a mud engineer on the drill-ship may set up relevant views to capture flow rates, differential pressures, and other parameters with relevance to critical operations. These views can help optimize the performance of specific pumps, mixing units, etc., as they relate to blending recipes, material utilization, and solids removal.

- **Modeling and analysis** improve understanding into events via drill-down screens, uncovering cause-and-effect relationships in multivariable situations. The complexity of deepwater drilling operations results from interactions among multiple processes, equipment, materials, weather and downhole factors such as the formation being drilled. Some of the latest software capabilities can help users analyze the complexity so that relationships around intricate processes and abnormal process situations are better understood and acted upon.

For instance, there are advanced software tools to create models that can help eliminate noise from parameters that are not affecting the process while isolating parameters critical to operations. These models can be used offline to perform “what if” scenario analysis and troubleshoot process behavior (for example, to validate data anomalies), or can be implemented online to help an operator filter alarms, eliminate spurious sensor measurements, etc.

Leveraging root-cause analysis can help maintenance personnel isolate failure modes such as moving parts in pumps; create relationships to particular operating regimes and for startup speed; help improve operational procedures; and extend asset life. With the added insight that sophisticated analysis provides, operators can troubleshoot problems faster, optimize processes, and help prevent future problems.

- **Predictive monitoring** is key to reducing risk by utilizing real-time, accurate data to help operators “look ahead,” and evaluate “what-if” scenarios to anticipate problems based on current process conditions or simulated conditions. Analytical process models coupled with predictive tools can provide active messaging and decision support such as condition-based maintenance regimes that help improve key performance indicators like availability and downtime for critical equipment.

Maintenance costs in deep-water exploration and production operations are an order of magnitude higher as compared to onshore operations, particularly for subsea components. Operators have to maintain a delicate balance between safety, extending asset service life, and costs. Access to accurate usage data (for example, time in service, critical operating parameters and process conditions associated with the operation) can help estimate “wear and tear” to critical parts, and identify replacements and adjustments that need to be made with greater precision.
Analytical models may be created to extrapolate effects of multiple process variables and then monitored as a means to estimate time between repairs, list of parts to be made available, testing, and validation. Such models may not only help prevent unnecessary downtime but extend the life of critical equipment by enabling operators to anticipate parts, materials, and expert availability—resulting in reduced operating costs.

- **Reporting, secure data archiving, and audit trails** provide accessibility to accurate information, enabling better coordination across operations and supporting compliance efforts. With capabilities like accurate data capture, secure timestamps and source identification, oil and gas companies can leverage consistent, comprehensive internal and external recordkeeping for regulatory compliance, inspections, and liability protection. There is a greater need for such information as owner operators go into deeper waters and into environmentally sensitive regions of the world to look for hydrocarbon deposits.

  Software capabilities may include electronic signatures, verification, and validation, which not only make recording of activities efficient, but also secure data into verifiable archives and retrieve data in the form of structured reports. Having maintenance records online helps verify when equipment or a system was serviced, what parts were replaced, who certified the work, and other pertinent details.

  For instance, knowing how long a riser assembly has been in service vs. in storage or on-deck can help schedule maintenance, and access to on-demand reports enables efficient sharing of information with critical stakeholders such as inspectors. Anytime access to service records help expedite maintenance, and avoids unnecessary maintenance or last-minute drills to satisfy regulatory needs. Furthermore, consolidated records help with end-customer reporting, better utilization of OEM expert time, and automation of periodic compliance reporting.

  Industry norms indicate that predictive maintenance costs are less than 15% of the cost incurred for maintenance after breakdown. Similarly, preventive maintenance costs are typically 50-60% less than breakdown maintenance costs—supporting the significant advantage of predictive and preventative software capabilities.

- **Contextual propagation and knowledge management** are receiving greater focus by companies that increasingly realize the immense value of delivering actionable intelligence and collaboration to support users across the enterprise, and have significant potential to help E&P companies build a competitive advantage by enabling increased reliability, safety, and profitability. With high growth in deep-water drilling and a lack of new petroleum engineers to replace a retiring workforce, the need for a knowledgeable workforce is evermore critical.

