Data Management

Exploration process optimization: a vision for the integrated exploration workflow

Microsoft has formulated a systematic approach to streamlining the process involved in every stage of exploration with reduced costs and optimal use of human resources in mind. Upstream market development manager Mike Sternesky describes the thinking behind the vision.

In today's petroleum industry, two of the primary issues facing oil and gas players are cost control and human capital. Unprecedented upward price volatility has escalated costs by almost 200% in the past three years, greatly multiplying the risk factors for exploration projects. Further, a generation of the upstream industry's most seasoned and knowledgeable exploration and production (E&P) professionals are preparing to retire, with a smaller number of qualified workers set to take their place. Although specific timing may be uncertain, many in the industry expect to see substantial shortfalls of E&P professionals in the coming years. The industry requires an integrated exploration process open to innovation and emerging technology to continue to reduce exploration costs and overcome the looming gap in available human resources.

This optimized exploration process is a key enabler for business growth and brings value where opportunity exists to reduce costs through better innovation. The process makes use of additional computing resources to boost productivity, introduce new ways of connecting and sharing insights into technical and engineering advances, and to better automate the data management function. The ability to absorb more data during analysis will improve business insight, resulting in reduced cycle time, reduced cost and reduced risk. These efforts will enable top-line revenue growth as exploration excellence is turned into bottom-line performance.

Integration challenge

At its essence, this optimized exploration process enables geoscientists and engineers to make use of guided workflows based on scientific and engineering principles that provide open and easy access to data and the collective best practices of the company. It also integrates potential outcomes in a highly collaborative and interactive environment to help industry professionals better define and select exploration projects that meet the risk and return requirements of the company.

In spite of the high importance given to integration of the workflow among professionals, there are still major bottlenecks that impede the rapid progression of work to an orderly conclusion (i.e. to drill or not drill a prospect). These impediments include:

- Poor user experience in applications supporting the exploration workflow
- Barriers to collaboration caused by physical distance among teams or functional professionals, poor communication links, and limited bandwidth to remote locations where hydrocarbons are found
- Lack of interoperability among various application platforms and disparate sources of information

Data management also remains a huge bottleneck to the flow of information. It has been widely reported that integrated teams spend 60% of their work time searching for, retrieving, formatting, and reformatting data. Clearly, today's data management processes require far too much time in collecting and framing data for decision-making purposes.

A large majority of time and energy is spent in basic data assembly and data quality processes. A reduction in the time spent on front-end data collection would enable
more opportunities for critical data analysis, thus improving insight and decision quality.

Saving just 20% of upstream professionals’ time through better accessibility of data would have a tremendous impact on the bottom line, translating to an estimated savings of approximately half a billion dollars per year for a company with 10,000+ E&P professionals.

**Enabling exploration process optimization**

Microsoft has studied the E&P industry through work with customers, developers and independent software and hardware providers, and has developed an integrated view of the top issues facing the E&P industry. Key challenges – whether for independent or major E&P companies – involve cost-effectiveness, cycle-time reduction, risk reduction, systems/software interoperability, effective communication, and better portfolio management in order to create a totally integrated work and system environment.

The keys to reduced cost, greater innovation, and faster growth can be summarized as follows:

- Reduce decision cycle time and risk
- Integrate disparate systems on different platforms
- Interconnect diverse systems and make them interoperable
- Communicate with remote systems
- Achieve flexibility and agility
- Achieve performance and scalability
- Capture and share knowledge and keep up to date with innovation
- Connect experts/professionals from within the organization and from third parties/consultants

By aggregating these requirements, Microsoft has developed a vision for the evolution toward exploration process optimization that consists of four core capabilities. They are:

- Connected systems. Software networks that span applications, devices, and professionals can help streamline processes, improve knowledge sharing and reduce costs. Connected systems enable interoperability of legacy and more up-to-date role-based applications and workflow tools. Connected systems also take advantage of industry data standards such as PRODML, WITSMIL and PPDM.

