

CERI Crude Oil Report

Digital Oil and Gas

Andrei Romaniuk

The subject of digital transformation tops the agenda of companies globally. It has and will continue to have such a profound impact that corporate strategists start to ponder about the place of digital strategy in the corporate world. Is it in the same pool with financial, operations, HR, supply chain, marketing strategies? Or, is it more important than those? Some would place digital strategy as high as a business or corporate strategy. What's certain is that Information Technology (IT) strategy is no longer "enough".

A whole domain of technologies has recently emerged and caused a new term – digital – to "consume" IT. The pace of digital transformation understandably goes at a different speed in each sector. Some sectors – information technology, financial, trade, entertainment, or knowledge-intensive – were quick to embrace digital. Others got in gradually. What's the place of digital in the oil & gas sector

This is the first CERI article that touches on digital transformation in the energy sector, specifically, oil and gas. Hence, its goal is to review the existing technologies and their benefits to the industry. Canadian oil and gas face high costs, low commodity prices, emissions reduction targets and market access challenges. Digital technologies can be a part of the solution to these challenges for the Canadian oil and gas sector.

Why now?

The rapid evolution and adoption of technologies marked the start of the next industrial revolution – Industry 4.0. This trend coincided with the new reality of a \$50-\$60 per barrel oil price environment in a global oil and gas industry. This incentivized companies to find ways to cut costs while keeping operations safe and production reliable; to maintain financial performance – margins and return on equity (ROE), within reasonably acceptable ranges for investors. The digital technologies, while requiring investments, deliver a long-term promise on top of conventional cost-saving techniques which

have been successfully employed by the industry.¹ Digital technologies can further help in bringing about a more resilient and lean industry. Certainly, as the oil and gas industry starts to embrace digital, more efficiencies could be envisioned in the future.

The other challenge which the industry must cope with is to reduce its emissions. To do so, it must find ways to produce the same energy cheaper and more efficiently. It means using less energy for production, processing, and delivery of the product to customers. By introducing more digital technologies, the industry not only gains those efficiencies but also helps in branding itself as a modern industry.

Lastly, as renewable energy becomes cheaper, the oil and gas industry must keep up with producing competitive energy. Renewables edge oil and gas-sourced fuels, including electricity, on emissions, but likely will do so on costs soon. To keep up, the oil and gas industry needs to continue innovating and embracing digital technologies to stay in the game. The oil and gas industry is capital-intensive and dominated by long-term projects, and hence, has a limited opportunity to squeeze efficiency once a well is drilled, a platform or plant is installed. This makes the challenge more difficult while digital solutions may help to unlock efficiencies and effectiveness needed to stay competitive.

These factors represent a need for new solutions. Several developments underpin the surge of digital technologies which can fill this need.

First, ever increasing and cheaper computing power – conventional as well as quantum. The latter can bring computing to a new level. It is so powerful that those who work on it report that the challenge in commercialization, in part, is in finding a complicated enough problem which quantum computing would be suitable for.

Second, with cheap and accessible storage and data sensors, the amount of data that businesses can store has dramatically increased. This leads to better insights into how businesses operate, helps identify and address inefficiencies or understand the reasons behind successes. It also allows discovering what was hidden in data using artificial intelligence and work with data more efficiently through business intelligence suites.

Third, the ubiquitous availability of mobile smart technologies – mobile phones, tablets, custom devices and sensors –

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Editorial Committee: Ganesh Doluweera, Dinara Millington, Allan Fogwill

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connected to the internet allowed for many new business models. Significantly increasing the speed of wireless connection is the second aspect which permits pushing and analyzing more and more data, including in real-time.

Combined, these developments allow for a new digital wave of technologies to emerge and penetrate the market.

What are the benefits?

So, what are the benefits for oil and gas companies?

First what needs to be realized is that the oil and gas industry is capital-intensive with massive physical assets – wells, offshore platforms, processing plants, pipeline infrastructure, refineries and upgraders, and gas stations. Irrespective of digital trends, the whole value chain of the industry is still relevant. One needs to find, extract, process and deliver the final product to a consumer. All physical processes with regard to physical materials will need to be there in some form. For example, software companies moved into selling their software online and eliminated physical stores and CDs; email offered a digital product which substituted physical paper mail. Oil and gas companies, on the other hand, cannot get rid of physical assets, processes or products because of digital. However, with digital technologies a company can change the way it does business – change its business or operating model.

