Next level oil, gas and chemicals

While digitalization has been gradually making inroads in the oil, gas and chemicals industries, it has primarily been at an asset level or in functional or geographic pockets within an organization.

Market dynamics and challenges are forcing a massive change in the OGC industry's approach to technology, but business objectives will remain the same:

- Optimize operations
- Improve reliability
- Generate value through competitive differentiation by streamlining costs, staying on schedule and managing risks effectively.

What's changing is the way O&G firms achieve these objectives. Digital technology's potential to revolutionize the OGC industry has become viable due a confluence of factors:

- Low oil prices driving the need for cost savings of up to 40 percent
- Declining sensor prices
- Increasing viability of secure cloud data storage solutions
- Wireless networking technologies capable of delivering up to 1 gigabit per second (Gbps)
- Computer processing power sufficient to handle petabytes

Accenture estimates that automation, SCADA and internet-enabled devices can lead to production gains of one to four percent through optimization and remote control of equipment, for example by varying pump speeds to react more effectively to well conditions. There is also a rising acceptance of cloud computing in the sector, predicated on solid data protection. Many of today's business leaders see the benefits of easily adjustable storage as a way of tamping down IT costs as well as facilitating more lucrative interactions with suppliers and customers.

Driving digitalization is a high priority for OGC executives. According to a global survey of oil and gas CEOs, 86 percent personally champion the use of digital technology and a similar percentage of US CEOs say that technological advances will transform their businesses over the next five years.

According to a 2015 Accenture survey, 60 percent of the 229 professionals surveyed say they are investing the same or more in digital technologies to improve performance, despite the market downturn. 80 per-

cent expect to continue doing so for the next three to five years and 90 percent agreed that investing in digital technology would increase business efficiency and value.

Good data is necessary for good decision-making, but acquiring that data can present challenges. Operators have told us about losses of up to one million dollars per day for shut-ins due to communications problems, often caused by out-of-date technology. Additionally, if there are gaps in the data, decisions taken by engineers will likely be suboptimal and profits will suffer, albeit in a slightly less obvious way.

Upstream

Digitalization in this sector varies greatly ranging from unmanned, automated drilling platforms with robotic crawlers inspecting dangerous flare stacks to oil fields where sensors hardly exist and some operations are still paper-based.

A key obstacle to wider digital deployment has been the time it takes for such initiatives to reach maturity and deliver results. There was little incentive to make such investments when prices were high. In an era of low prices and burgeoning unconventional sources, companies are decreasing capital expenditure (CAPEX) in favor of sweating existing assets. Global CAPEX spend on exploration is estimated to have fallen 26 percent from 2014 to 2015.

In the short term, upstream players will need to review their megaprojects and seriously consider the benefits of more fully integrated approaches leveraging standardized, leaner designs. To that end, the industry will also concurrently explore new business models that make it easier to deploy more digitalized solutions.

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Newer, smaller players such as Lundin Petroleum or joint ventures such as Aker BP have the scope to develop more disruptive business models. Smaller and more nimble operators can more easily explore non-traditional, fully automated production solutions.

The 2016 Upstream Oil and Gas Digital Trends Survey by Accenture and Microsoft found that:

- 72 percent of the respondents believe cost reduction is an important (27 percent) or the most important (45 percent) challenge digital can help address.
- 36 percent are investing in Big Data and analytics today but only 13 percent feel their company's analytics capabilities are fully mature; almost two thirds of them have an objective to resolve this within three years.
- 80 percent plan to invest the same or more in digital technologies over the next three to five years.
- 56 percent planning to use the cloud to enable analytical capabilities in the next three to five years.

For existing sites, the focus will be on optimizing processes by analyzing a wide range of data sets to gain enhanced operational insights – a task made significantly more complicated by the increasingly wide range of resources available to explore.

Traditional on- and off-shore exploration and production are markedly different enterprises compared with subsea, oil sands and shale. Unconventional extraction technologies have improved the viability of non-traditional sources but often bring with them new challenges and higher costs.

In the upstream sector there is considerable potential for equipment and assets to self-optimize and improve production. Some have projected that leveraging the Internet of Things (IoT), could save integrated oil and gas companies with an annual production of 270 million barrels more than $500 million in production and lifting costs.

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Consider, for example, that a single pump failure on an offshore rig can lead to $100,000 to $300,000 per day in lost production. Large companies typically handle more than 50,000 wells at a time. Predicting failures with smart sensors and control systems and being able to fix issues proactively makes compelling financial sense.

