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The Role of Big Data in Oil and Gas Industry Optimization

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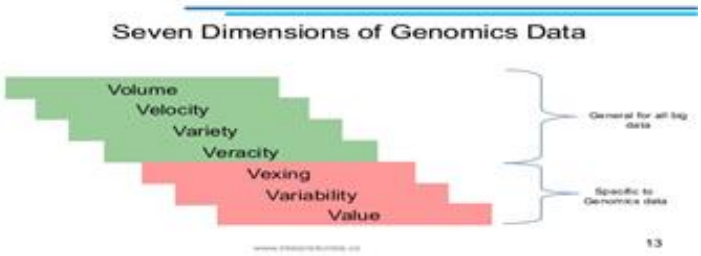
What is Big Data?

Big Data is all the information whose scale, variety, source, context, and complexity require emerging technologies and solutions to enable business growth and innovate. It may exist in various forms like structured, semi-structured or unstructured. According to CIO Review in 2015, "Big Data" is characterized by Seven "V"s: Volume, Velocity, Variety, Veracity, Vexing, Variability and Value.



Understanding and exploiting Big Data is one of the most significant and rewarding challenges in all industries.

Why the Focus is on Big Data?

Data has always been the cornerstone of decision making process. Informed and timely decisions based upon accuracy and consistency of data and/or information can lead to business excellence and achievement of a competitive advantage. For Oil and Gas firms understanding, leveraging, and exploiting this data and the associated information will help to achieve the following:

- Remain competitive throughout planning, exploration, production and field development;
- Maximize production with regard to maintenance and forecasting;
- Reduce production time, lower operating costs and improve productivity across the life cycle; combined with energy consumption performance improvement, i.e. energy efficiency; and
- Ensuring the seamless automated availability of information to the workforce at the right time.

Big Data Sources

Oil and gas companies analyze data from a variety of sources. These data sources can include those noted below and others:

- Data from sensors during oil and gas drilling exploration, production, transportation, and refining;
- Traditional enterprise data from operational systems;

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- Social media networking;
- Web browsing patterns (on informational web sites);
- Response data from job postings;
- Demographic data; and
- Historical oil & gas exploration, delivery, and pricing data.

Casual and Effect Relationship between Projects & Big Data

Many existing business capabilities can be improved when more and varied data becomes part of the Information Architecture. Information technology organizations at oil and gas companies typically work with their lines of business to build solutions that deliver the following when defining Big Data projects:

- Improved exploration return on investment;
- Improved production efficiency;
- Cost effective & timely supply chain and logistics management;
- Improved public & government relations; and
- Information technology operational efficiency.

Technology Integration

Management of industrial technology has traditionally been split between two distinct separate fields: information technology “IT” and operational technology “OT”. IT works from the top-down, deploying and maintaining data-driven infrastructure largely to the management side of the business. OT builds from the bottom-up, starting with machinery, equipment, and assets then moving up to monitoring and industrial control systems.

Traditional enterprise data management, such as Enterprise Resource Planning (ERP) or Customers Relations Management (CRM), is being dwarfed by operations data due to sheer volume and variety. But, most of this data is still in the dark. IT and OT developed separately with independent systems architectures need to come together and find common ground to develop a new infrastructure.

Oil and Gas Industries Challenges with Respect to Big Data

- Reservoir characterization;
- Exponential size increase in traditional data types – seismic logs;
- Management of exploring interpretation and simulation models; and
- Need to integrate real time data into earth model on rig and in office.

Drilling

- Risks to personnel and the public need to be reduced;
- Need to automate real-time decision making; and
- Need to unlock value in real time data and archived after the drilling phase is over.

Production

- Detect well problems before they become serious e.g. slugging; and
- Rapid optimization for maximizing the output.

Data Management

- Voluminous data volumes needing Big Data techniques;
- Data size preventing real time and after-the-fact analysis; and
- Preserving real time data.

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The ability to access, analyze, and manage vast volumes of data while rapidly evolving the Information Architecture is increasingly critical to oil and gas exploration and delivery companies.

