KAPSARC
مركز الملك عبدالله للدراسات والبحوث البترولية
King Abdullah Petroleum Studies and Research Center

Commentary

Digital Transformation in the Oil and Gas Industry: Hype or Hope?

May 2022

Majed Alsuwailem and Abdelghani Henni

For decades, the oil and gas (O&G) industry has provided the globe with the best value proposition in the form of reliable, affordable, and safe energy supplies. As global population projections soar, demand for all forms of energy is also set to rise, with hydrocarbons expected to play a dominant role in the energy mix for the foreseeable future. However, current global greenhouse gas (GHG) targets and today's definition of clean energy highlights the opportunity for emissions management and creates an economic incentive for producers and consumers to decarbonize, each playing a critical role in the energy transition.

Fourth Industrial Revolution (4IR) technologies such as artificial intelligence (AI), machine learning (ML), cloud computing, blockchain, and the Internet of Things (IoT) have already changed our everyday lives. O&G companies have an opportunity to embrace 4IR technology to generate tectonic shifts in their operations in terms of improving efficiency and meeting GHG targets.

Major O&G producers are raising expectations and emphasizing the role of digitalization in reshaping the future of the industry, propelled by a series of macroeconomic, social, and technological trends.

In fact, O&G companies have long used digital technologies to improve decision-making for exploration and the operation of assets, including hydrocarbon reservoirs, pipeline networks, and downstream processing facilities. Nonetheless, many large-scale digital transformation efforts, such as digital oilfield initiatives, have had setbacks and challenges, falling short of their promises for a variety of reasons. In the era of energy transition, major O&G producers are raising expectations and emphasizing the role of digitalization in reshaping the future of the industry, propelled by a series of macroeconomic, social, and technological trends.

This commentary explains what digital transformation is to a non-technical audience, examines the growing role of upstream digital transformation in accelerating the energy transition, and underscores the importance of security and resilience measures in minimizing operational disruptions while embracing digital transformation.

What is Digital Transformation?

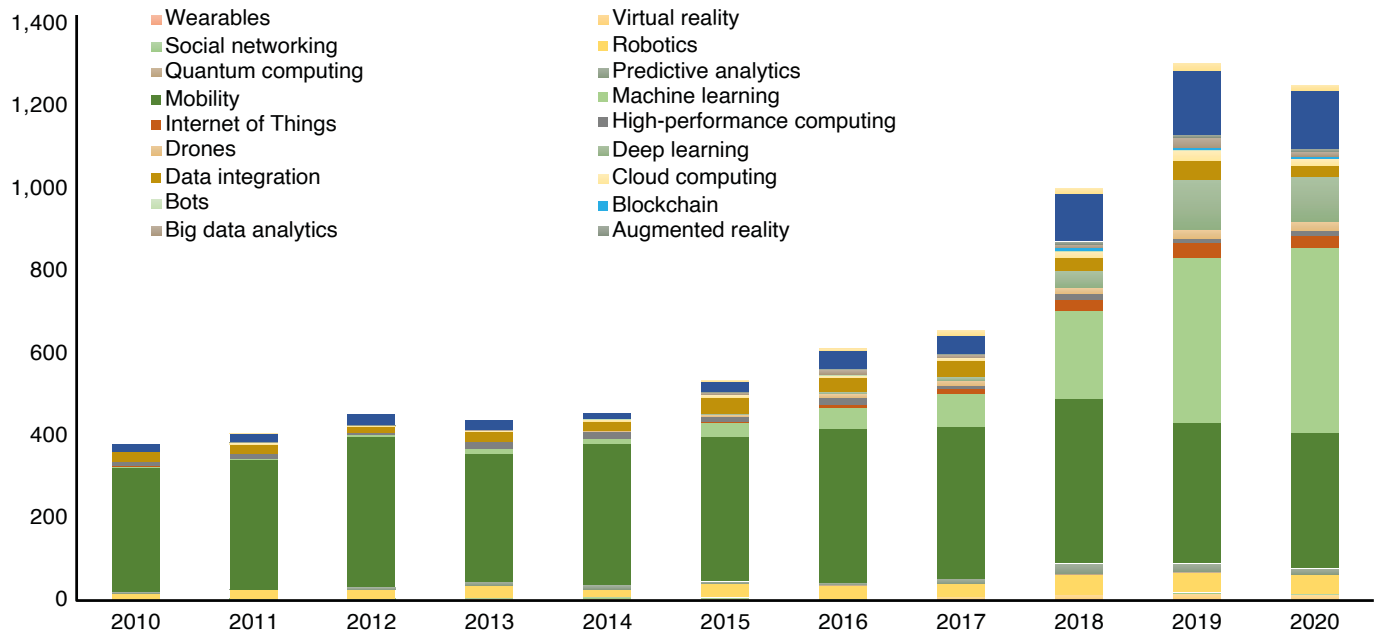
In the past decade, the O&G industry has become increasingly competitive, with multifaceted challenges such as climate change, decommissioning oil fields, and a changing workforce.

