McKinsey&Company

Richard Ward

A billion-dollar digital opportunity for oil companies

Oil & Gas March 2016

Making better use of existing technology can deliver serious returns—by increasing production, streamlining the supply chain, or reducing engineering time.

The computers in the offices of the average big oil company can find an additional $1 billion in value, if you let them.

Modern advanced-analytics programs are able to diagnose, sort, compare, and identify cost savings, or opportunities for increased production, in a manner beyond the capabilities of the average employee. The tools that allow you to do this have been available for several years, but adoption by the oil and gas industry has been slow. This is partly the result of the recent crash in oil prices, but competing internal IT projects and organizational reluctance to put in the effort required are also factors.

In this article, three stories are told. In each story, the average big oil company (AB Oil Co.)[1] could realize $1 billion in cost savings or production increases by deploying technologies that exist today.

Finding $1 billion in the supply chain

The vendors have been brought in for meetings. AB Oil Co. has demanded discounts, and the vendors have agreed. What more can be done to save money?

For the past several years, hundreds of millions of design, procurement, and operational choices have been made by the organization. Valves have been sized and ordered, casing-team contracts awarded, and orders for cement placed, pretty much with the same vendors in the same way. In the meantime, some vendors were charging less in one field than another; some crews had fewer failures than others; one supplier had lowered the cost of an entire class of suitable products. But AB Oil's engineers never took advantage of any of these opportunities. Why? Because there is too much of this type of information: there are too many dynamic variables in too many places for any single person to know everything, or enough to make optimal decisions. It is too much even for a team of professionals dedicated to the task.

But it is not too much for your computers.

[1] This article assumes the average of the 20 largest oil-producing companies in the world.

The new generation of advanced-analytics programs are able to execute a massive analysis of all these data, normalize them, and identify opportunities for cost savings that can be leveraged across future operations.

In one case, a super-major drilling horizontal shale wells in North America found that its costs, as well as those of its competitors, varied highly across plays. The company assembled a data team and collected information from finance, operations, competitor investor presentations, and industry news stories. A software program did bottom-up analysis, churning through millions of records, normalizing, correlating, and seeking high-probability maximums and minimums, guided by an experienced team of engineers and procurement staff. At the end of this multiweek process, the team could confidently propose critical changes to casing design, procurement, and casing crew selection.

The savings came to $700,000 per well. As this company had about 1,300 future wells to drill, the total potential was $910 million—not quite a billion, but awfully close.

Saving $1 billion in engineering time

AB Oil Co. employs tens of thousands of engineers and technicians working on thousands of projects. They are scattered around offices and facilities in many locations and time zones. Instinctively, we know that not all those projects can be successful, or even efficient in how they operate. The challenge for oil and gas companies long has been how to quantify, and thereby identify, the poor performers. Project reviews inevitably surface unique circumstances that justify the status quo, and reviewers are rarely given the resources to drill down to the root causes of poor performance.

But your computers can.

A new analytical method to study this exact problem was developed in the world of Formula One racing, in which global racing teams have hundreds of engineers pursuing thousands of technical projects in parallel. Researchers gathered communications data (for example, email subject lines, dates, and names), interim work products (for example, meeting presentations), time sheets, staff locations, and travel expenses. Then, using analytical tools, they were able to gain comprehensive views of the efficiency and effectiveness of the different teams. Without the bias of any top-down assumptions (for example, that bigger teams are less efficient), the tools processed millions of correlations and hypotheses. Each step in the analysis highlighted high correlations with and predictions of high performance while eliminating low-value insights. After thousands of iterations, two clear sources of inefficiency became apparent.

Teams that communicated infrequently but needed a high degree of coordination underperformed as a result of misaligned priorities or personality conflicts. This resulted in missed deadlines and aimless, unproductive work.

Teams that communicated more frequently than would be expected, given their need for coordination, turned out to be struggling to schedule basic review meetings or problem-solving sessions across time zones. This resulted in wasted hours of effort, and hours wasted waiting on others. (All this showed up on the time sheets of these teams.)

In both cases, once the data were in, remedial actions included canceling projects, reassigning staff, and establishing better working norms. In documented cases, teams saw a 15 to 20 percent reduction in charged engineering hours across their portfolios of projects.

Oil and gas engineering teams exhibit similar structures and behavior but lack the tools to quantify team efficiency. Given current fully loaded engineering costs, AB Oil Co. would only need to find about 1,500 surplus engineering positions out of tens of thousands to capture $1 billion in value over three years. This endeavor—and that $1 billion—are well within the capabilities of the analytical method.

Increasing production by $1 billion

Despite the current industry focus on cost cutting, value can still be created by increasing production. For example, the relationship between workovers and production optimization can be expressed by the Pareto Principle (or the 80/20 rule), whereby 80 percent of potential production increases in existing fields come from roughly 20 percent of the wells. Historically, it has been difficult to identify the 20 percent of wells with the most impact on production, in order to invest workover time and effort proportionally. Traditionally, the investigative process required multiple analyses from several technical tools to produce an evaluation. This required moving and reformatting data from system to system. But this process is often so burdensome and frustrating that organizations abandon evaluations before they ever reach an informed decision, resulting in workover programs that focus on targets of opportunity rather than the best targets.

