



**RE-CONCEPTUALIZING
OIL AND GAS INDUSTRY THROUGH
THE ADOPTION OF DIGITAL TECHNOLOGY
POST OIL PRICE CRASH OF 2014**



Author

Birgitta Purnama Putri

Editors

Dirgayuza Setiawan, M.Sc

Viyasa Rahyaputra

Designer and Layouter

Ristyanadya Laksmi Gupita

COMMON ABBREVIATIONS

O&G : Oil and Gas

R&D : Research and Development

E&P : Exploration and Production

EBITDA: Earnings Before Interest, Tax, Depreciation, and
Amorization

EV : Enterprise Value

DCF : Discounted Cash Flow

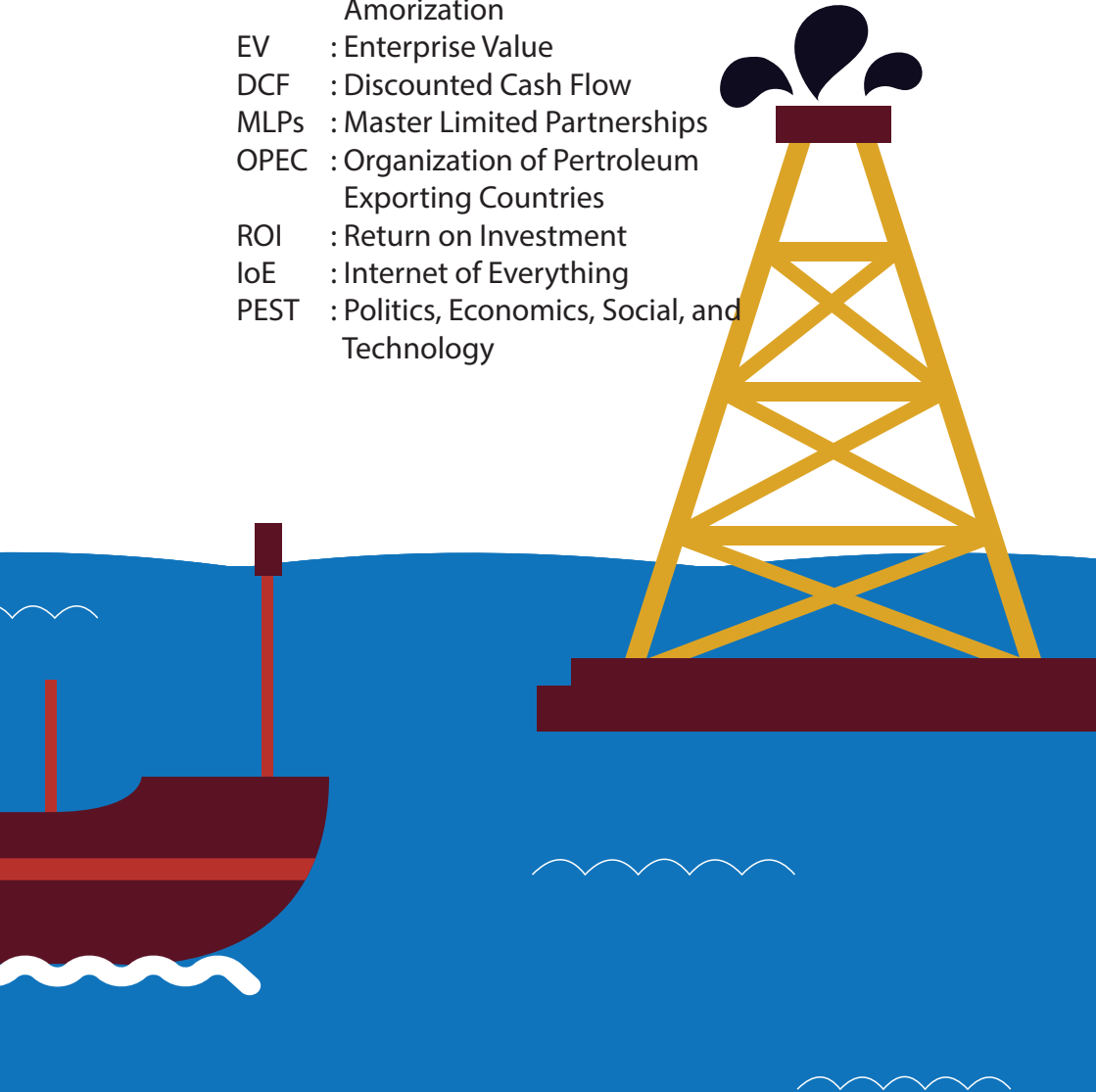
MLPs : Master Limited Partnerships

OPEC : Organization of Petroleum
Exporting Countries

ROI : Return on Investment

IoT : Internet of Everything

PEST : Politics, Economics, Social, and
Technology



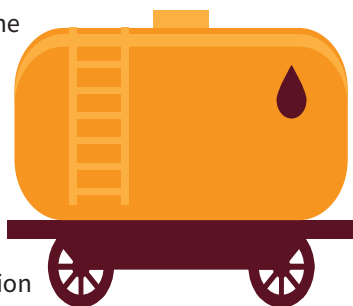
SUMMARY

The oil and gas industry has undergone a fluctuating yet prolific progression over the past decades. The industry indeed produces significant economic contribution to mankind in general, as basic productive activities require significant amount of energy to run. A major competitive industry involving different players, the industry sector also grooms innovative solutions which may or may not be streamed from the overall business innovations and trends. Since the oil price crash in 2014, the industry is forced to adjust, and much cost is wasted. Digital technology has indeed been incorporated in the overall business process, but it becomes the highlight from which the industry can take most benefits after 2014, especially amidst the uncertain and unhealthy business environment in their sector. This case study analyses the adoption of digital technology by mentioning the valuation approaches to re-conceptualise the O&G industry.

INTRODUCTION

