Big Data: Is the Energy Industry Starting to See Real Applications?

By Vivek Chidambaram, Hugo Evans, and Kristen Etheredge

Kristen Etheredge is a partner with A.T. Kearney. She is based in Dallas and can be reached at kristen.etheredge@atkearney.com. Vivek Chidambaram is a principal with A.T. Kearney. He is based in Houston and can be reached at vivek.chidambaram@atkearney.com. Hugo Evans is a director with A.T. Kearney Procurement & Analytic Solutions. He can be reached at hugo.evans@atkearney.com.

Imagine a scenario where a category manager could connect field valve, combustor, or artificial lift failure rates across a variety of operating environments to specific brands and models of equipment. Or imagine another scenario where a supply chain professional could more precisely predict necessary replacement parts usage by understanding the level of experience of the service crews maintaining the equipment. These are increasingly real applications of Big Data across the manufacturing space. Procurement organizations are at the nerve center of this data and have the ability to significantly impact operational performance, costs, and project performance metrics by using data that has historically been available but hard to access.

We will specifically explore the applications to the oil and gas industry (O&G) in this article, but these applications are relevant across multiple industries.

The oil and gas industry operates at the forefront of technology applied to exploration and production. High performance clusters, large reservoir models, seismic models, and large volumes of production data are regularly analyzed. Working with large data sets and advanced analytic modeling (Big Data), therefore, is not a new concept.

Traditionally, Big Data has centered on data sets with significant volume, variety, and velocity of data. However, recent advances have O&G executives in the industry struggling to play catch-up with industries such as financial, media, and consumer products. These are using a wide variety of unstructured data sources (video-, text-, and social media-based analytics) to generate differentiated competitive insights. They have quickly incorporated new analytic techniques to mine data and enhance their traditional analytics capability. Big Data analytics is not so much about the literal handling of large volumes of diverse data quickly, but rather implementing a program with the requisite mechanisms in place—execution requires expanded levels of cross-organization data access, insight generation through advanced analytics, and value creation by proactively identifying opportunities and resolving issues.¹

Adoption of a successful Big Data program involves more than just technology; it is a fundamental shift in skill sets (for the business and IT organizations) and a mandate from the C-level to create and foster a culture of analytics.

Fundamentally, the industry includes many specialized oil field service (OFS) providers, long project cycle times with high potential for cost escalations, disparate systems, and a varied range of sophistication among suppliers. This complex structure has led to data being captured across multiple suppliers or departments within the organization. Big Data advances have now enabled the industry to look at old data through a new prism—capturing existing data across disparate platforms and connecting it in a way that enables meaningful business decisions.

Similar to how the Internet brought a huge change to information accessibility, leveraging

The oil and gas industry has always collected data, even if it was hard to access. With new systems and analytic tools, procurement can use Big Data to make smarter sourcing decisions that have a real impact in the field.
existing data to predict future trends and support procurement decisions can fundamentally change how procurement organizations function within O&G companies.

**Oil and Gas Industry Data**

All O&G companies collect a wide variety of performance data; for example, in exploration and production (E&P) companies collect geologic and geophysical information and logs, supplier information, project data, sensor outputs, and human resource information. Processing this data in each of the operational silos allows individual organizations to continuously improve established measured metrics. For example, costs for services and equipment can be managed, service provider downtimes are monitored, and production deferment measurements are continuously improved. Consequently, areas are optimized individually, rather than collectively, which limits the overall value realized across the organization. True breakthroughs in performance can only be achieved by looking at interrelated activity across the value chain and analyzing implications.

Internal efforts to go across silos and consider total costs are often stymied by the nature of the data access—the data is housed in different systems or software, time cycles for project data are long, and paper and mixed format data are difficult to process. Recent technology advances have spurred increased capability and sophistication to identify correlations and bubble up insights that could not be identified at in the past, including:

- For the same specification, which pieces of similar equipment (for example, combustors or separators) result in higher operating cost? Which suppliers make them? What kind of operating impact does the equipment have over time?
- How should maintenance frequency be optimized across different shale fields with unique characteristics?
- What supplier interfaces and KPIs need to be improved?
- How does staffing and talent management affect project performance?

These types of questions yield Big Data applications that O&G companies are beginning to aggressively leverage. One such new domain is procurement.

