

DRILLING FOR NEW BUSINESS VALUE

# How innovative oil and gas companies are using big data to outmaneuver the competition.

A Microsoft White Paper

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## Executive summary

As the buzz about big data makes the leap from technology magazines to mainstream business press, leading executives are recognizing a significant opportunity. The goal of this paper is to help oil and gas (O&G) leaders understand why big data is important to their industry—and how some of those leaders are already using it to gain market advantage. It also offers guidance on how big data can be used to gain valuable operational insight and to assist in decision-making.

Big data is information that is so large, complex, and fast moving that it's difficult to handle using everyday data management tools. In the O&G industry, big data can come from traditional sources, such as equipment monitoring and maintenance records. Data from these sources is often captured and used as needed. But until recently it was not always retained for long-term use. Big data can also be extracted from relatively new or previously untapped sources, such as seismic input, weather patterns, or social media. Combining these disparate sources of data can lead to interesting insights that empower decision-makers.

Many O&G companies heavily instrument their equipment and processes. Additionally, many firms are developing "Oilfield of the Future" and "Digital Oilfield" type initiatives to better to monitor, control, and optimize their assets digitally. This trend, along with the industry-wide focus on the "Internet of Things," will lead to the generation of large amounts of additional data.

With the proper infrastructure and tools, O&G companies can gain measurable value from all of these data sources. As the amount of data, the number of sources, and the frequency of data updates increases, so too does the value of big data. Potential applications in O&G include:

- **Equipment maintenance:** using data collected from pumps and wells to adjust repair schedules and prevent or anticipate failure.
- **Production optimization** using powerful modeling capabilities to anticipate costs and production volumes.
- **Price optimization:** using scalable compute technologies to determine optimum commodity pricing.
- **Safety and compliance:** using weather or workforce scheduling data to avoid creating dangerous conditions for workers and mitigating environmental risks.

With tools and expertise from Microsoft®, O&G companies can now prepare to unlock the value of big data. Leading-edge tools from Microsoft are helping O&G companies democratize the use of business intelligence and big data. Leveraging the familiar Microsoft® Office interface, these tools enable companies to more effectively gather, analyze, share, and disseminate data and related insights via self-service business intelligence.

Collaboration tools are needed to help promote cooperation between groups that typically do and do not work together. Social networks can be used to discuss and interpret data to understand trends and patterns that emerge from data generated throughout the value chain. Data scientists, drilling engineers, and others who are part of the data value chain in an O&G company can benefit from collaborating with one another across departments and geographies.

**"As anyone who uses Facebook, Twitter, and other social services knows, sometimes the shortest path to the right information is just knowing who to ask."—FRANK SHAW, CVP COMMUNICATIONS, MICROSOFT**

## Understanding the appeal of big data

The oil and gas industry is experiencing rapid market, competitive, and regulatory change. Faced with the unending search for natural resources and the fluctuating global demand marked by pricing volatility, firms need every bit of insight they can produce. The need to address health, safety, and environmental risks adds even more urgency. Yet sorting through exponentially growing volumes of data inputs for actionable business intelligence becomes increasingly challenging.

O&G companies must capture and manage more data than ever before—and that information is being churned out at an ever-increasing velocity. According to industry analyst firm IDC<sup>1</sup>, the digital universe now includes 2.7 zettabytes of data. (A zettabyte equals almost 1.1 trillion gigabytes.) Companies are struggling to store, analyze, and gain useful information from these huge volumes of data.

For example, in the recent Microsoft “Global Enterprise Big Data Trends: 2013” report<sup>2</sup>, nearly 300 IT decision-makers from a variety of industries were surveyed. Approximately 62 percent of respondents currently store at least 100 terabytes of data, and 32 percent expect the amount of data they store to double in the next two to three years. And the vast majority of these professionals view the ability to use growing data volumes as an important business asset.

For these firms, big data offers opportunities to create new business value. When asked about their highest big data priorities:

- 62 percent of respondents want to develop near-real-time predictive analytics or data mining capabilities in the next 24 months.
- 58 percent of respondents plan to expand data storage infrastructure and resources.
- 53 percent of respondents hope to analyze increasing amounts of unstructured data.

Yet these decision-makers also acknowledge certain struggles as they seek to derive business intelligence from big data. When asked about their challenges:

- 49 percent of respondents cited managing data growth.
- 41 percent of respondents said integrating disparate business intelligence tools.
- 40 percent of respondents indicated using tools to analyze data and glean insights.