Digitalization[1] refers to enabling or improving processes by leveraging digital technologies such as smart sensors, robotics and digitalized tools such as big data, AI and ML (Gupta 2020). In the past decade, the O&G industry has become increasingly competitive, with multifaceted challenges such as climate change, decommissioning oil fields, and a changing workforce (Roberts, Flin, Millar, & Corradi 2021). Subsequently, digitalization has gained greater momentum and is perceived by leading O&G enterprises as a pivotal vehicle to improve efficiency, unlock opportunities, and accelerate the decarbonization of the O&G value chain.

The number of publications on digital technology in the O&G industry has increased threefold since the year 2000. Since the year 2000, over 7,500 technical papers on digitalization have been uploaded by petroleum professionals to the OnePetro[2] technical library. The number of publications saw modest growth from 2014, as depicted in Figure 1. This is attributable to the 'big crew change,' which will be explained in the following section, in addition to the collapse of oil prices, driving companies to further optimize their costs and create additional value. After the declaration of the Paris Agreement on climate change, publications on digitalization in the O&G industry greatly increased as many O&G companies laid out their plans

to decarbonize the O&G value chain, while ensuring that health, safety, and environmental precautions were always met. Most recently, a significant increase in publications on digitalization was observed during the COVID-19 pandemic, which purportedly further accelerated the digital adoption by O&G players.

Figure 1. Number of publications on digitalization in the O&G exploration and production industry.



Source: KAPSARC Analysis based on reviews of paper abstracts in OnePetro.

'Digital transformation' as a concept is relatively new to the O&G industry. Introduced in the early 2010s (Hudson 2012), the term describes business model transformation through using digital solutions. It covers several different organizational, social, and technological approaches and has gained momentum since 2017, following the 2014-2016 industry downturn. During that period, most O&G companies were compelled to downsize their workforce, and many senior O&G professionals opted to exit the market. The high concentration of individuals in mid- to late-career stages has all but disappeared in what is commonly referred to in the industry as the 'big crew change.' As the O&G industry started to recover from the aftermath of the oil recession, new members of the workforce in their twenties and early thirties started to join. These new entrants, mostly digitally savvy, will play a key role in enabling the digital transformation (Parshall 2017).

The first attempts to digitalize O&G operations date back to the 1980s. Most of these were in the fields of geoscience and reservoir simulation and were driven by advanced computing and big data replacing manual processes and delivering faster, more reliable outputs to enable sound decision-making. They created intelligent oil fields, smart oil fields, and digital oil fields, facilitated by an array of interactive and complementary technologies enabling companies to gather and analyze data throughout production sites. Intelligent wells provide

constant data through fiber-optic sensors connected to the IoT in the drilling apparatus about the well and its environment. These enable operators to respond to changing circumstances in real time. The intelligent oil field is where operators, stakeholders, and service companies seek to take advantage of improved data and knowledge management, enhanced analytical real-time systems to generate more efficient business models.