Leading oil and gas companies have already begun treating drill and production data as key company assets as they realize analyzing big data can help them focus on their more productive wells, resulting in significant revenue growth. Longer term, the offshore industry is likely to change dramatically from what it is today,

Offshore fields will be explored beyond the continental shelves currently being developed, too, running FPSO vessels or non-traditional platforms in deeper waters and more remote locations than they do today. Most of the offshore equipment will move to subsea. As a result, life cycles will need to be longer, with lower maintenance and improved efficiencies over current standards.

With entire production lines moved to the seabed, more autonomous, remote-controlled equipment will be deployed and managed by onshore operators taking decisions from miles away based on data from the source with long stepouts. Equipment such as transformers, switchgear, motors and variable- speed drives will need to function well without intervention for up to five years.

Less than a decade ago, being able to step out 10 kilometers (km) was considered an achievement. The difficulty inherent to long step-out systems means that only some 40 such systems have been successfully installed to date, most within 40 km from shore, and these by a small number of companies.

ABB, however, has mastered the technology that allows long step-out systems beyond 40 km. The Åsgard subsea gas compression project for example has a 47 km long step-out (2 x 15 MVA). Under a joint development program with Statoil, Total and Chevron, ABB is developing new subsea power solutions which will able to transmit power (from shore) up to 100 MW over distances up to 600 km and to power equipment at depths of up to 3,000 meters.

It is anticipated that this solution will be ready for first pilot installations in 2019, enabling operators to extract oil and gas in considerably longer and deeper areas than currently achievable.

Midstream

Many midstream operators already deploy a substantial amount of digital components with advanced measurement devices such as electric flow metering and data-intensive pipeline inspection gauges (PIGs). However, there is still room to optimize further through better distillation of the data firms currently collect and by gaining additional information through the deployment of drones to conduct pipeline flyovers where regulations permit. Better fleet optimization will also improve through greater use of increasingly sophisticated tracking technology.

Additionally the market environment has changed significantly with the growth in unconventional energy which needs to be transported, particularly in the form of liquid petroleum gas (LPG) and natural gas. Midstream players will need to expand capabilities, or adapt aging infrastructure to track and optimize greater flows of an increasingly complex array of products to and from a variety of new locations.

Better deployment of technology will help companies use their pipeline data to optimize routes to market and react quicker to changing volumes and fluctuating prices. For example, careful surveillance of electricity market indicators may signal increased future demand for gas. Machine and sensor data, weather information, geolocation data can be more effectively mined to improve predictability and performance. Be-

ing able to leverage insights from big data models will give savvy operators a competitive advantage.

On the supply side, it may be that by analyzing flow history and better tracking existing conditions, midstream companies may become better at predicting where and at what pressure and volume product will arrive. Improved forecasting algorithms will mean they can better optimize their configuration plans and increase revenues from their assets.

It will also help with theft protection and leakage detection. The former is a key issue both for financial and safety considerations. Theft from pipelines and other sources is estimated to cost over $37 billion globally. Given a tanker can be filled in less than 15 minutes, prompt illegal tap detection through accurate, real-time monitoring is a useful tool in the battle to keep revenues where they belong.

Detecting and deterring illegal tapping can also save lives as there are many instances where such thefts have led to loss of life. An oil pipeline explosion caused by inept thieves in San Martin Texmelucan, Mexico in 2010, for example, killed 27 people, injured another 52 and destroyed over 115 homes.

Other costly, potentially dangerous risks that IoT technologies can mitigate are undetected leakages or spills which not only add to operator costs but result in more stringent regulations for everyone else.

Pipelines can fail for a variety of reasons, many of which can be minimized through increased automation and real-time surveillance. In short, midstream companies will increasingly use advanced analytics to improve profit margins through initiatives such as better pressure monitoring, more efficient transportation fuel cost management, more accurate supply and demand forecasting and a better view of overall operations.

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Downstream

Downstream players, frequently plagued by long periods of low margins, are comparatively more mature in their pursuit of standardized solutions and already have a long track record of using digital technologies to improve performance and manage risk. Much of this segment's systems are already under surveillance via sensors on equipment sending real-time data to control room technicians. They have control loops that adjust themselves and process analytics or simulation capabilities that help employees to make predictions on system changes.

However, sluggish global growth and the highly commoditized market for petroleum products mean downstream companies will need to explore new areas of process optimization and market development. McKinsey estimates that petrochemical producers can increase their return on investment (ROI) by an

additional 10 percent through optimizing each element of their operations.

Adding new technology alone on an asset-by-asset basis, however, will not be enough. Not only must it be tied to delivering the key business described above, it must be deployed on a holistic basis in order to realize its full potential. In fact, ABB has proven that by integrating automation, safety and other systems companies can save 20 to 30 percent in CAPEX and OPEX investments.