ConocoPhillips reportedly set out to change this dynamic in 2013 with the implementation of the Plunger Lift Optimization Tool (PLOT) project. However, the use of the word “tool” is a bit of a misnomer. The project took what was already there—analytic tools for wells and plunger lift systems, data from multiple sources (including Excel spreadsheets), and the engineers’ knowledge of what needed to be done—and simplified it. The simplification was accomplished through the use of what is generically known as software workflow automation, or robotic process automation. In short, this technology sits next to existing tools and data sets, copies the processes executed by the engineering team, and then improves upon them by using automation and knowledge of the hidden commands contained in every major software tool. PLOT integrated 43 different charts and graphs (generated from multiple systems) into a single flow that told the performance story of a well from beginning to end. (This technology was originally developed outside of the oil and gas industry to help integrate and automate call-center functions.) The principal value of PLOT was that nothing new needed to be created to integrate the workflow. No new databases or data models were required, as the tools function at arm's length.

Using PLOT, ConocoPhillips reportedly increased production by 30 percent in the field where this capability was implemented. Over three years, and assuming a net price of $40 per barrel, this increase in production will yield an additional $1 billion in revenue—all by using digital technology available to anyone and everyone.

These capabilities and tools have been developed outside the oil and gas industry, in places such as financial-services firms, Silicon Valley, and university laboratories, but they are now finding meaningful use in oil and gas. In general, these fall into two categories.

Advanced analytics/machine learning. The past few years have seen a dramatic increase in the development of tools and techniques that allow for better-than-human levels of statistical analysis and model building. These have been enabled by the computational ability to assemble incredibly large data sets and the layering of different analytical techniques into a high-performing stack. Weekly, there are announcements of new analytical systems capable of surpassing human levels of performance in tasks such as facial recognition, optimum-path calculation, and predictive pattern identification. We see these technologies and techniques increasingly applied in business and engineering situations where there is an abundance of data and information, the potential to find best and worst cases, and the opportunity to identify complex patterns over time. Applied to the needs of the industry, experiments have begun, with production systems implemented in procurement (as with dynamic should-cost models), maintenance, and construction.

For an example of what the future may hold in machine learning, search for "DeepMind" and "Atari" online. Videos demonstrate how Google DeepMind developed a program that learned how to beat an old Atari video game and then designed a more efficient strategy for winning.

Simplified process automation. Traditionally, integrating software systems has been similar to a civil-engineering project. Large, inflexible components are bolted together as rigidly as possible in the hope of creating stability and longevity. However, this approach often leads to hard-to-change systems that cannot adapt to changing situations. In the past few years, new, more flexible approaches have been developed in which the integration software (once known as middleware) acts more like a person at a keyboard than a tangle of wires and connections. Process-automation tools read data from the available screens and application-programming interfaces of one system and then enter these data into the next, without hard-coded instructions. Marketed under labels such as software orchestration, robotic process automation, and simple automation, these platforms run on all types of hardware, including smartphones.

Putting these capabilities—machine learning and process automation—to work requires organization and an organizational strategy, as not all tools apply to every asset, and not every organization has the skills to take advantage of the tools.

However, to some extent, every company has the opportunity to use and benefit from them. Experience has shown three factors are especially important to the success of technology-driven opportunities:

1. Portfolio thinking. As in exploration, where it may take a few wells to find the sweet spot in a play, it sometimes takes more than one pilot to discover which technologies work best in different situations. It therefore makes sense to launch several pilots of high-potential technologies, managing them—and the resources devoted to them—as a portfolio.

2. High-performing teams. Just as private-equity firms invest in experienced teams to develop speculative plays, oil and gas industry management should encourage already-successful teams to pilot promising technologies. Such teams already know how to manage risk and disruption, and they are therefore ideal for exploring and exploiting advanced-analytics and machine-learning capabilities.

3. Frequent reporting. One of the benefits of digital technologies is that they make rapid iteration possible. That allows mistakes to be made, and work-arounds to be implemented, more quickly (and at lower cost) than they can be with physical systems. Reporting progress on a frequent basis encourages creative problem solving and involves management more actively in digitally derived process improvements.

These success factors are characteristic of high-performing organizations. Such organizations are best able to recognize the potential of their leaders and achievers, manage risk as a portfolio of outcomes, and hold teams accountable—if not for results then at least for effort and persistence.

Because the price of oil will continue to change, one determinant of success is a company's ability to adapt and develop new ways of working that are well suited to current conditions. In today's low-price environment, the thoughtful implementation of technology-enabled, highly efficient processes will distinguish those companies best fitted to survive. □

Richard Ward is a senior expert in McKinsey's Houston office.