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Use Case of Digital Technology Creating Value in Today's Oil & Gas Industry by Reducing Cost and Enhancing Drilling Performance

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Abstract

Digitalization is the key to the optimization and an enabler for automation. Data is everywhere around us and is growing in volume and utility at all levels of personal, corporate, and governance usage.

The two top publicly traded companies in the world by market cap are Apple and Aramco or in other terms: tech and energy. A recent article in World Oil by Future Market Insights (2022) highlighted that the data business in oil and gas is expected to be valued at $145 billion in 10 years.

Now, the question becomes: is data the end goal or merely what an end-user does with it? The answer is that it is all about telling a story with data such as is highlighted in many books like Storytelling with Data (Knaflic, 2015). When people and organizations create graphs that make sense and weave them into compelling action-inspiring scenarios, they bridge the gap between data and decisions with a Digital Dashboard. This is the important step in adding value to the data.

One key focus for operators in today's market is to be able to look at the consumption of various products, especially diesel, at today's prices in the US and around the world, with the focus on lowering diesel consumption. For example, one oil-based drilling fluid in a long lateral can cost up to $500K in diesel for dilution only. The impact of combined data and predicting reduced usage and costs for decisions, such as lateral length, can be a critical part of controlling operational cost.

The above is only one of the numerous stories that can be extracted from the data in a digital dashboard that clients can access. Operators who use the comparable data output have provided very encouraging positive feedback and have asked the companies to make it available to them externally as well.

Key takeaways for adding value to data today's clients are:

- **Track** all activity including wells, operational aspects, consumption, KPI's, and costs
- **Look** for performance and cost data outliers which should be studied to understand why these wells performed outside of the norm or anticipated KPI's and outcomes
- **Find** ways to benchmark performance to the appropriate peer-group via public data
- **Use** data to remove risk from decision-making processes.

In this paper, which is focused more on the fluid aspects of well construction, the authors share these some applications and subsequent benefits realized by this approach. Applying similar techniques to your data, value can be reaped from the data that will lead to reducing costs and drastically improving performances.

Introduction

The industry is still digesting several headwinds faced in recent history from downturns to pandemics and supply chain shortages the likes of which as have not been witnessed before. Much of the funding to oil and gas producers and explorers have dried up for several reasons including being predictability for returns to shareholders as well as ESG drivers, even ESG governmental mandates. Investors today are looking for operators that can demonstrate via data that they can consistently drill wells at a predictable cost and production with no surprises.

The above economic drivers combined with the Great Crew Change of knowledgeable personnel retiring has left the industry with one option – *do more with less*. That is true for almost everything we do today.

Historical Behavior of Planning Wells

Historically, planning a well hasn't been a simple task. In fact, it has typically been a time-consuming process. This is mostly due to a lack of data sources. However, even with access to a wider range of data, the information found was usually unreliable and unverified. These inconsistencies, along with the trade-secret approach of many in-house models used to predict key fluids parameters, make searching public data sources, like the Texas Railroad Commission (TRRC) database, and arranging it in a usable fashion, both skill and art.

Thankfully today, there are various data providers and software that are able to aggregate public data. These new tools along with assistance from SME's now have the ability to clean, organize, and verify the information in a presentable way so that the data can be used effectively to ultimately save time and increase efficiency.

The dream of a semi or even fully automated well planning cycle is closer now to becoming a reality than ever before. These new tools can provide usable solutions at every point in the life of a well, from scouting to long-term production and even completion and workover activities. Figures 1, 2, and 3 illustrate improved level of data for well planning from past, present, and future.

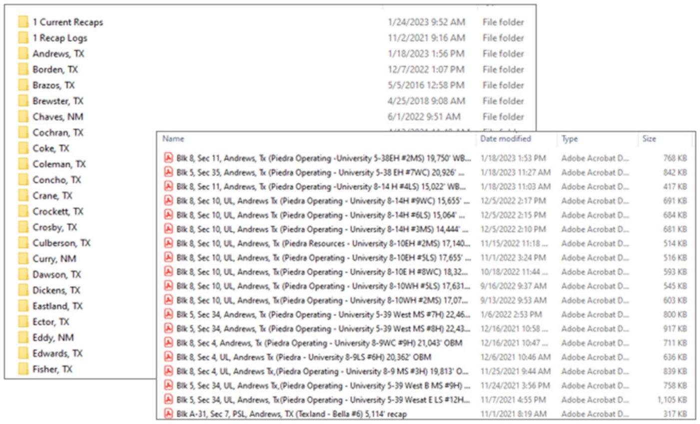

Figure 1 – In the past, data was discrete files for each well.