Modern civilization is powered by fossil fuels. Use of fossil fuels has made possible the expansion of human population from 1 billion in 1820 to 7.5 billion today.ⁱ Since the debut of the industrial revolution in 1800 by the invention of the steam engine, mankind greatly increased the use of fossil fuels. Fossil fuels are more favourable than renewable sources for their combustible characteristic that can be used directly or with little refinement. Uranium, sun ray, wind or biomass as renewable sources cannot be put directly into one's gas tank. It is obvious that no renewable source or combination of sources can harvest enough energy in quantity or form to sustain modern civilization current lifestyle. Energy from renewable sources will increase, but without fossil fuels, the energy available will be only ten to twenty percent of the need.ⁱⁱ

For almost three hundred years since the debut of the industrial revolution, mankind continues to consume the fossil fuels that took nature three billion years to produce and are projected to be depleted by 2100. Oil and natural gas fuel more than 97% of our nation's vehicles, land sea and air.ⁱⁱⁱ As chemical feedstock, they are key components of manufactured goods, surgical equipment, fertilizers, phones, CD's paint, wind power generators, et cetera. In 2013, oil accounts for 31 % of the primary energy production,



coal's contribution is about 29%, and natural gas contributes 22%. The rest is made up by bioenergy at 10%, nuclear energy at 5%, and hydropower at 2%. The other renewables constitute the remaining 1%, a number obtained by proper rounding of values for the major sources of energy (Figure 1).^{iv} Renewable sources cannot provide the quantity or forms of energy needed to replace fossil fuels.