These breakthroughs helped operators integrate various subsurface static and dynamic processes and maximize the economic value of hydrocarbon exploitation and extraction. Different reservoir simulation models were developed commercially and in academia. These increased the widespread adoption of these models in the O&G industry, such as POWERS (which evolved in terms of its capacity and processing power and was later known as TeraPOWERS) by Saudi Aramco and the Integrated Parallel Accurate Reservoir Simulator (IPARS) by the University of Texas.

The success of digitalization in this domain encouraged operators to adopt digitalization in O&G drilling and production. A wave of digital oilfield initiatives swept through the industry in the 1990s and the early part of this century (World Economic Forum 2017). Saudi Arabia's first digital oilfield initiative in a large greenfield was Qatif oilfield (Al-Dossary, Al-Ghamdi, and Al-Ahmari 2008). This was followed by a large scale implementation of digital oilfields as Saudi Aramco efficiently exploited economies of scale. Given the company's low cost per barrel, Saudi Aramco was able to absorb the high sunk and switching costs associated with these digital initiatives in exchange for lowered operating costs. Elsewhere, O&G operators find it difficult to absorb these incremental costs, deterring many from embracing digitalization.

Most of these digital projects, however, have experienced setbacks and challenges and have underdelivered for various reasons, including volatile oil prices, high initial investments, and organizations lacking agility and adequate competencies in the digital space.

Main Inhibitors of Digital Transformation

In the O&G industry, most of the early successes in the digital transformation space were in pilot tests or small-to-medium greenfields, especially in remote locations (e.g., offshore platforms and installations). Most of these digital projects, however, have experienced setbacks and challenges and have underdelivered for various reasons, including volatile oil prices, high initial investments, and organizations lacking agility and adequate competencies in the digital space.

Due to the high costs associated with digitalization, many operators opted not to digitalize, citing that the capital expenditures in setting up digital infrastructure and the operational expenditures in maintaining these systems exceeded their benefits. In reality, it was more to do with an inherent resistance to change than costs. Some even deployed a few digital applications as smokescreens to appease the public and portray themselves as energy innovators. For decades, operators were able to operate using out-of-date technologies and did not seek the latest and greatest innovative solutions. However, with rapid technological breakthroughs, the cost of digitalization has dropped considerably in the last few years thanks to increased competition among technology developers, increased data storage capacity and faster processing times. Slowly and progressively, operators appreciate the value digital technology brings to their businesses, especially in remote operations, data analytics and modeling, and human-machine interfaces.

Furthermore, the boom-and-bust oil price cycles have had adverse implications for investment in digital transformation projects. When oil prices are high, O&G companies make long-term plans to develop and deploy digital transformation strategies and relevant business models. Ideally, digital adoption should be counter cyclical to reap its benefits during downturns. In reality, when oil prices fall, most digital transformation projects are either postponed or completely shelved, and digitalization picks up again once oil prices are higher.

Despite the price swings which tend to affect O&G players' digital transformation, the digitalization of operations is inevitable and is set to transform the global energy landscape in the coming decades, making it more connected, reliable and sustainable. Major O&G producers have been leveraging their comparative advantages in project management and operational excellence and replicating digital projects as they pivot to the energy transition and decarbonization space. Thus, three strategic archetypes have emerged recently that address the energy transition with digitalization at the epicenter of the process.

Energy diversifiers: The first business model has been pioneered by European supermajors such as Shell and BP. They aim to become integrated energy companies by capturing a larger portion of the energy value chain and deriving value from electrons and hydrocarbon molecules.

Optimizers: Major O&G developers, such as Saudi Aramco and Occidental, remain focused on O&G operations while reducing their scope 1 and 2 emissions by tapping into natural carbon sinks. This emissions reduction effort includes preserving and restoring marine environments and deploying carbon capture, utilization, and storage (CCUS) projects, and expanding into the geothermal energy space.

Catalyzers: A handful of operators such as Ørsted have pivoted to focus on renewables in the short-to-medium term and have shifted away from fossil fuels. They have built large renewable capacities by being efficient and having commercially optimized in the countries they operate in. They use government offsets and carbon credits to achieve carbon neutrality.