For O&G firms, advances in instrumentation, process automation, and collaboration are increasing data volumes even faster. Some experts believe these volumes are growing by a factor of five each year.<sup>3</sup> The data volume is coming from sensors, spatial and GPS coordinates, weather services, seismic data, and various measuring devices. Other sources include data market feeds, social media, email, text, images, and multimedia. Much of this data is “unstructured” or “semi-structured,” which means it’s difficult or costly to either store in traditional data warehouses or routinely query and analyze.

1. Vesset, Dan and Benjamin S. Woo. “Worldwide Big Data Technology and Services 2012-2015 Forecast.” IDC. March 2012.

2. Microsoft. “Global Enterprise Big Data Trends: 2013.” September 2012.

3. Brown, Brad, Jacques Bughin, Angela Hung Byers, Michael Chui, Richard Dobbs, and James Manyika. “Big Data: The Next Frontier for Innovation, Competition, and Productivity.” McKinsey Global Institute, McKinsey & Co. May 2011.

With this growth in mind, O&G companies need help deploying solutions designed to extract business insights from their data assets. Microsoft has extensive experience in helping organizations use big data to meet their business goals, and we are uniquely qualified to guide the O&G industry in deploying new technologies and services that will deliver the full business value of big data.

## Making smarter, faster decisions

Within the volumes of big data are valuable nuggets of information that can help firms gain new insights and improve the bottom line. Yet O&G companies face big challenges in quickly manipulating large volumes of data and mining it for relevant information. To support rapid decision-making in key areas such as reservoir modeling, drilling, production optimization, and real-time consumer marketing, analysis and insights must be delivered in near real time.

For example, a company that trades energy options for hedging must be able to make rapid-fire decisions while weighing dynamic factors such as weather patterns, crude quality, and market demand. To get a detailed picture of these factors, the company needs to quickly analyze huge volumes of data. This analysis requires high-powered processing, intuitive software interfaces, and rapid querying and business intelligence iterations. Under these conditions, most traditional analysis tools would fail. The data's huge volumes, rapid rate of generation, and lack of structure would prevent timely or complete analysis.

To support decision-making in near real time, O&G companies need tools that integrate and synthesize diverse data sources into a unified whole. Let's consider a company that wants to optimize the retail price of gasoline at the pumps. Among the factors analysts must consider are:

- Competitor strategies, such as marketing campaigns designed to capture local market share.
- Local population characteristics, such as demographics and growth.
- Locations of retail outlets and competitors.
- Customer sentiment, such as social media chatter about the company.
- Personalized loyalty discounts based on near-real-time consumer behavior.

Another place where rapid decision-making can potentially save O&G companies a large amount of money is preventative maintenance. Equipment failure, particularly when it is not anticipated, can be very expensive. Big data analytics can predict equipment and system failures, alerting crews to repair or replace equipment before the point of failure.

Being able to process big data makes it possible to derive insight from the relationships that will surface when all of these sources are processed as a whole. But to unlock this value, O&G firms need access to the appropriate technology, tools, and expertise.

## Preparing to unlock big data's value

Just as business management needs to prepare for big data, so too must IT departments take steps to develop a technology infrastructure that provides a common, reliable foundation for storing and analyzing its data assets. The [Microsoft Upstream Reference Architecture \(MURA\)](#) framework can help.

### Big data and the Microsoft Upstream Reference Architecture framework

Created to meet the needs of the O&G industry, MURA provides a bridge between the needs of the business and the Microsoft technology that supports IT (see Figure 1, "The guiding principles of MURA"). The principles