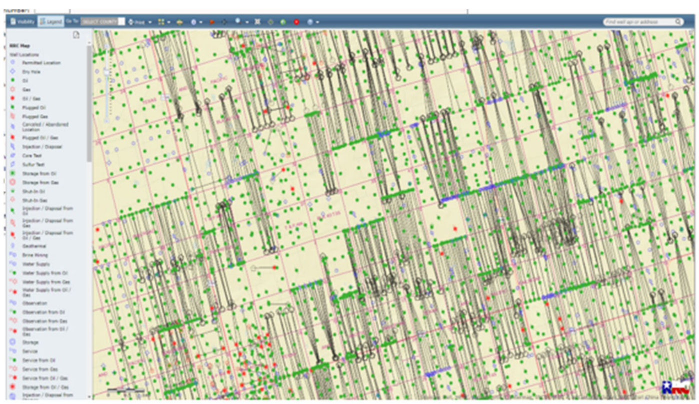

Figure 2 – Present time data frequently is mapped by locale so the user can assess the relative location of the wells being studied.

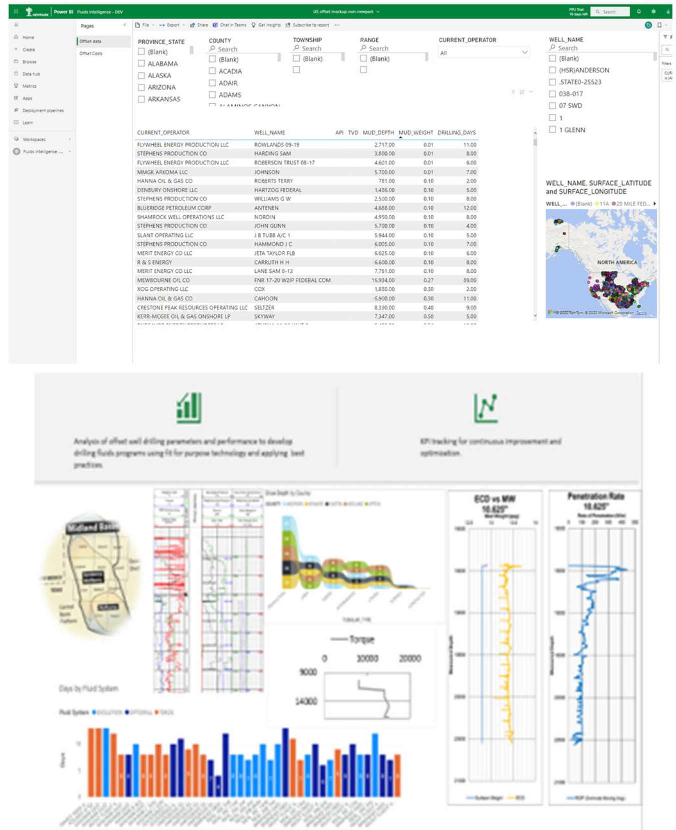

Figure 3 – The next generation of data will use multiple ways to illustrate combined data to better illustrate significant trends or quickly identify outliers.

Data Analytics Role in Creating Efficiencies

The industry has continuously been seeking ways to improve efficiencies and optimize operations, this is the nature of progress. However, this has become increasingly important in recent years. Factors like the Great Crew Change and personnel downsizing, fueled by back-to-back downturns, has made efficiency not only a priority but a necessity for survival in today's markets.

The ability to automate some of the well planning cycle and actually allow the drilling engineer to have enough time to follow ongoing drilling operations requires data analytics and digital tools. Today, a drilling engineer must oversee multiple rigs, run KPI's, and track performance in near real-time. By using these tools, insights can be gained into the main influencers of non-productive or flat time and even invisible lost time. With near real-time analytics, operators have the ability to control costs, adjust parameters, and avoid pit falls that traditionally were thought of a "part of the process". Key data like events recorded and collected, can provide the required visibility project engineers and clients need to anticipate and meet these challenges.

Digital Dashboards for Analytics

Businesses today generate every increasing volumes of data. These data are stored in data warehouses or data lakes. Recently, these terms have also been combined into "lakehouse". Increasingly large volumes of data are hosted on cloud platforms like AWS, Azure or Google Cloud.