Regardless of the archetypes highlighted earlier, incumbent players can make a big dent in digital transformation and, simultaneously, address climate change. These firms have a disproportionally large stake in climate policy outcomes, and therefore they have a strong self-interest in leading the whole O&G industry to address climate change. In most O&G conferences and conventions, incumbents often signal to others the importance of embracing digitalization not only to address climate change but also to improve their operational efficiencies and unlock sweet spots that are often overlooked. Consumers are also increasingly paying more attention to environmental issues, which influences their energy choices. According to a white paper published by the World Economic Forum, the intrinsic and extrinsic values of digitalization in the O&G industry range from between $1.6 and $2.5 trillion. Intrinsic values are engendered by efficiency gains and extrinsic values are realized by an adherence to environmental, social, and corporate governance principles (World Economic Forum 2017).

Digitalization of operations is inevitable and is set to transform the global energy landscape in the coming decades, making it more connected, reliable and sustainable.

Incumbent players can make a big dent in digital transformation and, simultaneously, address climate change. These firms have a disproportionally large stake in climate policy outcomes, and therefore they have a strong self-interest in leading the whole O&G industry to address climate change.

Digital technologies promise safety and efficiency gains, minimize the environmental impact of hydrocarbons, and enable effective decisions via enhanced technology-data-process capabilities for the O&G industry. However, employees' unwillingness to change and inadequate organizational practices have been major factors hindering the pace of digital transformation. Previous processes placed less emphasis on market-based demand for digitalization and focused more on imposing it using a supply mindset. This discouraged many operators from reaping the benefits of digital transformation and kept them sticking to old norms.

Data, by itself, no longer provides competitive advantages to its holders. The effective use of data as a currency of exchange is now the key differentiator.

Data, by itself, no longer provides competitive advantages to its holders. The effective use of data as a currency of exchange is now the key differentiator. O&G companies got accustomed to operating in silos and controlling the amount of data shared across different functions within the organization. Slowly and gradually, O&G operators learned to break these barriers and overcame information asymmetry as they warranted unnecessary costs. Some operators, such as Equinor, were quite forthcoming and embraced data democratization. The company voluntarily shared all operational data pertaining to selected brown oilfields, offshore wind projects, and carbon capture and storage projects with academia and its service provider. This was in order to institute a culture of change, build trust, foster innovation, and cement its commitment to becoming a preeminent energy diversifier and a technology powerhouse (Equinor 2022).

Digitalization and a Net-Zero Future

O&G companies are required to be innovative nowadays more than before, even if this means looking for crossover technologies from other industries such as aerospace, automotive, and medicine to help drive efficiency, boost productivity, and reduce their carbon footprints.

Climate change requirements have brought the industry's license to operate under scrutiny, as O&G operators are compelled to reduce their emissions and reach net-zero carbon emissions by 2050. Global stakeholders want more visibility into the activities, risks and opportunities in the O&G sector. The world could not simply 'unplug' from O&G in order to meet climate mandates; it also needs to focus on energy security and economic growth in developing countries. O&G companies are required to be innovative nowadays more than before, even if this means looking for crossover technologies from other industries such as aerospace, automotive, and medicine to help drive efficiency, boost productivity, and reduce their carbon footprints.

The industry is increasingly digitalizing its operations to decarbonize. It is also reducing its GHG footprint, which is crucial to protecting the industry's license to operate across every stage of the well lifecycle. Decarbonization could happen by detecting and reducing emissions per foot drilled, reducing power consumption, and optimizing well footprints, among other solutions.

Digital solutions also present some of the industry's best opportunities for achieving performance gains and reducing emissions. This could be done using open, cloud-based platforms and applications, digitally connected technologies, edge computing and autonomous systems, among other technologies. As reducing GHG emissions becomes one of the top priorities for O&G companies, digitalizing operations, or moving into so-called 'intelligent' or 'smart' oil fields is now a necessity rather than a choice. Intelligent fields are now being used by operators, partners, and

service companies to take advantage of improved data and knowledge management, enhanced analytical real-time systems, and more efficient business models.