  Workflow software tools can capture hard as well as soft “tribal” knowledge into electronically implemented work processes, integrating both automated and manual business and production processes, including validation and verification of actions by operational or field personnel.

  Such verification could be as simple as certification that an action was completed via an electronic signature or a more sophisticated combination of geospatial location verification, bar codes, and RFID to certify that the right part was brought to the right piece of equipment and implemented using a prescribed procedure by a certified technician.

  Workflow software also enables companies to create information-rich, circumstance-based workflows, disseminating actionable intelligence as standard operating procedures for improved operational reliability and efficiency. Capabilities with a process plant model and a workflow engine are critical as processes become complex with environmental challenges, remote locations, greater depths and interdependencies between sophisticated operations.

  **Enterprise intelligence** is the culmination of all of the critical capabilities discussed above that provides a true holistic view to help companies predict and optimize performance across the operations. It delivers contextualized information and intelligence that enables E&P companies to leverage condition-based maintenance and decision support, which drive operational efficiency, help optimize capacity, and increase profitability.

  Advanced software with enterprise capabilities are crucial for effective decision support because it provides context to data from disparate sources and transforms this data into meaningful information for better understanding into interactions and relationships, as well as the ability to model and predict future performance with greater accuracy.
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For example, creating simple models of performance visibility such as time spent on critical operations like drilling, circulating, reaming, connecting, washing, and logging can provide in-depth understanding into resource utilization compared to “progress to goal” to help optimize decision making.

Such software can also help users create sophisticated multivariate models to isolate process variables that may be affecting an operation or a critical asset such as correlating mud pressure changes on the topside with down-hole conditions, bottom-hole assembly performance, mud-pump performance, and mud composition.

The value of enterprise intelligence offers great potential because of the depth of insight it can deliver. For instance, predictive models around processes or assets can provide a current view of power consumption across disparate systems on the ship and the ability to predict future consumption scenarios based on past performance, expected operating regimes, and other interdependent relationships.

| Optimize efficiency and performance | • Gain insight into critical parameters to improve utilization of equipment and processes, and optimize parts inventory  
• Use analytics to improve operational procedures and extend asset life  
• Understand cause-and-effect relationships for faster, better troubleshooting  
• Leverage predictive modeling to anticipate parts, materials and expert availability |
|------------------------------------|---------------------------------------------------------------|
| Decrease operating costs           | • Use modeling to estimate time between repairs and identify replacements/adjustments for maintenance, minimizing downtime  
• Increase compliance with accurate reporting and data management  
• Capture and digitize expertise and create information-rich circumstance-based workflows  
• Avoid expensive overhaul of subsea components with condition-based maintenance |

Scalability and interoperability provide a critical advantage

Lastly, an important consideration for E&P companies to deploy a holistic technology strategy is the selection of an open and layered approach that leverages a service oriented architecture (SOA) framework. Such a foundation is modular, scalable, and easy to maintain and operate, and it allows companies to seamlessly integrate with existing and future technologies and improves interoperability between different applications—resulting in significantly faster time to value and reduced costs.

SOA simplifies systems and delivers a solid backbone for leveraging “real-time” and historical information, providing an infrastructure to distribute the information between different applications. With SOA, developers also have common architectural services like security, event management, and user services, which reduce engineering efforts. It also allows for “plug and play,” whereby functionality can quickly be added, changed, or removed to meet evolving needs and market demands.

Conclusion

As increasing global demand for oil and gas resources and profitability pressures drive E&P operations farther offshore and into harsher environments, operational efficiency and optimized production have become a business imperative. Now is the right time for companies to consider a holistic technology strategy that enables intelligent asset management at the enterprise level—transforming the sheer volume of data into contextualized information that can be propagated across the enterprise for critical decision support.

There is a tremendous opportunity for E&P companies to enhance production with an open and layered, flexible intelligent asset management software solution that complements their existing and future technologies. The increased visibility and understanding that the latest software capabilities enable will help companies move from a reactive, localized approach to a holistic, predictive model—driving optimized upstream production operations and maximized return on investment.

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