Advancing digital field operations

Technology bridges the gap between oil and gas computing and office/cloud computing.

As digital technologies developed during the last 20 years, the oil and gas industry began its own digital transformation, using the Industrial Internet of Things (IIoT) and Big Data analytics to enhance the E&P lifecycle. Halliburton’s Voice of the Oil Field tool bridges oilfield operation computing domains with office/cloud computing domains in real time.

The technology represents a shift from many digital oilfield programs that were implemented between 2000 and 2010 and focused on operational data. Technologies such as IIoT, edge analytics, Big Data analytics and cloud computing enable collecting and transmitting more data in real time as well as faster and more accurate simulation models. The Voice of the Oil Field tool uses these technologies and integrates all related data within the complete value chain of production operations, making it possible for multidomain analysis and Big Data analytics to identify patterns that could not have been detected in the past.

The technology accelerates the monitoring, analysis and optimization loops of production operations. Production operations in digital oilfield implementations include a fast loop that keeps operations within the operational envelope, a medium loop that focuses on well and surface network optimization, and a slow loop that optimizes reservoir recovery while maximizing production by combining well/surface models with dynamic reservoir models.

The technology accelerates production operation loops by continuously integrating production information and updating subsurface and surface models, thus enabling real-time reservoir optimization. Using data-driven proxy models and edge analytics, Voice of the Oil Field can implement intelligent closed-loop optimization at field levels, allowing increasing efficiencies of wells and equipment for complete field optimization.

Through sophisticated first-principle and data-driven models to capture the complexities of reservoir management processes, the tool also delivers scientific depths of analysis for precise recommendations.

Integration with IIoT

To obtain real-time data from wells and equipment, the technology offers seamless integration to IIoT devices, including sensors and actuators that provide instantaneous information about production process dynamics and equipment performance. These IIoT sensing devices connect automatically to a control network using self-discovery capabilities, which means that once the device is turned on, it is immediately recognized by the network and can share information. With the integration of IIoT devices, Voice of the Oil Field technology is able to capture a wide variety of signals and data such as pressures, temperatures, levels, flow rates, pump speed and amperage, video, motion, and personnel locations.

Edge devices execute real-time analytic algorithms to facilitate production monitoring, event detection, alarming and closed-loop production optimization for wells and facilities. Edge devices can analyze real-time operational data, providing a “reflex” capability to the well and giving it a greater degree of autonomy. Edge devices enable self-monitoring, self-control and
self-healing features for individual wells as part of an integrated system that incorporates field analysis and simulation systems.

**Open platforms**

Open platforms are integral for implementing specialized production operation solutions. The new technology features an end-to-end open platform that provides access to information from any domain in E&P life cycles along with advanced analysis, workflow orchestration and visualization capabilities.

Additionally, the tool applies a comprehensive infrastructure of Big Data analytics that comprise not only the systems and libraries used for implementing analytics but also specialized algorithms designed to address the challenges of the oil and gas industry.

Integrating digital applications, companies have increased their reservoir limits significantly, resulting in a decrease of up to 20% in upstream and downstream capex. Some companies have begun using 4-D seismic imaging to add a time-lapse dimension to traditional 3-D imaging, enabling them to measure and predict fluid changes in reservoirs. This enhanced view of reservoirs typically increases the recovery rate by as much as 40%, boosting upstream revenue by up to 5%.

Another important characteristic is that the integration platform, specialized applications and simulation models are implemented in the cloud.

The tool’s automated workflows orchestrate data, simulation models and petrotechnical applications. The workflows executed during the production life cycle can be categorized as production operations support, production surveillance and loss remediation, and production optimization.

Production operations support includes workflows that automate daily executed tasks. Production surveillance and loss remediation workflows analyze well and facility performance, detect/predict failures or operational events, and forecast production rates. The implementation of surveillance and loss remediation workflows have reported a five- to tenfold time reduction in the detection of operational events, resulting in decreased downtime and deferred production.

Production optimization workflows use first-principle and data-driven models to optimize the production of individual wells, the field production network or the entire reservoir. Several case studies demonstrate that implementing production optimization workflows has generated a 5% to 8% increase in production and a 20% operating cost reduction in operating fields.

**Sample implementations**

IoT devices are used for field data capture, high-speed connections to field devices and a cloud-based integrated production environment. This provides access to relevant data and comprises simulation models and specialized applications for performance analysis and production optimization. Edge analytics also are implemented to enable well pad event monitoring, well health diagnostics, closed-loop control and optimization capabilities.

Voice of the Oil Field makes it possible to implement an intelligent completion optimization solution that combines advanced simulation and workflow automation to improve completion designs and optimize the downhole valve settings to maximize production per zone while delaying water breakthrough in operating wells.

The subsurface and surface instrumentation installed at the intelligent completion is integrated with edge analytics, in which proxy models and edge analytic algorithms optimize the downhole valve configuration in response to operational events in real time. Integrating near-wellbore and reservoir simulations that are continuously updated with real-time data intelligent completions will allow the analysis of the fluid patterns in the reservoir to optimize the intelligent well’s inflow control valve/inflow control device configuration for maximum recovery.

Integration of real-time data, well-test information, and well and surface network models enables analyzing performance of artificially lifted wells and optimizing the configurations of pumps or other artificial lift equipment. This helps optimize the efficiency and run time of equipment while maximizing production. This artificial lift optimization tool provides operational monitoring, well performance evaluation and artificial lift efficiency optimization. This tool includes edge analytics designed to run on the edge device at the field level to execute smart alarming, pump failure and tripping detection, pattern recognition, and intelligent control. The technology also minimizes downtime for artificial lift equipment and identifies opportunities to maximize equipment efficiency and increase production.

**References available.**

Have a story idea for Operator Solutions? This feature highlights technologies and techniques that are helping upstream operators overcome their challenges. Submit your story ideas to Group Managing Editor Jo Ann Davy at jdavy@hartenergy.com.