Many companies have also started to invest in carbon capture, utilization, and storage (CCUS) to decarbonize their operations. This comes amid the migration to ultra-mature production and concern about rising GHG emissions. As such, the implementation of carbon capture and storage projects is coming into sharper focus than ever before, especially in the Middle East. Saudi Arabia alone has nearly 500 oil- and gas-bearing reservoirs across the Kingdom (Shabaneh, Al Suwailem, and Roychoudhury 2020). The use of analytical techniques such as machine learning in CCUS helps to scrutinize reservoir qualities and design optimal carbon injection rates for prospective CCUS projects. For existing projects, such as the Uthmaniya CCUS project, digital technologies such as fiber-optic sensors monitor carbon injection along the CCUS chain, especially in the wellbore and pore space (Alhashboul, Almufti, and Kokal 2017).

Innovation … Where the Rubber Meets the Road

Digitalization has been driven by startups. The greatest breakthroughs in digitalization were driven by a few entrepreneurs who transformed the digital landscape and created new demand for their products and services. This does not bode well for an industry that has historically resisted change, as discussed earlier.

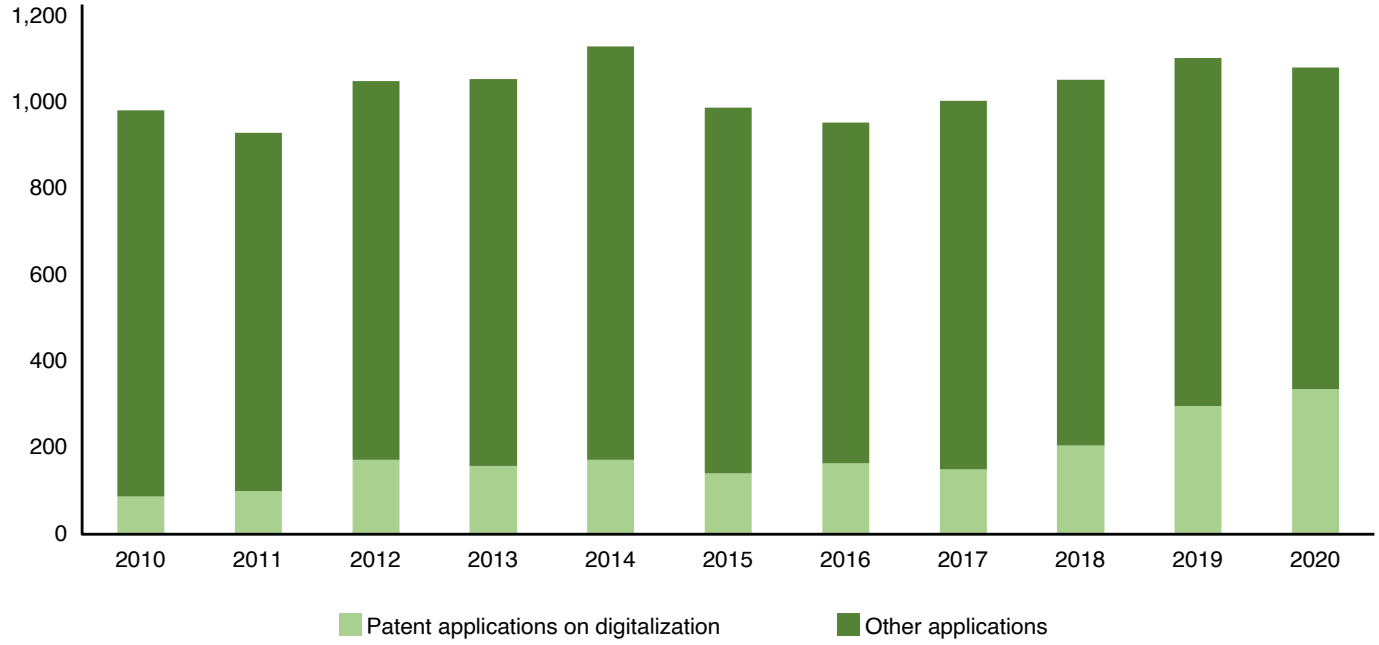
The main barrier facing the O&G industry in achieving its digitalization objectives of improving efficiency and achieving net-zero targets is a lack of innovation in the sector and an ecosystem that nurtures it. When they were founded, O&G producers were driven by curiosity and developed an ecosystem that embraced failures as lessons learned. As they grew bigger and their operations became more complex, this entrepreneurship abated.