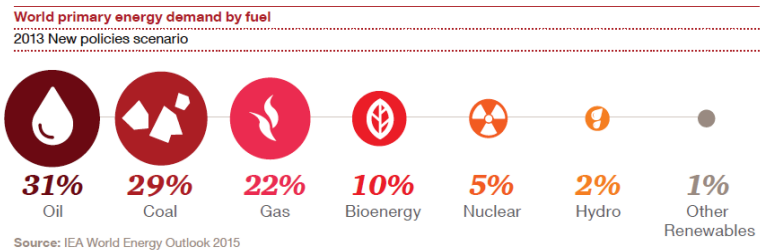
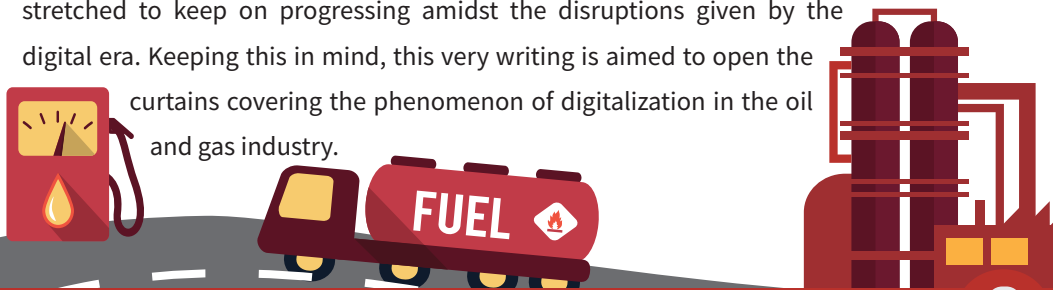


Figure 1 – World Primary Energy Production

The Oil and Gas (O&G) business is a global industry that impacts all aspects of our lives. O&G represent global commerce on a massive scale. World energy markets are continually expanding, and companies spend billions of dollars annually to maintain and increase their O&G production. Large quantities of O&G flow daily from "exporting" regions such as the Middle East, Africa and Latin America to "importing" regions such as North America, Europe and the Far East. Over 200 countries have invited companies to negotiate for the right to explore their lands or territorial waters, hoping that they will find and produce O&G, create local jobs and provide billions of dollars in national revenues.^v

Seeing the importance of the industry for humanity in general, the industry needs to stay alive for humanity to keep on running with their productivity. Along with the very well-known era of digitalization occurring in the past years or so, the industry is also stretched to keep on progressing amidst the disruptions given by the digital era. Keeping this in mind, this very writing is aimed to open the curtains covering the phenomenon of digitalization in the oil and gas industry.



THE NATURE OF BUSINESS AND THE URGENCY OF DIGITALIZATION

Robert M. Grant introduces Political, Economic, Social, and Technological (PEST) analysis for assessing the macro environment and its impact on the industry environment, in which O&G industry has obviously been affected by those elements in all its business operation cycle.^{vi} **First**, political factors – including government interventions through tax policy, environmental law, labour law, trade restriction, tariffs, and political stability – are significant in the O&G industry. The first political determinant is the powerful impact of OPEC (the Organization of Petroleum Exporting Countries) on crude oil price and production. A higher crude oil price leads to the higher price of energy, which in turn negatively affects other directly or indirectly dependent trading practices. **Second**, economic factors – such as economic growth, interest rates, exchange rates, and inflation rate – have major impacts on how businesses operate & make decisions. They affect particularly the costs and profitability of the business. The recession is one of the important determinants. Due to the world recession, so the oil demand dropped, oil industry suffered a 12% drop in turnover. **Third**, social and demographic trends can affect the demand for a company's products and how that business operates.¹ These factors include cultural aspects and health consciousness, population growth rate, age distribution, and career attitudes. **The last one**, also a major factor for the modern O&G industry, is technological shifts, including R&D activity, automation, cloud computing, cyber security, et cetera.

In response to tackle challenges such as the scarcity of sources and the operational risk mitigation, O&G industry redefines its boundaries through digitalization. Technological advancements are being introduced at each stage of oil production, from analyzing potential drilling sites, acquiring land rights to develop new sites, drilling and extraction, pipeline construction, project operation and maintenance, and standardizing organizational procedures.

¹ The negative effect of oil exploration such as various oil spills that have occurred in the 2012 oil spill in the Gulf of Mexico when there was a strong opinion on the sustainability of resources or green issues in oil sources located countries. In this case, the governments led to strengthen their regulations related to deep-water oil exploration, which has made oil exploration less efficient in terms of cost and duration. Another example is a trend towards alternative solutions to oil such as coal-25%, gas-20%, renewable energy (hydropower, 13%, nuclear -7%).