**Procurement Applications**

A procurement organization’s biggest challenge is an unhappy facilities engineer or field surveillance engineer who faces operational issues with equipment or services that were technically sourced per specifications. Operational issues, such as a combustor from a supplier that performs poorly for no apparent reason, a dehydrator tank that requires maintenance, valves that stick, or tubing and casing that corrodes too rapidly, cause a variety of performance difficulties at the field level for various procurement sourcing decisions. If operations data could be processed in a systematic fashion, it can be used to improve procurement performance and pinpoint specific quality improvements for equipment and services. However, procurement decisions rarely incorporate actual field data and performance for procured parts—this data exists, but the inherent life cycle of projects and the limitation of traditionally available Excel-based analytics often result in the information not being used. Without actual data and feedback on performance, the procurement team is not armed with critical total-cost-of-ownership-type input to make holistic equipment selection. The next set of productivity improvements in procurement are going to come by integrating operational data and adopting a data-driven mind set.

---

**EXHIBIT 1**

**Production Operations Data is Often Never Used by Procurement Organizations to Ensure Better Sourcing Decisions**

<table>
<thead>
<tr>
<th>Operational Metrics Relevant to Procurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in Frequency of ESP Maintenance</td>
</tr>
<tr>
<td>Plunger Return Failures</td>
</tr>
<tr>
<td>Service Provide Response Time</td>
</tr>
<tr>
<td>Chemical Tank Service Failures</td>
</tr>
<tr>
<td>Combustor Trips</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sourcing Decisions and Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier Performance and Trends to Determine Future Awards</td>
</tr>
<tr>
<td>Performance-Based Contracting Centered Around Key Operational KPIs</td>
</tr>
</tbody>
</table>

**Data Taxonomy**

- Vendor Demographics
- Time of Events
- Sourcing Responsibility
- Specifications
- Frequency of Measure
- Impact Etc.

**Operational Metrics**

- Well Surveillance
- Facility Surveillance
- Maintenance

**Issues**

- Sticky Chokes
- Corrosion
- Plunger Trips
- ESP Failures
- Calibration Errors
- Chemical Tanks Empty

**Equipment**

- Tubing, Casing, Valves, and Trees
- ESP Systems
- Tanks, Separators
- Instrumentation
- Consumables

**Functional Groups**

- Maintenance
- Procurement
- Operations
- Information Technology

**Source:** A.T. Kearney analysis
Even when operations data is used, it is often used simply to optimize KPIs associated with well-known cost buckets such as installation and service costs. It rarely incorporates operator feedback and data on specific parts, suppliers, or equipment design. Leveraging Big Data concepts can help procurement teams gather more information quickly and collaborate with operational teams to make more informed procurement decisions across the equipment life cycle. This requires gathering data across disparate systems and diverse organizations. The next step is applying an appropriate hierarchy and taxonomy to identify relationships and trends across these data sets and functions. Creating the taxonomy and organizing the data requires three critical components: functional industry knowledge; deep operational expertise; and analytical and data expertise.

Leveraging data-driven decision making also captures and codifies legacy data in an industry that is facing a talent gap as experienced personnel retire. Incorporating Big Data analytics will not only improve ongoing operations, it can lay the organizational foundation to secure critical information and empower teams to make better decisions across the value chain.

An example of operational production data typically involves groups involved in surveillance (wells and facility) and maintenance (see Exhibit 1). Several equipment failure modes exist. Some are reservoir-driven and difficult to control, but others—such as correlating vendor demographics, event timing, and specifications to field performance—can be improved with procurement data analytics.

More often than not, systems and data experts lack the operational and functional knowledge to leverage data effectively. Combining systems and operational O&G expertise helps organize the data in a fashion to search for operational issues across a desired data taxonomy, develop the required analytical insights associated with specific parts or suppliers, and arm procurement organizations to make better sourcing decisions. Further, as a function, individuals within the procurement organization will need to become more conversant in the language of analytics. Talent development is a topic for a future paper, but it is important to note that people should be comfortable with basic analytic concepts so that they can be directly involved with the development and dissemination of analytic insights.

Conclusion

As an industry, O&G inherently knows how to handle large masses of data; however, expanding that competency to improve the velocity and depth of analytical insights will bring a significant competitive advantage. Making advanced data applications in procurement involves breaking down silos, developing taxonomies, studying correlations, and visualizing the findings to unleash the power of data-driven insights. Typically, IT and systems personnel do not have the industry knowledge and expertise to make sense of vast data, while those with industry expertise do not typically have functional analytics skills; however, combining the analytics capability with industry expertise becomes a powerful combination.

Leveraging data-driven decision making also captures and codifies legacy data in an industry that is facing a talent gap as experienced personnel retire. Incorporating Big Data analytics will not only improve ongoing operations, it can lay the organizational foundation to secure critical information and empower teams to make better decisions across the value chain. Ultimately, a comprehensive Big Data program will enable procurement organizations to engage in activities such as being able to connect operational issues and corrective actions with individual suppliers to create a 360-degree view of supplier performance. ☁️

1 Advanced analytics refers to sophisticated techniques that include statistical modeling, predictive analytics, text mining/analytics, simulation, optimization, and visualization.