The main barrier facing the O&G industry in achieving its digitalization objectives of improving efficiency and achieving net-zero targets is a lack of innovation in the sector and an ecosystem that nurtures it.

Most technologies follow an ‘S’-shaped performance curve over their lifetimes. The penetration rate of a novel technology is very slow at first. Then it hits an inflection point, with the technology gaining acceptance and increasingly penetrating more markets. This acceleration continues until the technology matures. The pace of technological adoption and propagation in the O&G industry is slower than in other industries. For instance, the first horizontal well was drilled in Texas in 1929. The first hydraulic fracturing experiment was performed in 1947, and it was commercialized in 1949. Even though these technologies were known and commercialized, it took nearly half a century to scale them up in the shale sector (Al Suwailem and Williams 2022).

Digital technologies can catalyze innovation in the O&G industry, and thus potentially promote a more positive public perception of it. One useful way to measure the pace of innovation and identify technological trends in an industry is through patent applications. Figure 2 illustrates the number of patent applications from the 10-largest O&G companies in terms of market capitalization. Despite the oil price swings, the number of patents has remained relatively steady at around 1,000 applications per year. Remarkably, since 2017, patent applications for digitalization technologies have gained traction, constituting approximately one-third of the patent application filings in 2020 (Figure 2).

Figure 2. Number of patent applications by the 10-largest oil companies in terms of market capitalization, as of October 2021.



Source: KAPSARC Analysis based on patent application filings at the World Intellectual Property Organization.

Note: The 10-largest oil companies by market capitalization as of October 2021 were Saudi Aramco, ExxonMobil, Chevron, Shell, PetroChina, TotalEnergies, Gazprom, ConocoPhillips, BP, and Rosneft (Bhutada 2021).

The management of big data, an area of expertise more commonly associated with companies such as Google and Microsoft, represents another challenge to the oil and gas industry.

The management of big data, an area of expertise more commonly associated with companies such as Google and Microsoft, represents another challenge to the oil and gas industry. Big data has been a problem in O&G, especially seismic data. The largest data centers in the O&G industry are owned by seismic interpretation firms, such as Landmark Graphics (now Halliburton Graphics) that grapple to manage it properly. The digitalization of operations has created new challenges in managing and analyzing the seismic data to optimize resource extraction, manage well operations, improve reservoir performance, and avoid disruptions. To overcome these challenges, many operators partnered with cloud storage providers to store, administer, and analyze large quantities of data. Examples of this include Saudi Aramco's partnership with Google Cloud Platform, and TotalEnergies' partnership with Amazon (Arab News 2020; TotalEnergies 2021).

The growing importance of big data may affect the skillsets required in operations and how petroleum professionals are taught at universities. The industry has also lost its attractiveness among Millennials, leading to a shortage of skilled people, especially those with technology skills. The younger generations are tending to avoid joining the O&G industry due to it having a long history of booms and busts.

Millennials and Generation-Z "see the industry's careers as unstable, blue-collar, difficult, dangerous and harmful to society." Sixty-two percent of teenagers aged 16 to 19 say a career in O&G is unappealing, according to a survey of 1,200 young Americans, including 39% who say the industry is very unappealing (EY 2017).

Millennials and Generation-Z "see the industry's careers as unstable, blue-collar, difficult, dangerous and harmful to society."

The bad news is that the O&G industry does have a talent problem right now. Too many experienced workers, including highly trained engineers, are retiring from the industry, and there are too few newcomers to fill their shoes. Moreover, some are retiring with knowledge of proprietary and/or legacy systems that are no longer supported by their vendors. However, O&G companies may have found a way to overcome these twin challenges by embracing digitalization.