All this data is a goldmine and needs to be analyzed to optimize processes and help uncover insights to make data-driven decisions. The key words to this process are the following: ***Learn, Optimize, Repeat.***

Digital dashboards provide users with a quick and easy way to understand complex data, spot trends, and make informed decisions. To do so, they need to have the following characteristics:

- **Clear and concise** – The information on the dashboard should be easy to understand and presented in a visually appealing **way** (Figure 4)**.**
- **Relevant –** The data displayed on the dashboard should be relevant to the user's needs and responsibilities (Figure 5).
- **Customizable – Users should be able to customize the dashboard to meet their specific needs, including selecting which KPIs and data to display** (Figure 6)**.**
- **Timely –** The data displayed on the dashboard should be up-to-date and reflect the latest information.
- **Accessible –** The dashboard should be easily accessible from any device, including desktop computers, laptops, tablets, and smartphones.
- **Secure –** The dashboard should be protected from unauthorized access, and the data displayed should be secure and protected to avoid expose sensible client information.

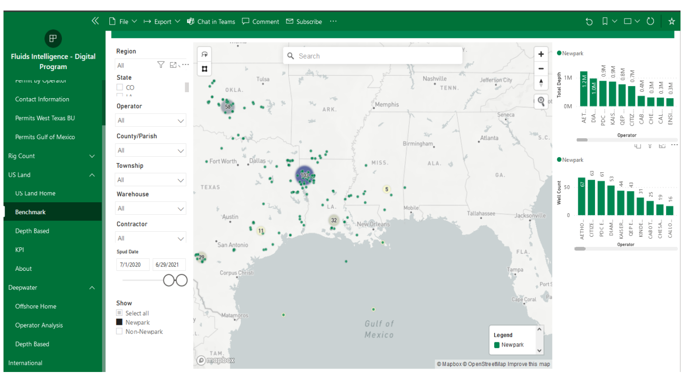

Figure 4 – Example of a new digital visualization tool.

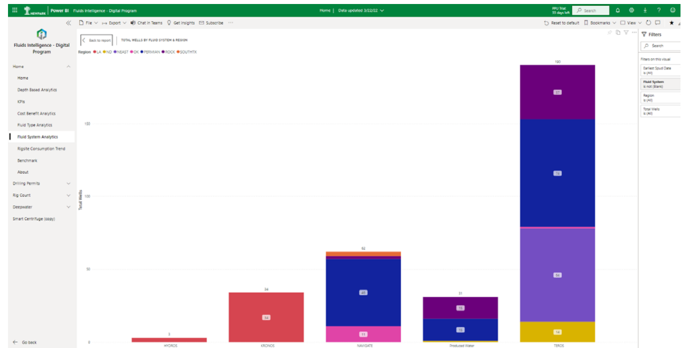

Figure 5 – Benchmarking performances with multi-project analysis.

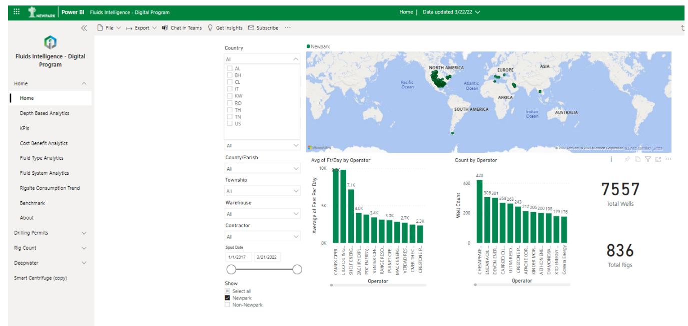

Figure 6 – Illustrated data using geographic location and project KPI's.

Real-Time Data Streaming

Real-time data streaming and analytics have improved significantly from the past, where it was severely limited by things like connectivity, bandwidth, etc., to where it is almost the norm today and any mid-size to large operator has a real time data/operations center. This might be either company owned or outsourced to a third-party company that handles the storage and hosting requirements.

The key to real-time data visibility is the calculations must respond fast enough to reflect both the 1-second refresh rate that one can get today from the rig and the calculation rate to update the displays correctly. This conundrum can be sorted by deciding:

- How accurate is the data?
- What is the data cleansing process in real time?
- What is an acceptable delay to clean the data?
- What is an acceptable refresh rate?
- Is it reasonable to refresh at this time interval?

A key point to be made is just because we can collect data every second, doesn't mean we have to use data at this rate. Every application should have its own boundary conditions for how fast data can be processed and what makes sense for the end user.

Foundation for Successful Digital Projects

A successful digital project is one that takes "data" and turns it to "knowledge" that aids in making a "decision". The next section will discuss the elements of this foundation from data to knowledge to decisions.