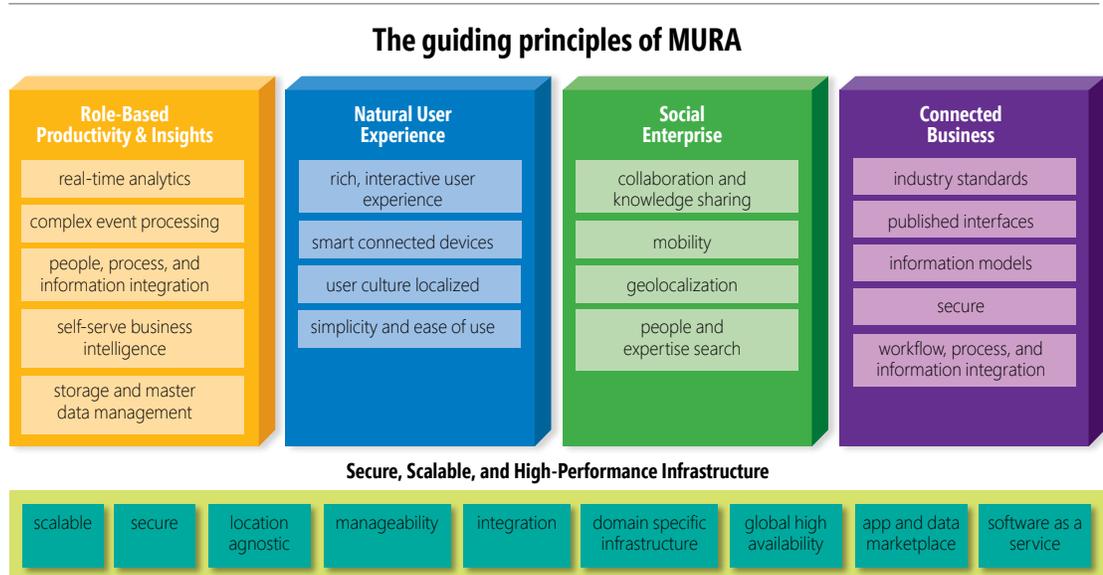


Figure 1

Source: Microsoft Corp.

behind MURA are derived from key trends that drive the upstream O&G industry today, including the retirement of experienced personnel and the knowledge gap created in the mid-career demographic between very young and very experienced workers, known as the "Big Crew Change," and the "Digital Oilfield," which enables an enormous amount of real-time data to be collected. MURA excels when mapping business trends like these to new technology, such as social media, mobility, cloud, and big data.

For example, the big data trend plays a key role in the first "role-based productivity and insights" pillar. This group of guiding principles supports the business need to gain maximum insight from the vast amount of business-related data and to maximize the productivity of workers. A quick review of each principle on this list reveals much of interest to the O&G industry today:

- **Real-time analytics.** Rich statistical and analysis packages for data mining, discovery, and reporting for information consumers with diverse interest and skills.
- **Complex event processing.** Stream processing engines that can detect and filter real-time events, either on-premises or in the cloud.

- **People, process, and information integration.** Business workers use a variety of software tools and systems to do their jobs—often with related or even the same information or data. These tools or systems should be seamlessly integrated to avoid continuously importing and exporting data from one system to another system to complete user tasks. This integration extends to workflows that include multiple users in their execution.
- **Self-serve business intelligence.** To help them gain deeper insights into the increasing quantities of relevant data that is collected, workers should be able to use tools to find, select, and explore data in the different and flexible ways that make sense to them. They should be able to perform this process on their own and without, for example, having to define a report and then request that report from IT.
- **Storage and master data management.** Repositories that can capture and enable the analysis of operational and business data. These may be located on-premises, in the cloud, or in a hybrid mixture of both.

O&G companies can use the MURA framework to envision and create a target state for a big data infrastructure. Following the guidelines, IT and management teams can plan business systems and deploy software and solutions that can best realize the value of big data. Although the MURA framework is not prescriptive—that is, it doesn't lay out specifics of the architecture's structure and function—it does describe a set of principles for establishing consistent performance.

### Key components of a big data initiative

What are the key components needed to support a big data initiative? The precise tools and solutions depend on a company's unique goals and project scope.

Whatever your goals, Microsoft offers a full suite of technology components designed to help O&G companies support big data initiatives. Figure 2, "The Microsoft Data Platform," on page 8, depicts how Microsoft Office, Windows Azure™, Windows Server®, and Microsoft® SQL Server® can integrate to deliver a complete data platform for your solutions. Each of these components is comprised of products that can be pieced together to deliver needed functionality. For example:

- Microsoft SQL Server has many powerful data warehousing, cleansing, and management tools, as well as advanced analytical and reporting tools.
- Windows Azure enables several key big data capabilities, including Microsoft® Office 365™ and Microsoft® HDInsight™.
- Self-service business intelligence capabilities like Power BI and Power View, when combined with big data analytics, provide a way to parse and generate results based on custom needs. Empowering users to manage their own data gives them ownership and minimizes IT involvement in working with data.
- Microsoft Office includes familiar products like Microsoft® Excel® that business users can use to gain insight and explore possibilities.
- Windows Azure Marketplace is an online marketplace for buying (and selling) finished Software as a Service (SaaS) applications and premium datasets. Third-party applications and data, available from private and government sources, can be combined with a company's own data to enrich it.