Cybersecurity in the Oil and Gas Industry

Digitalization is helping the sector to combat climate change and optimize processes to reduce emissions and help it decarbonize. However, cybersecurity is a major issue, fueled by the rising cyber attacks on energy facilities around the world. Recent victims of cyber intrusions include the United State's Colonial Pipeline in 2021, which affected O&G supplies in parts of the country, with some states even declaring emergencies; and oil tanks in Germany SEA-Tank's facilities in Antwerp in Belgium and Evos in Holland, which affected terminals with oil storage and transport globally. Cybersecurity has become a real challenge, especially as the attacks have become more sophisticated.

As digitalization advances, tackling cybersecurity requires resiliency and putting security measures and safeguards in place.

As digitalization advances, tackling cybersecurity requires resiliency and putting security measures and safeguards in place. Responses to cyber attacks must be multilayered, repelling the most common attacks, with a nuanced approach for advanced and emerging threat vectors. To protect critical information, organizations must not only address the security of traditional informational and operational technology environments, they must also deal with the added complexities of IoT. Furthermore, they might also integrate innovative digital business process disruptors, such as robotic process automation, blockchain and artificial intelligence. Never before has it been so important to ensure that security efforts are integrated into every facet of an organization's operations.

Closing Remarks

As 4IR shapes the way we live, the digitalization of O&G interoperability has become a sobering reality and is on the cusp of a revolution. It necessitates not only moving companies' data to cloud platforms, but also modifying the way companies function by incorporating new digital technologies in every aspect of their businesses.

The growing pressure on industry players to reduce their GHG emissions has also become a top priority for O&G companies. The digitalization of operations will help facilitate this objective. Furthermore, soaring energy prices offer the industry an opportunity to further boost its digital transformation efforts and enhance its cybersecurity. Therefore, digital transformation is not only a hope for the industry, but a strategic necessity for it to thrive in the energy transition and get its groove back.

Digital transformation is not only a hope for the industry, but a strategic necessity for it to thrive in the energy transition and get its groove back.

Acknowledgments

The authors thank Colin Ward, Shahid Hasan, Turki Al-Ragas, and Lina Al-Hamdan for their guidance and insights.

Endnotes

1 Digitalization is often mistaken for digitization. The latter is merely focused on capturing and managing data, whereas digitalization is broader and encompasses workflows and processes and how they can be optimized and enhanced to increase efficiency gains and generate revenues.

2 OnePetro is an aggregator, not a publishing house. It has the most comprehensive online library of technical literature for the O&G exploration and production industry, with over 200,000 publications.

References

Al Suwailem, Majed, and Bertrand Williams. 2022. “Integrated Oil Companies and the Requiem for A Transition: How Are They Coping with Climate Change?” KAPSARC.

Al-Dossary, Faisal, Abdulrahman Ahmed Al-Ghamdi, and Abdulrahman Saeed Al-Ahmari. 2008. “Experiences and Benefits are Gained by the Implementation of the First Intelligent Field in Saudi Aramco, (QTIF field).” Abu Dhabi International Petroleum Exhibition and Conference. Society of Petroleum Engineers.

Alhashboul, Almohannad, Abdullatef Almufti, and Sunil Kokal. 2017. “Surface Facilities Design for the First CO2 EOR Demonstration Project in Saudi Arabia.” EAGE Conference and Exhibition, Paris. Society of Petroleum Engineers.

Alturki, Fahad, Abdulmohsen Alkhalaf, Tadeusz Patzek, Majed Alsuwailem, Bert Williams, Frank Felder, and Ahmed Mehdi. 2022. “How Can Governments, Oil and Gas Enterprises, and Research Institutions Collaborate to End Routine Gas Flaring?” KAPSARC.

Arab News. 2020. “Saudi Aramco teams up with Google Cloud to offer services to customers in Saudi Arabia” *Arab News*, December 21. https://www.arabnews.com/node/1780631/business-economy

Bhutada, Govind. 2021. “Ranked: The Largest Oil and Gas Companies in the World.” *Visual Capitalist*, October 25. https://www.visualcapitalist.com/ranked-the-largest-oil-and-gas-companies-in-the-world/

Bloomberg, Jason. 2018. “Digitization, Digitalization, And Digital Transformation: Confuse Them At Your Peril.” *Forbes*, April 29. https://www.forbes.com/sites/jasonbloomberg/2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/?sh=1a6776102f2c

Casat, Gianfranco, Vedrana Savic, Valentin de Miguel, Trevor Gruzin, and Yoshinori Tachibana. 2021. “Youthquake meets green economy: Why businesses need to care.” Accenture.