Data Workflow

The flow of data from a rig site to a customer typically involves several stages and frequently includes several workflows. The most common one is the Knowledge Discovery in Databases process (KDD) as shown in Figure 7 and discussed over the next few paragraphs.

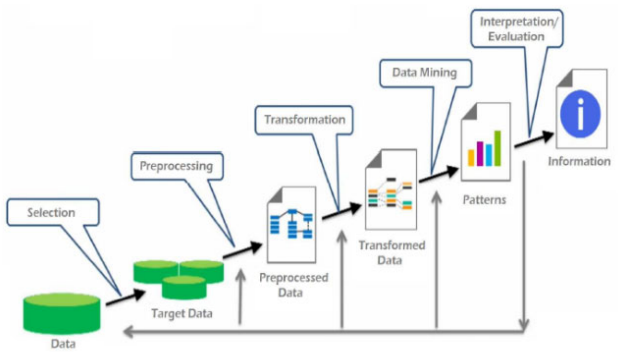

Figure 7 – Knowledge discovery in databases (KDD) process.

First, data needs to be categorized by how it is generated i.e., sensor vs human-generated data. Data is collected at the rig site using various sensors and instruments, such as sensors to measure temperature, pressure, and flow, or downhole tools to obtain geophysical data. The collected data is then transmitted to a central data repository or multiple depending on who has access to the data and who owns the data. Data storage can take several forms such as a data center or cloud-based storage, where it can be organized, processed, and analyzed.

On the other hand, human-generated data may be subject to a different type of error such as typos, different vocabulary, or, in the old days, even failure to match the units used on the well to the units inherent in any computer calculations. This data also needs vetting, but typically using different methods where an SME in the specific domain that the data relates to can train a model and set logical data government rules to prevent any errors from propagating into the dataset and the models.

Once the data has been processed, it is usually reviewed by subject matter experts to ensure its accuracy and quality. The workflow is summarized as below:

- Collect at the source (reports)
- Push to DB
- Pre-process the data
- Transform the data
- Visualize the data

Data governance means that if necessary, the data may be adjusted or corrected, and then it is made available to the customer through a secure, web-based portal.

Data management focuses on data selection – determining which data is needed for the analytics. There is no need to select data that just grows the database but is not contributing to any of the value-added functions.

Once the data is prepared, clients can then access the data and use it to make informed decisions about their operations in what is typically called Decision Support Systems (DSS). In addition to the raw data, customers may also receive reports, visualizations, and other insights based on the data, which help them understand the data and make more informed decisions.

Standardization

The industry today generates gigabytes per rig per day but a recent study showed that about 80% of the data generated is not used for well planning purposes. The challenge when one looks at downhole tool data or rig data that there is very limited standardization taking place today in our industry from data structure to format to time stamp or other attributes around each data point collected. One key initiative that has been active in tackling this is DSAT (Drilling System Automation Taskforce) which looks for standardization, data error identification, and paves the way for collaboration in any environment including OSDU (Open Source Data Universe), thus making the data useful across more platforms and applications.

Leveraging Public Data

To turn data into knowledge, one has to ask: "do I have all the data I need?" and the answer will most likely be "No". Each company whether an operator or service company or a rig contractor generates their own data internally but that's only part of what's out there.

Data is almost a reflection of market share where the amount of data owned by a certain company is typically directly proportional to the company's activity in a certain basin. In other words, if company A has 10% market share in acreage and well count, one would expect that company to have at least 10% of the data of this field and so does each service company associated with this basin. In that case, this is a key point to use to train AI models on the data and then propagating the model through available public data sets.

Using public data for this purpose will be an effective way to increase the amount of data that can be mined to gain insights and knowledge quickly. The data analytics will help to process and interpret large amount of data by uncovering patterns, finding correlations, and trends. The final results are more accurate digital dashboards to the end users where these data are been displayed after the process of data mining public data.

Public data sources may be more difficult to aggregate than one would think and through experience, it was found that some companies specialize in aggregating and curating this data into more usable formats.

The key to public data is to understand which attributes expire with time and which ones remain valid. Fluid density for example remains valid for a longer duration than other data fields but at the same time loses context with depletion or not understanding the number of casing strings per well. A data field that expires much faster is performance metrics like footage per day or days per well which change with changes in drilling technology such as more capable rigs, use of RSS and advanced bit and cutter technology.