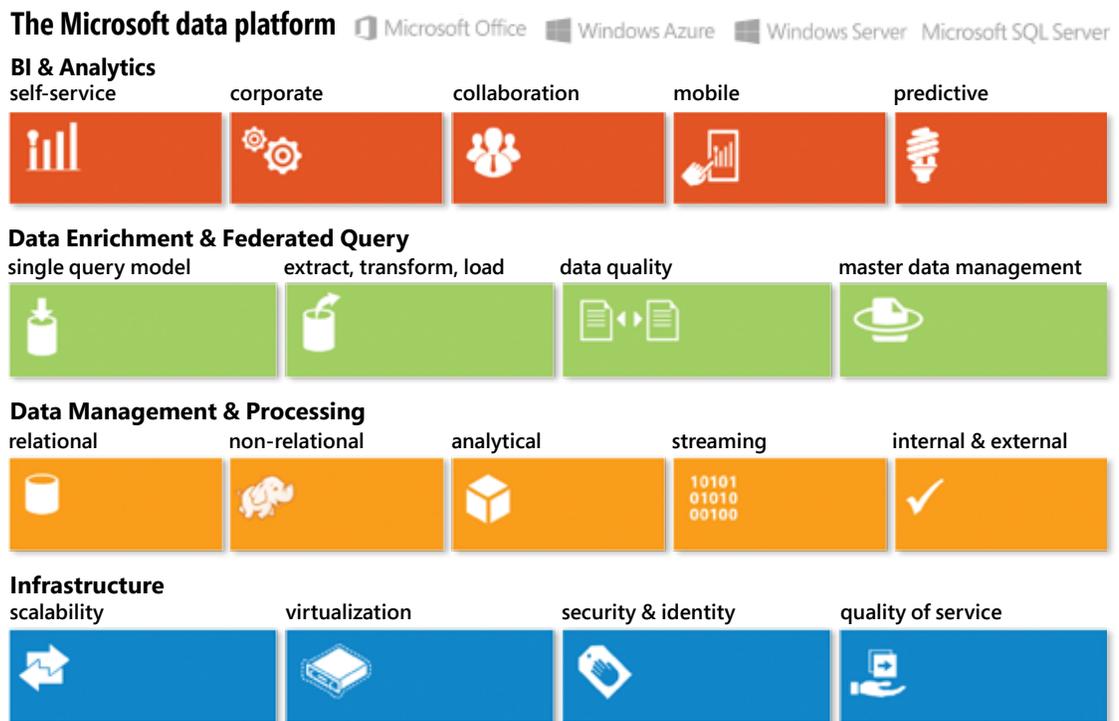


Figure 2

Source: Microsoft Corp.

## Deploying big data initiatives in O&G

Big data technology has applications across the entire oil and gas value chain—from geology and exploration to production and operations, transport and refining, and retail. The following sections highlight possible big data scenarios in these areas.

### Exploration and development

When exploring for new resources, big data and the use of advanced analytics combine to perform “identity traces.” This combination is invaluable for identifying previously overlooked, yet potentially productive seismic trace signatures.

Other forms of advanced exploration become possible, too. Relying on historical drilling and production data from local sites, for example, can help scientists verify assumptions when new surveys are restricted by environmental regulations. Similarly, reviewing information, such as weather patterns and ice flows, from data marketplaces can help analysts make connections with operational processes, such as the impact of storms on rigs.

Other areas where the analytical tools associated with big data can benefit O&G exploration include:

- **Enhancing searches.** Combine enterprise data, including financials and back-office operational detail, with real-time production data to deliver new insights to operating groups.
- **Assessing acreage and generating new prospects.** Create competitive intelligence using sources such as geospatial data, news feeds, or other syndicated information sources.

### Drilling and completions

Using big data to anticipate likely interruptions to drilling is of obvious interest to providers. Being able to use large data volumes to identify conditions or anomalies that would impact drilling can save millions in labor and equipment costs alone. Meanwhile, real-time information returned from supervisory control and data acquisition (SCADA) systems on wellheads can be used to look for opportunities that maximize asset performance and optimize production.