Digital technologies help in broader terms to:

- Increase resource base
- Increase initial production rates, recovery, production and returns on assets
- Decrease costs and improve margins by automation, finding efficiencies, and substantially changing processes
- Transform business processes and cut overhead costs
- Reduce emissions and waste by operating more efficiently
- De-risk operations by improving compliance, predictive maintenance, and incident prevention
- Improve overall performance and safety
- Transfer offshore work to onshore
- Improve customer interactions and increase trust

Ultimately, these measures impact margins, returns and shareholder value.

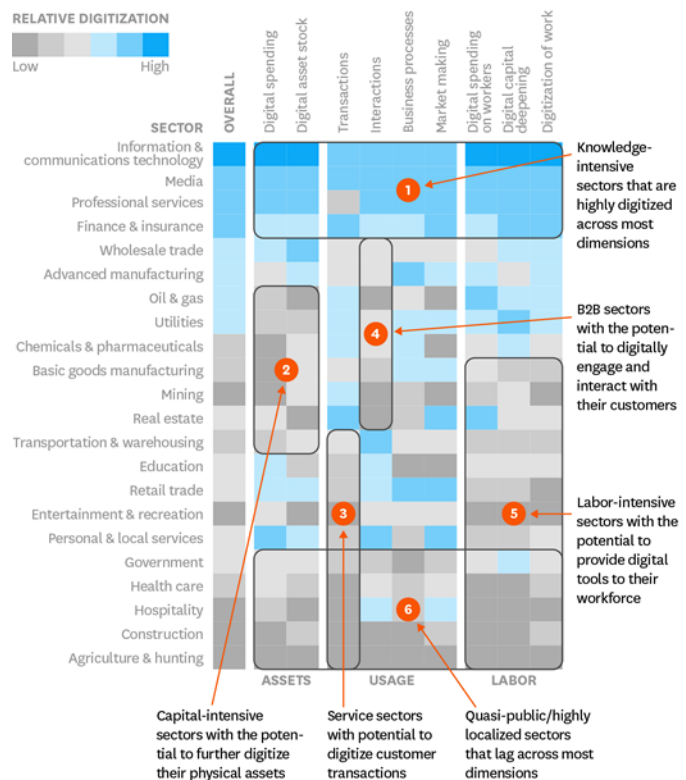
According to the McKinsey Global Institute (Figure 1), oil and gas ranked relatively high among the 30+ sectors in the US. It lagged in digital asset stock, interactions and market making metrics while remaining on par with other more digitally advanced sectors.

Figure 1: Digital Advancement of Industries

Source: McKinsey Global Institute, 2015

How Digitally Advanced Is Your Sector?

An analysis of digital assets, usage, and labor.



SOURCE: DATA ANALYSIS AND EXPERT INTERVIEWS CONDUCTED BY THE MCKINSEY GLOBAL INSTITUTE

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While the industry might have the image of a “dinosaur” with outdated technologies, it has, in fact, been quite digitally advanced.

Here are just a few examples. The industry has been employing 2D/3D seismic processing and interpretation tools with virtual reality and large visualization rooms. It has used linear programming algorithms for refineries and supervisory control and data acquisition (SCADA) systems for pipeline monitoring. Service companies have used smart Measurements and Logging While Drilling (MWD/LWD) systems which enabled analyzing the drilling process in real-time. Other examples are automated platform and plant safety systems and underwater autonomous underwater vehicles (AUVs) used for surveys; smart underwater production complexes and “intelligent” fields, which monitor and optimize field production.

Oil and gas have been a large spender on research and development (R&D), totalling almost 50% of the entire energy sector. The share and absolute dollar amount have decreased since 2014 but still amounts to more than \$15-\$20 billion annually worldwide according to Bloomberg.²

Still, several experts in digital oil and gas, including Calgary-based Geoffrey Cann, who recently published his best-selling “Bits, Bytes and Barrels” book on digital transformation in oil and gas assets, believe that “the industry is in its early innings”.