- Collaborative environments. Through rich interfaces and collaborative experiences, professionals can improve collaboration and standardize workflows through benchmarking and explicit work assumptions and thought processes.

- Information-driven software. New application platforms and frameworks can dramatically improve the way the E&P community finds, organizes, and acts on information, facilitating better collaboration, more transparency and enhancing efficiency by better tracking personnel performance and continually optimizing guided workflows.

- High performance computing (HPC). By reducing the complexity of HPC, parallel computing can be more accessible and help address the increased need for computational power that will allow for greater reliance on scientific data modelling to guide every day decision-making.

The powerful combination of these capabilities optimizes the exploration process and brings value across the entire sector in myriad ways. For example, consider the following technical challenges and issues encountered in the exploration process. Although in no way comprehensive, these critical functions are a cross-section of workflow processes that can be optimized with the adoption of an integrated and agile platform that embraces the newest technologies.

*Data collection.* The ability to locate all relevant data for an exploration play can make the difference in assigning the correct assumptions to the reservoir characterization and the models constructed to simulate its performance. More data is better and the ability to find relevant data is vital.

However, the number of information sources is staggering, with multiple data repositories both inside the company and from third party resources – all containing terabytes of structured and unstructured information. Enterprise search tools are available today that dramatically improve the speed and relevancy of search. The quality control aspects of this task also consume far too much human resource. Simple-to-use spreadsheet add-in software allows massive amounts of data (i.e. hundreds of millions of rows) to be quality checked using the familiar Excel application.

*Data analysis.* Analytic processes involve the use of multiple specialized applications to process seismic data, render 3D images, correlate logs, and perform attribute analysis. The review of calculated 3D images is typically performed in specially designed collaboration environments where teams of geophysicists, geologists, and reservoir engineers gather in customized viewing rooms to see how collective minds can create insight that the same group working in isolation could not develop.

The capture of the richness of the thought process is enhanced by software that allows each person in the review team to share an interactive and linked electronic notebook organized for the needs of each participant and synchronized automatically in real time as notes are taken.

*Synthesizing geophysical models.* Exploration professionals work with extremely large amounts of data in
vetting and analyzing exploration plays. Once a characterization of the subsurface area of interest is agreed upon, geologists construct a detailed earth model that simulates the characteristics of the reservoir.

The computational requirements to relate all the data in the model are enormous. However, to consume more data and reduce cycle time a robust HPC environment is needed. Today it is possible to achieve HPC at the desktop level to perform computation and data intensive tasks and be more productive.

Once a geophysical earth model is built, petroleum engineers construct reservoir models to simulate the performance of the reservoir. These models are also very compute intensive and HPC capability can make the power of compute clusters easily available to the knowledge worker looking to run multiple realizations of their models. Multiple calculations of the model varying key assumptions helps quantify risk. The faster these models run, the shorter the cycle time to first oil.

Calculating performance risks and test models. At this stage the visibility and explicitness of the model assumptions are critical to ensure important variables are considered in the evaluation. New software forms tools, along with electronic content management (ECM) capabilities are well suited for managing the risk profiling task, avoiding the confusion of standard network file folders.

Building cost models. The applications available to build and run cost models are also compute intensive. New operating systems running on 64-bit processors can run these applications faster than conventional 32-bit systems. However, some of the relevant applications are not yet available for 64-bit operation. New operating systems enable users to run a virtual 32-bit PC environment inside the 64-bit environment so that critical software that has not yet been updated can be used, while still enjoying access to the most up-to-date platform capabilities.

Designing discovery wells. This is another of the many highly collaborative tasks in this process. Specialized applications calculate the engineering dynamics of the proposed well trajectory and depth, optimize the well path to minimize torque, and drag and optimize the cost profile while minimizing risk of catastrophic failure. These applications can be virtualized for collaboration or displayed in a virtual meeting environment when a view-only collaboration session is required. New software applications utilize limited bandwidth networks and automatically optimize the transmission to scale back bandwidth demand for those users so constrained.