Related areas where analytics can enhance geoscience include:

- **Leveraging scientific models.** Incorporate geologic measurement and scientific models into everyday processes, such as shale development.
- **Improving engineering studies.** Engage sophisticated subsurface models and conduct detailed engineering studies on wells to identify commercial prospects earlier and with less risk.
- **Optimizing subsurface understanding.** Use big data tools to understand the earth's subsurface better and to deliver more affordable energy, safely and sustainably.

### Production and operations

Big data is of great interest to production and operation work. Being able to predict future performance based on historical results, or to identify sub-par production zones, can be used to shift assets to more productive areas. Oil recovery rates can be improved, as well, by integrating and analyzing seismic, drilling, and production data to provide self-service business intelligence to reservoir engineers.

Better predictive maintenance also becomes possible:

- **Preventing down time.** Understand how maintenance intervals are affected by variables such as pressure, temperature, volume, shock, and vibration to prevent failure and associated downtime.
- **Optimizing field scheduling.** Use this insight to predict equipment failures and enable teams to more effectively schedule equipment maintenance in the field.
- **Improving shop floor maintenance planning.** Integrate well and tool maintenance data with supply chain information to optimize scheduling of shop floor maintenance.

### Enterprise security

In recent years, O&G companies have spent enormous sums on security, deploying a wide range of technologies designed to protect their intellectual property.<sup>4</sup> So using big data to better manage internal network threats is a natural fit. Correlating network events with metrics over time, identifying patterns, and predicting cyber-terror threats is critical, particularly in light of recent events at oil refineries in the Middle East.

#### The Microsoft big data profiling model

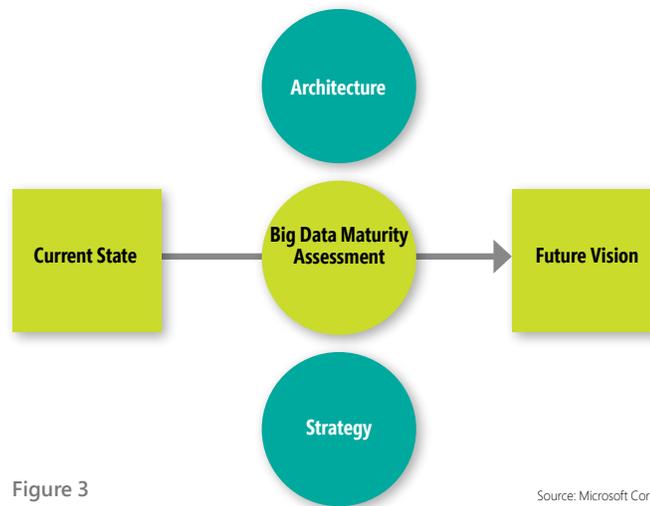


Figure 3

Source: Microsoft Corp.

With enhanced security and operational monitoring as their goals, O&G companies are beginning to apply analytics to identify anomalous information patterns on networks and to perform more effective intrusion detection. They are also anticipating IT security breaches by using predictive analytics and bolstering security with data from video monitoring.

Meanwhile, there is growing interest in deploying complex event processing (CEP) technology to monitor security concerns in the O&G industry in real time by:

- **Combining data from multiple sources** to infer events or patterns that indicate a current or imminent threat.
- **Making faster decisions**, supported by faster delivery of decision support information, to identify possible threats.

4. Microsoft. "Security in Upstream Oil and Gas." March 2013.

## Getting started with a big data initiative

The scenarios being developed by O&G firms demonstrate that big data is becoming an essential part of competitive success for companies in this industry. To move forward with a big data initiative, executives should proceed deliberately and carefully.