UNDERSTANDING O&G INDUSTRY'S VALUE CHAIN THROUGH VALUATION METHODOLOGIES

The O&G plays a significant role in the contribution of world's economy. Regarding dollar value, the O&G industry is one of the biggest sectors. O&G companies perform many types of work, and some energy companies are more integrated than others. The industry itself is characterized by complex operations that range from scanning for potential wells to the actual drilling process, all of which may take up to years to complete.^{vii} The O&G industry's value chain is classified into three distinct segments:

1. Upstream

The upstream segment, commonly referred to as the Exploration and Production (E&P) sector, encompasses the exploration for potential underground or underwater O&G fields, and the drilling of exploration wells to recover and to bring crude oil, natural gas and related liquids to the surface. Examples of global E&P companies include Exxon Mobil Corporation, Royal Dutch Shell plc, and BP plc.

2. Midstream

The midstream segment starts at the gathering system, which collects O&G from the wellheads. This process helps in the delivery from production sites to refineries. At the processing plant, various products, such as natural gas liquids like ethane and butane, are separated from the oil and gas. Examples of large midstream companies include Enterprise Products Partners L.P., Kinder Morgan Inc., and TransCanada Corporation.

3. Downstream

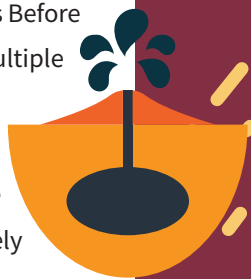
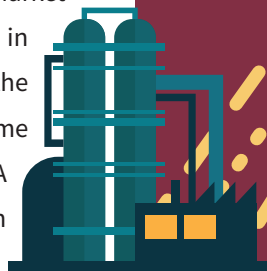
The downstream segment refers to the filtering of raw materials obtained during the upstream phase, selling and distributing natural gas and crude oil derived products such as liquefied petroleum gas, gasoline/petrol, jet fuel, diesel oil, other fuel oils, asphalt, and petroleum coke. The downstream sector includes refineries, petrochemical plants,

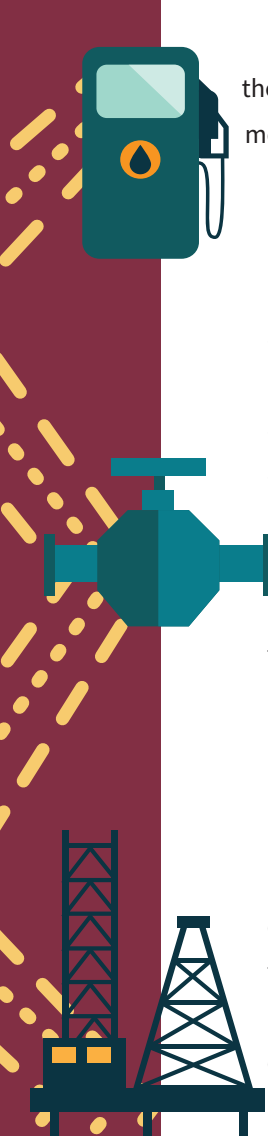
petroleum product distribution companies, retail outlets, and natural gas distribution companies. Examples of large downstream companies include Valero Energy Corporation, Sunoco Inc., and Citgo Petroleum Corporation.

Apart from previous three segments, there are oilfield services that provide support services for the O&G industry. Oilfield services offer supports for drilling, cementing, surveying, treating (e.g., with acids or chemicals), and perforating, to upstream O&G producers on a fee or contract basis. Examples of large oilfield services companies include Halliburton Company, Schlumberger Limited, and National Oilwell Varco.^{viii}