For example, integration can simplify selection to not only assemble the most efficient equipment mix, it can also reduce the footprint by up to 60 percent meaning less civil work, construction and materials are required. Additionally, projects are more likely to come together more quickly and with less risk.

Of course, once things are up and running, a critical part of managing the bottom line is to ensure refinery downtime is minimized. Still, such shutdowns remain relatively common. According to the US Department of Energy, refinery shutdowns from 2009 to 2013 in the US alone averaged 1.3 incidents per day. Electrical problems accounted for 20.6 percent of these shutdowns with electrical equipment failures and power supply problems leading to over 80 percent of the disruptions.

In addition to power outages, ineffective maintenance practices are hitting refinery profits hard. ARC consultants estimate that suboptimal maintenance procedures cost refiners $60 billion per year globally in unscheduled downtime.

Strategically integrated systems standardize and streamline the parts involved making ongoing repairs more straightforward and providing for easier upkeep and system expansions. For example, if making updates is a matter of configuration, rather than programming, there is significantly less risk of a process disruption.

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Another way to minimize downtime is to take advantage of inexpensive, non-intrusive sensors, advanced wireless mesh networks and real-time asset-monitoring systems. These make it possible for OGC companies to shift away from a time-based maintenance strategy to one based on the actual needs of a given piece of equipment. Avoiding unnecessary repairs is not only cheaper, but also minimizes opportunities for things to go wrong.

Additionally, if your equipment tells you it is likely to break down soon, you have the opportunity to take proactive action before it fails. Not only do you avoid the opportunity costs of an unplanned shutdown but also your repair costs will be cheaper as they will be undertaken on a non-emergency basis.

Why then is predictive asset monitoring not more widespread in the OGC industry? At the moment companies appear to be tracking individual assets; it is much rarer to see plant-wide operations, let alone multi-site tracking. Those companies able to step back and see the bigger picture of enterprise-wide in-

tegration will achieve a significant cost advantage over those who stick to more traditional and narrowly focused approaches.

In addition to improved maintenance strategies, another way technology can help downstream players generate competitive advantage is by improving their visibility beyond an individual plant or group of refineries into the wider hydrocarbon supply and demand chain. Doing so can yield benefits from a cost-saving and revenue-generating point of view.

Technology is making it easier for refiners to optimize their raw material costs. Investing in information systems which give refiners clearer visibility into the complete hydrocarbon supply chain makes it easier to optimize the quantity and quality of crude blends purchased. For example, the level of bitumen and sulfur in cheap crudes can offset any price benefits due to the increased operating and maintenance expenses which may be required. Having sensors on refinery equipment enable downstream firms to gather information on the trade-offs in processing the different crudes. This combined with pricing, availability, delivery and inventory information empowers them to optimize purchases by quickly working through robust scenario planning.

Likewise, deeper insights into the end-user needs will help petrochemical manufacturers adjust more nimbly to changing demand patterns.

Opportunities offered by high fidelity simulation
Many companies are currently able to use simulators in a low and medium fidelity manner, for example with respect to simulating parts of processes. ABB, however, is now providing customers with the opportunity to create 1:1 copies of their physical plant in a digital form. This means customers can simulate decisions and know exactly what such actions will deliver if applied for real.

This can be particularly useful in the development phases of a new plant or platform. By being able to simulate the entire electrical side of a plant early on customers can better predict, plan and budget for the required power needs.

The rising importance of cyber security
While harnessing the IoT has the potential to generate significant competitive advantage for those who deploy it correctly, companies must be even more vigilant than ever before in protecting their assets.

In the pre-digital world, it was easier to see the threats coming as they typically had a physical presence. Now, operations can be disrupted by unseen players from thousands of miles away.

The cost of cybercrime in the energy sector is second only to that in financial services. According to the US Department of Homeland Security, of the 245 major cyberattacks reported by asset owners and industry partners in 2014, 32 percent were against the energy sector, topping the list that year. In the equivalent 2015 report, energy cyberattacks remained high at 16 percent, second only to critical manufacturing.

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Fortunately, solutions exist to protect assets from cybercrime but OGC companies will need to ensure their assets are protected correctly from the start and remain vigilant on an ongoing basis. This may sound obvious but in conducting cybersecurity reviews it is not uncommon for us to find that protection software is not up to date, particularly in the area of process control. Also, in many cases, cybersecurity measures have been bolted on after the fact, which can create potential cracks for attacks to wedge their way through.

Digital technologies are being adopted at different rates and in different ways depending on the particular needs of OGC industry players. The one constant, though, is that every aspect of the industry is changing. The firms that are able to leverage these emerging technologies to gain insight—not simply data—from their operations will be in the best position to apply what they learn to create competitive advantage.