Equinor. 2022. “Data sharing in Equinor.” https://www.equinor.com/en/what-we-do/data-sharing.html

EY. 2017. “How do we regenerate this generation’s view of oil and gas?”

Gupta, Sen Mark. 2020. “What is Digitization, Digitalization, and Digital Transformation?” ARC Advisory Group, March 24. https://www.arcweb.com/blog/what-digitization-digitalization-digital-transformation

Henni, Abdelghani. 2015. “Crossover Technologies Enhance Innovation in Oil Industry.” *Journal of Petroleum Technology* Vol. 67, p 80–82. doi: https://doi.org/10.2118/0915-0080-JPT

Hudson, John. 2012. “Technology Focus: Intelligent Fields Technology.” *Journal of Petroleum Technology*, Vol. 64 (2012): 98. doi: https://doi.org/10.2118/0512-0098-JPT

Mittal, Anshu, Andrew Slaughter, and Vivek Bansal. 2017. “From Bytes to Barrels: The Digital Transformation in Upstream Oil & Gas.” Deloitte Center for Energy Solutions.

Parshall, Joel. 2017. “After Years, ‘Big Crew Change’ Has Passed, But Learning, Training Challenges Remain.” *Journal of Petroleum Technology*, June 28.

Roberts, Ruby, Rhona Flin, David Millar, and Luca Corradi. 2021. “Psychological factors influencing technology adoption: A case study from the oil and gas industry.” *Technovation* Vol. 102. no 102219. https://doi.org/10.1016/j.technovation.2020.102219

Shabaneh, Rami, Majed Al Suwailem, and Jitendra Roychoudhury. 2020. “World’s First Blue Ammonia Shipment Signals Prospective New Low-Carbon Energy Trade for Saudi Arabia.” KAPSARC.

TotalEnergies. 2021. “TotalEnergies and Amazon announce strategic collaboration.” July 29. https://totalenergies.com/media/news/press-releases/totalenergies-and-amazon-announce-strategic-collaboration

Tsvetanov, Tsvetan, and Srishti Slaria. 2021. “The effect of the Colonial Pipeline shutdown on gasoline prices.” *Economic Letters* Vol. 209. no 110122. https://doi.org/10.1016/j.econlet.2021.110122

World Economic Forum. 2017. “White Paper: Digital Transformation Initiative - Oil and Gas Industry.”

———. 2017. “World Economic Forum: Digital Transformation Initiative.” PowerPoint presentation.

Wright, Blake. 2021. “Hide and Seek: The Orphan Well Problem in North America.” *Journal of Petroleum Technology* 8: 30-34. https://doi.org/10.2118/0821-0030-JPT

Yu, Daneeva Yu, A. Glebova, O. Daneev, and E. Zvonova. 2019. “Digital Transformation of Oil and Gas Companies: Energy Transition.” *Advances in Economics, Business and Management Research*, 199-205. Atlantis Press.

About the Project

Saudi Arabia has introduced the circular carbon economy (CCE) concept as a holistic approach to managing the carbon cycle and addressing climate change. The digital carbon accounting project explores how digital tools can support the measurement reporting and verification of carbon cycles. It focuses on improving the transparency of carbon accounting practices and standards across commodity supply chains to promote and enable efforts to value carbon management within a global CCE framework.

About KAPSARC

KAPSARC is an advisory think tank within global energy economics and sustainability providing advisory services to entities and authorities in the Saudi energy sector to advance Saudi Arabia's energy sector and inform global policies through evidence-based advice and applied research.

Legal Notice

مركـــز الملـــك عبـــدالله للدراســـات والبحوث البترولية
King Abdullah Petroleum Studies and Research Center

www.kapsarc.org