Use Cases of Digital Tools in the Life Cycle of the Well

Safety Statistics

Below is an example of safety action cards broken down by category and analyzed using Artificial Intelligence for sentiment analysis and predictability of behavior (Figure 8). This enables the industry to operate with better safety performance.

Tracking downhole losses accurately is key to offset well analysis for other wells in the same field. Below is an example of wells that lost less than 10,000 bbl (Figure 9). Losses can be tracked by fluid type, system, category or subcategory.

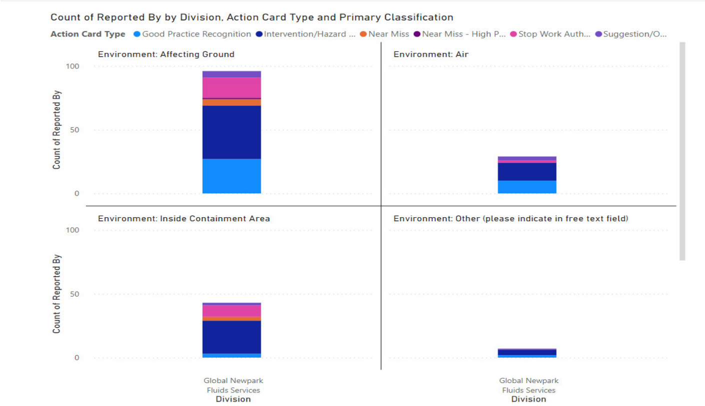

Figure 8 – Safety action cards analyzed using AI.

Losses Tracking

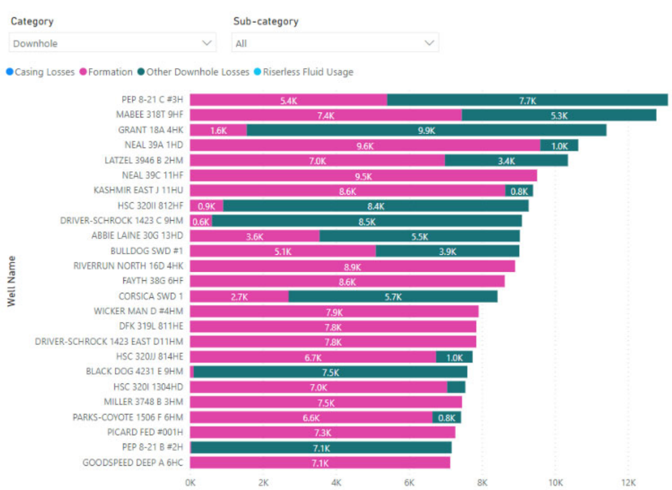

Figure 9 – Fluid losses.

Diesel Consumption

Figure 10 shows diesel consumption along the depth of typical wells using a two different non-aqueous systems. As expected, it is clear that the diesel consumption increases as the wells gets deeper. However, the graphic also helps identify wells that did a better or worse job of minimizing diesel consumption as they are the outliers (significantly below the norm, or significantly above).

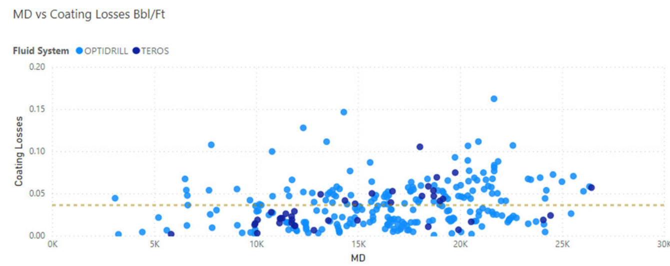

Figure 10 – Diesel consumption.

From there, we can look at the factors why this phenomena takes place but we know that oil consumption is a surface area function and the longer the lateral; the more time these cuttings spend there and the smaller they get. When we compare the time it takes for bottoms-up for the fluid and the cuttings by extending the lateral section by 10,000 ft (Figure 11), more meaningful data is realized.

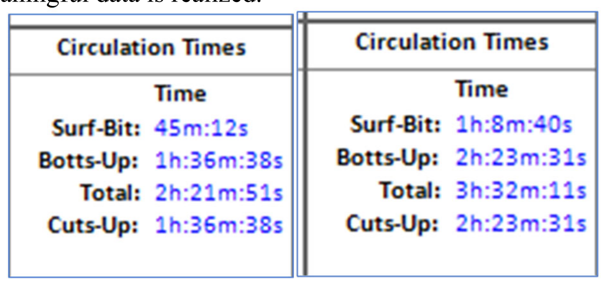

Figure 11 – Impact on circulation time to extend the lateral section by 1,000 ft.