What are the Technologies and Application Examples?

Essentially, the technologies allow real-time data collection, digitalization of assets, advanced and predictive analytics, in-place manufacturing, higher connectivity and increased automation, and new ways transacting.

Big Data and Business Intelligence. Big data refers to “very large datasets that include structured, semi-structured and unstructured data, from different sources, and in different sizes from terabytes to zettabytes. It has one or more of the following characteristics – high volume, high velocity, or high variety. Big data comes from sensors, devices, video/audio, networks, log files, transactional applications, web, and social media – much of it generated in real time and on a very large scale.”³ Analysis of such massive amounts of data allows for revealing patterns, relationships, and trends which could be of value to businesses.

Cloud-based solutions. Cloud-based computing power and storage (and other cloud-based services including AI, etc.) allows a company to use large computational resources as needed for its tasks as well as to support their rapid growth. Another similar technology – SaaS (software as a service) allows for a user to subscribe to software which is centrally hosted versus buying software and installing in the company’s premises. All in all, such solutions help to obtain assets as you go, in the amount that a company needs, which increases its flexibility and optimizes utilized assets.

AI and machine learning. AI is possibly the most promising technology as its inherent “thinking” and “decision-making” abilities compete with something humans believe to be their privilege. While there are many interpretations of what AI is, many definitions include the ability to perceive the external environment, learn from data, observations, and interactions and use that knowledge to act and make decisions. Essentially, AI should be able to perceive, learn, and problem-solve.

AI should be differentiated from advanced and task-specific algorithms which behave smartly and do the advanced analysis but do not allow for an algorithm to evolve on its own over time. Here, machine learning and deep learning has an ability to learn without explicit instructions but rather relying on patterns recognition and inference.

Industrial Internet of Things (IIOT). The term “internet of things” literally means connecting different assets/equipment, beyond computers, phones or tablets, to the internet so that an asset can exchange data with other systems adding the desired value compared to the non-connected state. For oil and gas companies, cheap sensors, good connectivity, big data and AI allows to analyze operations in real time, increase safety and performance, and make operations more reliable.

Blockchain. This technology is associated with cryptocurrency; however, it is not limited to such use. Blockchain allows for

different parties to hold the same information and have an extremely high level of confidence in the truthfulness of such data. Some of the examples for oil and gas include improved trust in financial transactions, contract management, and ease of dispute resolution.

Augmented and Virtual Reality. Augmented reality merges the real-world image of physical objects with an additional digital layer of information. Virtual reality (VR) allows a user to fully submerge into the virtually constructed world. Such technologies “create bridges between people, assets, places and information where business practices or business structure make it costly or difficult to bring these four things together.”⁴ For the oil and gas sector, VR lets workers “access” remote, underground, or difficult to access places. They allow the builder of a digital copy or prototype of an asset (e.g., a plant) and examine it, test it, or work with its digital twin when it is operational keeping an updated state of the facility for better maintenance. Collectively, such technologies have a significant impact on quality, safety and costs.

3D Printing. 3D printing technology shows potential for decreasing costs, improving performance and decreasing emissions for supply chains by producing a specific physical object right on site or close by. 3D printers can use different materials and have evolved to the level that they can print large objects such as bridges or houses or complex objects such as jewelry, ceramics, clothing, or guns. In effect, 3D printing can “decrease waste, produce lighter parts, produce a single complex part, lower shipping costs, save manufacturing time, and decrease emissions.”⁵

The combination of these technologies produces synergies that would add more value than when used separately. Some of the examples that digital transformation enables oil and gas companies to do include:

- AI-aided analytics of a large amount of data to debottleneck and find efficiencies
- AI-aided interpretation of geological data
- Augmented reality used for maintenance
- Autonomous monitoring and managing of a set of wells (intelligent fields)
- Autonomous on-site vehicles
- Digital twins of existing plants
- Digital wearable devices for geolocation, health, safety and job status
- Predictive maintenance
- Real-time tracking of the performance of complex systems
- Robotized and automated drilling rigs
- Surveillance and inspection by drones of remote wells and pipelines
- VR 3D visualization of seismic data and reservoirs
- 3D printing of parts on offshore rigs.