OIL AND GAS COMPANIES, BUSINESS CHALLENGES & OPPORTUNITIES

FUNCTIONAL AREA	BUSINESS CHALLENGE	OPPORTUNITY
Exploration	Understand the most viable areas to explore with potentially the greatest return (subject to market conditions)	✓ Improved geologic analysis through fault modeling and seismic analysis leading to more finds, more predictable outcomes, and better well planning; and ✓ Improved market forecasting to better determine when exploration and production could be viable.
Drilling and Production	Maximize operational efficiency while meeting environmental standards	✓ Better predictive maintenance thus enabling higher equipment availability; ✓ Sensors on drills indicating abnormal pressure readings help to predict and avoid risk of catastrophic failure; ✓ Better energy management enables decreased cost of drilling; ✓ Better asset and personnel management enables lower cost of production; and ✓ Remote operational control and monitoring of pipelines and equipment will lower cost, lower environmental risk, and better safety.
Supply Chain and Logistics Management	Optimal time for delivery of parts, supplies, and personnel needed at exploration and production sites	✓ Predictable time to delivery of critical parts, equipment, and qualified personnel; ✓ Minimal down-time; and ✓ Optimal fuel utilization and cost of delivery.
Real Estate Management	Retire and sell properties if no longer believed to be financially viable	✓ Sell properties while the properties maintain reasonable value; ✓ Use property sales to fund new exploration in more lucrative areas; and ✓ Track environmental regulations in locales and understand potential clean-up costs.
Public and Government Relations	Maintain good working relationship with community and government officials	✓ Faster determination of community sentiment toward exploration, drilling and production; and ✓ Fast response to requests for environmental impact and other drilling production records.
Market Pricing Forecasting	Understand market pricing direction and future impact on profitability of sites being explored and in production	✓ Make smarter decisions sooner on where and when to explore for oil and gas; ✓ Better align distribution of personnel, equipment, and supplies to the where needed; and ✓ Better manage real estate holdings.

Big Data and Its Importance in Oil and Gas Midstream Sector

Data analytics can help monitor pipelines and equipment and allow a more predictable and precise approach to maintenance. For example, sensors can indicate when equipment comes under unusual stress, allowing operators to perform preventive shutdowns or interventions that may avoid accidents or spills and also better energy performance and efficient operation of the equipment.

Improved capacity utilization is one of the great benefits of state-of-the-art information systems. To achieve production targets, operators need to be able to monitor assets in real time and ensure all assets (across all plants) are performing at an optimal level.

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Operators also need increased visibility and better insights that can be acted upon. This enables them to detect anomalies and fix issues before they occur, approaching no unplanned downtime. Asset performance management and operations optimization software can provide operators with answers as to which equipment is most important, how it should be maintained, and how unexpected failures can be avoided.

GE digital is one of the top performers in this field with its new innovative APM "Asset Performance Management" Software.

GE and its Customers Case Study

At GE's Remote Monitoring and Diagnostics (RM&D) Center in Atlanta, GE is leveraging its data-historian capabilities to collect data generated from 1,600 natural gas-fired turbines around the globe. The total output of these turbines can support the annual energy needs of over 60 million homes.

The data feeds into a central "cluster". A team of more than 20 M&D engineers analyzes this data to assist customers in enhancing their asset reliability and performance 24x7, 365 days per year. This data is then fed into a "Big Data" historian running in a Hadoop file cluster, where the team runs complex analytics across 100 million fleet operating hours. The business outcomes of GE Digital's Historian at the RM&D Center include:

- Reduced costs - Independent software-development costs have been reduced by $3 million.
- Higher-quality analytics - Data-driven decisions are correct and optimal. GE can now use larger data sets to create rules, thus reducing rule errors on unseen issues.
- Decreased infrastructure costs scaling well over $1 million include:
  - Data collection: From batch to real-time
  - Storage size: 10x reduction
  - Database cost: 4x reduction
  - App server cost: 4x reduction
  - Data retrieval: 10x improvement
  - Software development : Internal to COTS (commercial off-the-shelf)
- Subjecting machinery data - Subjecting machinery data to analysis and data-mining operations has yielded significant amounts of productivity for GE and business benefits to GE's customers through better management of their equipment (avoiding unplanned downtime).

GE APM (Asset Performance Management)

Poorly performing assets that are prone to failure not only create safety and environmental concerns, but are a major factor in failing to achieve production targets as well.

In particular, every time an oil refinery in the U.S. goes offline for unscheduled maintenance and creates a price spike for gasoline, the offending company is profiled on the evening news. Despite the revenue loss of not having production capacity the brand damage must be factored in as well. Clearly unplanned and disruptive breakdowns have multiple costs that need to be avoided.

An intelligent APM strategy based on predictive maintenance, leveraging Smart Connected Assets—using Conditions Based Maintenance (CBM) and Reliability Centered Maintenance (RCM) tools, coupled with appropriate predictive analytics to assess different risk scenarios, can help refining and other downstream operations maximize profit while complying with all environmental and safety related regulatory requirements.

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By using GE intelligent APM strategy, the oil and gas companies can realize the minimum core pillars to their operational excellence, which could be outlined as follows:

Virtually every Oil & Gas company has at least five (5) core pillars to its Operational Excellence platform which are:

- Asset performance management (APM);
- Energy management;
- Environmental, health & safety management (EHS);
- Operations management; and
- Quality management.

Halliburton Case Study - Using the Smart Approach

Landmark has successfully built and deployed one of the most integrated and modular solutions for the upstream oil and gas industry, called the DecisionSpace® platform, using a SMART approach which stands for simplification of the underlying technology infrastructure to address all phases of the oil well life cycle, scientific workflows and analytics value chain.

