Introduction

Since 2015, the oil and gas industry has experienced significant changes. Aging workforces, low oil prices, and pressure to reduce environmental footprint are among many factors forcing E&P companies to rethink how they operate; which is why there is so much interest in digital transformation. The increasing availability of lower-cost digital technology has the potential to unleash innovative ideas across the oil and gas value chain. But digital transformation is more than the use of new digital technologies to optimize workflows and improve business processes. It is the strategic application of technology, data, and people in order to achieve more desirable business outcomes.

Digital transformation in Oil and Gas is fueled by new technologies

- IoT and Drones for data collection
- The Cloud and associated Data lakes for data management
- Real-time data streaming for asset management
- Machine Learning for analysis

Consider 3D seismic acquisition using Drones and IoT, where real time visualization of data captured in the field plays a key role in assuring accuracy and the highest quality data possible:

Seismic acquisition in complex environments with hard-to-access topography, such as dense rainforest, using traditional acquisition and processing methods is expensive and hazardous. Often, the resultant seismic imaging is of poor quality as well. To address these issues, Total R&D created the METIS project (Multiphysics Exploration Technology Integrated System) with the objective of improving data quality and speed of data acquisition through real time quality control and processing.

Total, in partnership with Wireless Seismic, and SAExploration, conducted a seismic acquisition experiment in a remote area of New Guinea, using Wireless Seismic’s Downfall Air Receiver Technology (DARTs). Dropped from large swarms of drones over a targeted area, DART seismic receivers can be a highly effective option for gathering data in difficult-to-access areas, but they must be well-positioned and operational. Therefore, it is necessary to quickly validate the positioning and data quality from the DARTs.

Figure 1 Seismic Acquisition Using DARTS, IoT, and Onsite Data Validation. This Dart Fell Cleanly All The Way To The Ground (images courtesy of Wireless Seismic, Inc.)

To confirm that DARTs are positioned correctly, data is captured from each DART receiver during the drop, and proprietary calculations are used to monitor how successful the geophone drop has been. Immediate visualization of the drop analyses is essential to the operation. If any of the DARTs fail to land properly or seismic data is faulty or missing, the system command center will adjust and optimize
the acquisition plan in real time. This real-time monitoring and optimization minimizes data problems that might otherwise require reshooting parts of the survey: which would be an expensive waste of resources, time, and money.

**User adoption is a critical aspect to a successful digital transformation**

To fully benefit from digital transformation, companies have to change their way of working. They have to embrace new concepts such as remote workforces and virtual teams – where collaboration between teams is a key to successful projects. Investment in new technologies is also a must. Applications must be web-aware and mobile responsive. As millennials come into the workforce, they bring with them an expectation that enterprise applications/systems embed domain expertise and behave as intuitively as the applications they have become used to on their tablets and smartphones.

**Effective collaboration between oil companies and service companies is required.**

This does not mean giving up proprietary intellectual property, but users must be prepared to be flexible and be willing to integrate. We can start by making data accessible to all the stakeholders in a project. Too often, information is siloed. Geologists, Geophysicists, Engineers. The various disciplines tend to use their own local systems and work independently. They don’t share ideas and seek advice from each other as much as they should. By getting data out of the local systems used by the various disciplines, and centralizing that data in the cloud, it can be made accessible to anyone who needs it.

**Figure 2 The Digital Challenge**

In addition to being accessible, data needs to be easier to find. Oftentimes, explorationists spend up to 40% of their time not just searching for data but searching for the right data. We need improved data delivery so that explorationists have the right data at their fingertips when they need it, including better incorporation of real-time data in the decision-making process. We also need to make it possible to integrate disparate data – what one might think of as Geotechnical “mashups”. This will be especially important for effective machine learning, analytics, and advanced visualization.

Adoption of cloud technologies and cloud data lakes services make it possible to create meta data and indexes which can be used to organize all the data in a project – thereby facilitating intelligent searches and quick access to the exact data needed for analysis and interpretation. Furthermore, such centralized data, when organized by good meta data and indexing, also makes it easier to integrate disparate data for analytics or machine learning. After all, access is greatly simplified when all the data is in one place.

For example, the Open Subsurface Data Uniiverse™ (OSDU) Forum was formed to establish an open subsurface data model and reference architecture with implementations for Microsoft Azure, Amazon AWS, and Google GCP. The OSDU promotes application standards (APIs) to ensure that all
applications, developed by various parties, can run on any OSDU data platform. The goal of OSDU is to deliver the same value and services while running on different cloud service providers and in different data centers.

The new architecture and data model standards can then be completed with an application layer that will enable all your data to be accessible from a single place, make data searchable and discoverable, provide tools to integrate domain expert workflows and leverage AI/ML models, and deliver a collaborative work environment with advanced visualization to quickly share information between users and drive better decisions.

**Figure 3 Collaborative Work Environment With Advanced Visualization**

**Strong user adoption requires advanced visualization and collaboration**

New solutions can integrate expertise from several domains and bring consistency to their workflows by using the same visualization components across all their applications – thereby creating a single app experience.

We can see the benefit in this example of pattern recognition. Large operators can load a huge number of seismic sections from throughout the world, then apply pattern recognition to identify seismic features and attributes that are similar to a section from a known good field.

**Figure 4 Pattern recognition to identify similar seismic features and attributes on several volumes.**

The objective of this experiment is to speed up decision-making and lower the cost of exploration by “hi-grading prospects.” Rather than spending hundreds of hours staring at seismic volumes in order to
find prospects that may have potential. Interpreters can focus their time and effort on the prospects likely to be the most productive.

**Conclusion**

The oil and gas industry is experiencing significant change and is under great pressure to rethink how it operates. While lower-cost digital technology has the potential to unleash innovative ideas across the oil and gas value chain, digital transformation is more than the use of digital technologies to optimize workflows. An effective digital transformation is the strategic application of technology, data, and people working together in order to achieve more desirable business outcomes.

Our industry is beginning to recognize this. The Open Subsurface Data Universe™ (OSDU) Forum was established to develop an open data model and reference architecture that could be leveraged by anybody working with subsurface data. The OSDU application standards (APIs) ensure that all applications, developed by various parties, can run on any OSDU data platform: enabling a collaborative work environment with advanced visualization to quickly share information and drive better decisions. For Total’s METIS project, Wireless Seismic, SAExploration, and Total partnered to conduct safer, more accurate and cheaper seismic acquisition using drones, IoT, and real-time visualization in the field.

![Diagram](image)

*Figure 5 Domain Visualizations/Workflows*

In order to be effective, digital transformation must be holistic and integrate as much of the workflow as possible. Our industry still tends to operate in silos, with geology, geophysics, drilling, and engineering data often separated by applications and vendors. One cannot empower collaboration and improve operational efficiency while still operating in silos. It is necessary to break down those silos in order to generate a more collaborative and cross-domain environment.

The ultimate goal would be a single system, with a mechanism to aggregate and integrate data, built from as many common shared components as possible. These common shared components may come from different local systems or perhaps different vendors. Such a system would provide integrated visualization and analysis of any or all of the data, combining views from various domains – or perhaps combining data from different domains into a new innovative view.

**References**