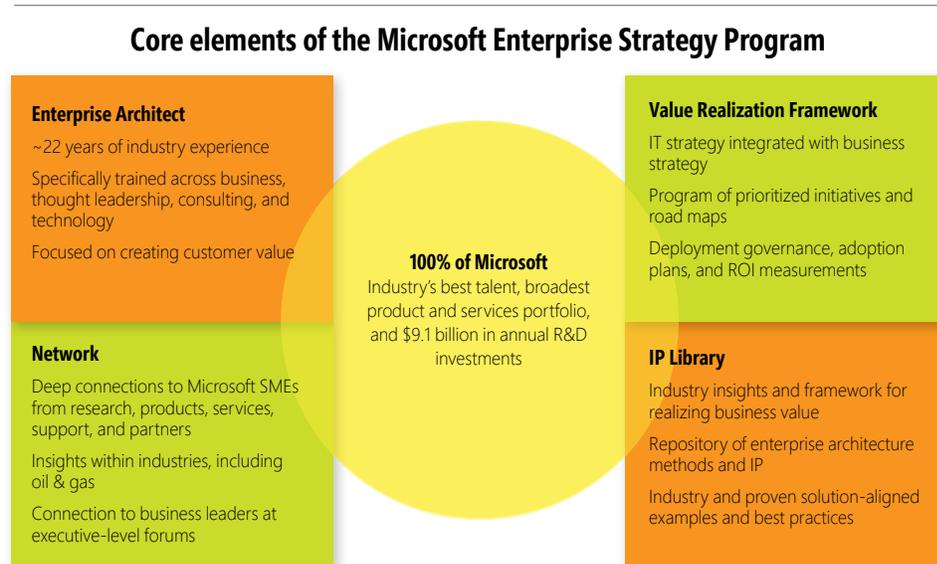


Figure 4

Source: Microsoft Corp.

Microsoft offers a recommended progression for O&G companies that are investigating the value of deploying a big data initiative. It begins with a big data maturity assessment that analyzes a company's current IT state, and then incorporates business strategy, future vision, and the possible IT architectural changes needed to get there (see Figure 3, "The Microsoft big data profiling model," on page 10).

Before diving into a big data initiative, O&G companies must first understand their existing IT environment. By conducting a maturity assessment, business leaders can take stock of their current state. The maturity assessment process should include asking business and IT leaders to answer questions about architecture, advanced analytics, data management, and governance, as well as planning and execution. This process can help companies:

- Identify business goals and objectives.
- Assess current big data capabilities.
- Specify next steps on how the company should proceed.

Out of this process, management should receive clear recommendations that address the people, process, and technology facets of the company's future business intelligence environment.

### **Integrating big data into enterprise strategy**

Microsoft helps customers with big data initiatives as part of its Enterprise Strategy Program (ESP), which focuses on helping companies realize value from their IT investments. As shown in Figure 4, "Core elements of the Microsoft Enterprise Strategy Program," on page 11, ESP consists of four core elements:

- **Enterprise architects.** Dedicated to the customer and charged with accelerating customers toward their business goals.
- **Network.** Subject-matter experts from across all areas of Microsoft, including O&G industry expertise, product groups, research and development, internal IT resources, and Microsoft Research.
- **Value realization framework (VRF).** This framework and methodology is designed to deliver on the value proposition of ESP. Using the VRF, Microsoft has worked on a number of specific challenges that are common to many customers and, as a result, developed the Big Data VRF Accelerator.
- **IP library.** A collection of exclusive intellectual property that includes comprehensive guidance, reference architectures, and implementation information, plus real examples from the field of Microsoft engagements.

### **Summary and conclusions**

By using big data to gain new insights, O&G companies can create enhanced business value that improves the bottom line and leads to true competitive advantage. To effectively make use of rapid and unrelenting growth in data volumes, companies must create new strategies that will help them manipulate this data, mine it for relevant information, and use it to support smarter decision-making. What's more, these firms need to invest in the appropriate technology components to support their big data initiatives.

Throughout the industry, O&G companies are beginning to create big data initiatives. From exploration and production to oilfield services and transportation, leading companies are taking steps to design initiatives and deploy technology that can help them pursue new business opportunities, reduce costs, and streamline operations.

By following the recommended steps outlined in this paper, O&G firms can plan and execute big data initiatives, both large and small, in ways that deliver maximum value. ●

## Additional information sources

For more information, please contact your account representative or visit the following sites:

[Microsoft Upstream Reference Architecture \(MURA\)](#)

[Microsoft "Security in Upstream Oil & Gas" White Paper](#)

[Microsoft Enterprise Strategy Program](#)

[Power BI/Power View](#)

[Microsoft SQL Server](#)

[Windows Azure](#)

[Azure Marketplace](#)

[Microsoft HDInsight](#)

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[What Microsoft is doing in the Oil & Gas industry](#)

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