Emissions Tracking

The visual below (Figure 12) shows the value of using data tracked and stored for each well to assign emissions value to fluid-related activities like trucking, conditioning, etc. to make sure we are maximizing the value for the operator while minimizing our environmental footprint.

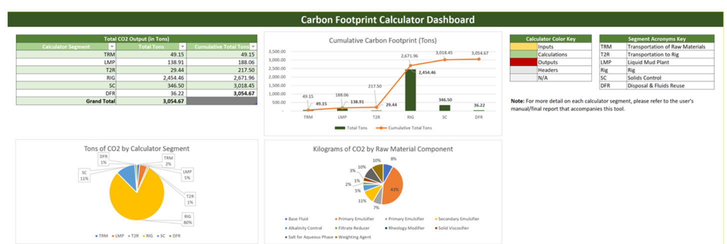

Figure 12 – Emissions value for fluid-related activities.

Conclusions

- Data utilization can be a powerful tool as demonstrated in visual examples drawn from safety, emissions and performance benchmarking.
- Data needs an SME to select which data is needed and when data would expire for certain analytics.
- Data has an expiration date depending on relevance. An example is not using footage per day data from 2010 to demonstrate what can be done from a fluid perspective when footage per day in 2023 has almost quadrupled based on advances in downhole tools and bits.

References

Future Market Insights. 2022. "Data Business in Oil & Gas Market Expected to be Valued at $145 Billion by 2032." World Oil e-Newsletter (April 22, 2022).

Jacobs, T. 2018. "An Inside Look at Anadarko Petroleum's Digital Transformation." *Journal of Petroleum Technology*, vol. 70, no. 11 (November 2018) 40-46. SPE-1118-0040-JPT. www.doi.org/10.2118/1118-0040-JPT

Jacobs, T. 2019. "Digital Transformation at BP is Starting to Add Up to Billions." *Journal of Petroleum Technology*, vol. 71, no. 7 (July 2019) 28-30. SPE-0719-0028-JPT. www.doi.org/10.2118/0719-0028-JPT

Johnston, J. and Guichard, A. 2015. "New Findings in Drilling and Wells using Big Data Analytics." Offshore Technology Conference, Houston, Texas, May 4-7, 2015. OTC-26021-MS. www.doi.org/10.4043/26021-MS

Knafklic, C.N. 2015. *Storytelling with Data: A Data Visualization Guide for Business Professionals,* Wiley.

Mahasivabhattu, K., Bandi, D., Singh, S.K., & Kumar, P. 2019. "Engineering Data Management Using Artificial Intelligence." Offshore Technology Conference, Houston, Texas, May 6-9, 2019. OTC-29358-MS. www.doi.org/10.4043/29358-MS

Mehta, A. 2016. "Tapping the Value from Big Data Analytics." *Journal of Petroleum Technology*, vol. 68, no. 12 (December 2016): 40–41. SPE-1216-0040-JPT. www.doi.org/10.2118/1216-0040-JPT

Murch, D.K., White, D.B., Prouvost, L.P., Michel, G.L., and Ford, D.H. 1994. "Integrated Automation for a Mud System." IADC/SPE Drilling Conference, Dallas, Texas, February 15-18, 1994. SPE-27447-MS. www.doi.org/10.2118/27447-MS

Ockree, M., Brown, K.G., Frantz, J., Deasy, M., and John, R. 2018. "Integrating Big Data Analytics into Development Planning Optimization." SPE/AAPG Eastern Regional Meeting, Pittsburgh, Pennsylvania, October 7-11, 2018. SPE-191796-18ERM-MS. www.doi.org/10.2118/191796-18ERM-MS

Smith, A., Geehan, T., McKee, A., and Zamora, M. 2010. "The True Cost of Process Automation." AADE-10-DF-HO-31, AADE Fluids Conference and Exhibition, Houston, Texas, April 6-7, 2010. Available from www.AADE.org

Taugbøl, K., Brevik, J.O., & Rudshaug, B. 2019. "Automatic Drilling Fluid Measurements." SPE Russian Petroleum Technology Conference, Moscow, Russia, October 22-24, 2019. SPE-196793-MS. www.doi.org/10.2118/196793-MS

Thambynayagam, M. 2019 "Digital Transformation: Quest for Operational Efficiency." *Journal of Petroleum Technology*, vol. 71, no. 7 (July 2019) 14-15. SPE-0719-0014-JPT. www.doi.org/10.2118/0719-0014-JPT