These plans, engineering specifications, and drawings must be shared with the drilling and completions contractors who bid and manage the process. The ability to use subscription-based cloud services to store and securely share this information is a new capability that eliminates...
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Sanctioning the initial well. Once the peer review and financial analysis is performed and approved, the authorization for expenditure (AFE) is prepared to provide budgetary authority to commit for the millions of dollars that may be required to drill the first well. This is a document that lives in enterprise resource planning (ERP) systems such as SAP. Many work processes cross at the AFE, and interoperability of this information for reuse to develop key performance indicators (KPIs) for managing functional execution such as drilling and procurement is necessary. Middleware exists today that enables the interoperability needed for the free flow of information between ERP and technical operating performance management systems and KPI dashboards.

Monitoring drilling in real time. Drilling progress for major wells is often monitored in real time so that geologists and engineers can provide immediate guidance to the drilling teams of impending hazards or make well trajectory course corrections because of new information logged by the drilling crew. These drill sites are often located in remote locations, and telemetry is fed to centralized collaboration environments around the world. Network bandwidth is often limited in these locations. Microsoft has redesigned its servers to reduce the communication burden and allow for branch caching of large files locally to increase the network throughput.

These analytical processes can allow for automated history matching which accounts for differences in the simulated production projection versus the actual production. By reconciling these differences, the forecast accuracy and reliability of the models can be improved and insight into the reservoir enhanced.

Handoff play with documentation to appraisal group. The handover of all the detailed documentation supporting the discovery well is needed for the appraisal staff to further delineate the size of the field, the total hydrocarbons in place, and the expected recovery of these hydrocarbons under different production well placement assumptions. Newest versions of collaboration server software make these transitions a seamless process, and enhanced ECM functions allow for examination of the details of the prospect development from play concept development to well completion.

Post process review. Each step in the exploration process is a stage gate to the next, and the play can be abandoned at any step that indicates the play is not prospective enough to justify the risks of failure and that further work is not justified. Every step should have a process map and business process workflow tool with a management tool that can track each step from initial work request to task completion. Now functional management software is the tool design to deliver all the capability described above.
domain experts can map the business process and have the IT department quickly turn that process design into executable workflow code using the Visio add-in Process Modeler 5 from ITP Commerce.

The system can then provide tracking of each step of the workflow process as it is executed. This capability enables visibility and insight into the elapsed time for both the machine process steps and the execution of the human workflow and can quickly highlight any bottlenecks in the process. Even with projects that do not pass through a stage gate, learning and insight is developed as to what crucial assumptions were incorrect and what quality steps could be introduced to avoid similar outcomes in the future. The workflow processes can then be easily changed to reflect the updated process. These systems are agile and allow for fast adaptation to changing business conditions.

**Keys to exploration optimization**
The use of an integrated, agile platform as outlined in the scenarios above can accelerate process improvement by:

- Performing data processing faster with HPC.
- Automating the basic data collection and QC process through software.
- Providing state of the art enterprise data search and analytics capabilities.
- Automating workflow management and providing KPIs on critical bottlenecks.
- Providing tools for capturing assumptions, interpretations, and knowledge, thus integrating best practices.
- Providing analysis frameworks allowing more time for critical thinking.
- Providing easy to create workflow templates for best practice sharing.
- Providing a platform, for exchanging ideas and information with other professionals.
- Visualizing key information on maps so that analogue well data can be easily found.
- Virtualizing applications for improved collaboration.

Microsoft’s vision for exploration process optimization, calling for industry adoption of connected systems, collaborative environments, information-driven software and high performance computing, will provide users with access to high quality and up-to-date information and data in timely fashion that enhances productivity, reduces cycle time and lowers both costs and risks for organizations grappling with today’s exploration sector issues and challenges.

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