The DecisionSpace Integration Server has the following advantages:

- Agility of combining logs from multiple sources and addressing the contextual data quality that increased the time to value from E&P Big Data;
- Reduce costs and risks associated with managing data, data mining, analytics, and increase efficiency in creating actionable insights from data sets; and
- Technology platform that is scalable, expandable to adapt and incorporate new data ingestion technologies, data storage solutions, big data analytics tools and technologies

Big Data and Energy Efficiency & Management

As digital technologies and data become more integrated in energy infrastructure (used to control energy production, transmit information about consumption, and monitor demand), the oil and gas plants will have an efficient energy performance. And according the old adage “What you can measure, you can manage”. By using the “Big Data” analytics and predictive approach, trends and patterns become well known despite the challenges that might be introduced due to uncertainties in this evolving field.

Conclusions

Industrial companies have begun an exciting digital journey. At the heart of this transformation is the power of data analytics to unlock new sources of value. However, the challenges of Big Data, threat of digital disruption, and changes in workforce dynamics are real. In order to exploit the fast-moving technology wave of the Industrial Internet, companies need to think strategically and holistically about the foundational elements of their data architecture, starting with industrial data management.

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Lighting – Is it Getting too Complex?

By: Thomas D. Mull, PE, PEM, CEM

In the last issue the question was raised: Is technology outpacing our needs in lighting? To phrase it another way, is employing the latest technology always beneficial? With the dramatic enhancements in lighting source efficacy and controls over the past few decades, we may be reaching a point where the innovation is purely for convenience, may not be cost-effective and subject to potential security issues.

Before looking at lighting, it may be helpful to examine how technology has impacted another area. The advances in the automotive industry have had a profound impact on our life. No longer is a car simply a mode of transportation. It has become a representation of our preferences with a focus on comfort, convenience and self-diagnostic capabilities.

New vehicles are reaching the showrooms packed with technology. Case in point: Wi-Fi capability, backup and side sensing capabilities, hands free parallel parking, driver override systems and others. Manufacturers are even developing driverless technology. Once the destination is programmed your "self-Uber" car takes you there without assistance, in theory.

Many of the advancements in automotive technology have been for efficiency and safety and are well founded. Others are purely "convenience" items that increase the initial and overall cost of ownership.

What happens when specific technology fails? The failure of a sensor is usually not a major issue. But, what are the consequences if the self-braking system malfunctions, suddenly stopping the car causing other vehicles to run into you? This is uncharted waters for insurance companies.

Admittedly, the downside of technology failures in lighting systems is less drastic. Also, increased flexibility and system control are attractive "conveniences". But, we should still evaluate technological advancements for lighting sources and systems considering three points:

1. The primary purpose of a lighting system is to provide the needed level and quality of illumination in an efficient and cost-effective manner, where and when it is needed to optimize visual performance.

2. The operating cost of lighting systems is becoming an ever *decreasing* part of our energy expenditure.

3. In today's environment, how secure are the controls for our system.

In any lighting design the first point should be the major focus. Therefore, let's look at the second item, since it has significant economic implications. In the early 1980s a southeastern electric utility, through customer data collection, projected that 39% of the kWh used in the commercial sector went to lighting. Similarly, for the residential sector the percentage of electrical energy used for lighting was about 10%. A 2012 study (latest available) by the US Energy Information Administration (EIA), noted by commercial sector grouping, the percentage of electrical energy that went to illumination. The highest was the Mercantile group at 15%. Offices/Banks was next at 14%. Both were over 60% less than the previous utility finding. Since that time, with the increased utilization of LEDs and improved controls, the contribution of lighting to the total electrical consumption of a commercial entity has fallen even further. With this decrease the potential savings available by employing additional technology becomes harder to justify based solely upon economics. Certainly, there are other considerations such a convenience and being the good corporate citizen. However, economics is still a primary driver in implementing change.

Trends:
Let's take a look at some of the technological trends in lighting and how they may influence future decisions.

- Enhanced Controls – More sophisticated controls and software are allowing lighting fixtures to communicate and be controlled by devices such as cellphones and tablets.

- Internet Connectivity – In addition to computers and cellphones, devices such as refrigerators, coffee pots and LED lighting fixtures can be controlled via the internet. In fact, lighting has been noted as an ideal platform for the internet-of-things to be built upon.

- Integral Lamps/Fixtures – Due to the extended life of LEDs, some manufacturers are building LEDs into the fixtures, rather than designing the fixture so that lamps can be replaced.

- Power Technologies Changes – Companies are working on DC LED chips that do not require a driver. An innovation under development is to provide power to new LED fixtures over Ethernet; i.e., provide electricity through data cables.

- Data Collection – Technologies based upon visible light communication are set to transform how we think of lighting. Li-Fi is similar to Wi-Fi, but utilizing light. Indoor Positioning tracks movement of people using luminaires and smartphones. Technologies such as this could open entirely new purposes for lighting products.

These are just some of the trends. While they may provide additional conveniences, control flexibility and other benefits, what will be the cost to the consumer? In addition, by relying on these technologies we may be opening ourselves up to unforeseen negative consequences. Next issue we will look at the potential downside associated with increased technology in lighting systems.