O&G company is valued depending on the company's operations.^{ix} The three standard valuation approaches – the Income Approach, the Market Approach and the Asset Approach are applied in valuing companies in the O&G industry. **The Income Approach** is designed to estimate the future cash flow a firm can expect to generate. A common income approach valuation tool is the discounted cash flow (DCF) model. A DCF model could be used to determine the present value of future cash flow, which is important because a dollar of earnings today is typically worth more than a dollar of earnings tomorrow due to inflationary and other systemic risks. Establishing the present value of anticipated cash flow allows us to see how much debt the company can handle as well as how much cash will be available to fund growth and distribute to shareholders. An evaluator may also use **the Market Approach** to value a company. One way to do this is by looking at the company's historical and/or projected EBITDA (Earnings Before Interest, Tax, Depreciation, and Amortization) and then applying a multiple of EV (Enterprise Value)/EBITDA derived from similar companies or industry transactions, to establish a range for the company's enterprise value. And then, **the Asset Approach** often generates a value that is less than other methodologies, and it can fail to adequately account for intangible assets. In contrary, it is more objective and relies on





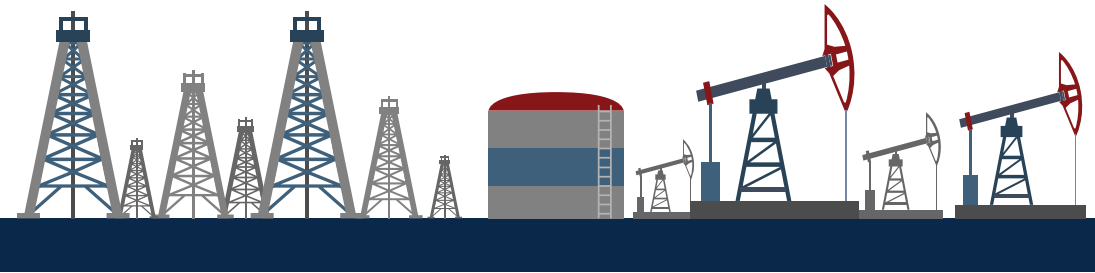
the concept that a rational investor will not pay more than the replacement value of the assets.^x

1. Upstream Valuation Considerations

E&P companies' primary assets are their oil and gas reserves — that is, hydrocarbons below the surface that have not yet been produced and are economically viable to extract. The value of an E&P company may be estimated by calculating the fair value of its reserves and then aggregating this with the value of other net assets on its balance sheet, assuming those net assets have been assigned market value. E&P companies are commodity businesses that have limited control over the prices they receive. They may vary their production and capital expenditures based on current and future price expectations, and they can hedge their production by using the futures market. The DCF method under the Income Approach is one of the primary approaches used to value an E&P company's oil and gas reserves. The value of the reserves is incorporated into the Asset Approach, and the E&P firm's balance sheet is marked to market using the Net Asset Value Method. Besides that, the Market Approach may also be an appropriate method of valuing an E&P company. When analyzing historical or projected financial metrics to use in the Market Approach, consideration should be given to some unique aspects related to the accounting of E&P companies.

2. Midstream Valuation Considerations

Conventional variations of the Income and Market approaches (e.g., DCF and EBITDA-based multiples) may be appropriate in valuing midstream E&P companies, which are frequently incorporated as master limited partnerships (MLPs). MLPs traditionally pay out almost all available cash flow on a regular basis. They avoid double taxation and offer higher distributions and yields to investors. To obtain the tax



benefits of a pass-through entity, MLPs must receive their income from qualifying sources, such as the exploration, mining, extraction, transportation, storage, distribution, and refining of oil and gas, and the production of alternative fuels such as biodiesel. The majority of MLPs are pipeline businesses, which earn stable income from the transport of oil, gasoline or natural gas. In evaluating valuations for midstream companies, consideration should be given to yield data and trends for the subject company. Amid the current downturn in oil and gas commodity prices and the decline of the industry overall, midstream public companies' yields have increased, but these higher yields are due primarily to lower valuations rather than to the growth in distributions.

3. Downstream and Oilfield Valuation Considerations

The valuation of downstream companies, such as refiners, often benefits from lower prices of the commodity feedstock. The crude oil serves as a primary feedstock for downstream companies. Lower feedstock prices may result in higher crack spreads – the profit margin or differential between the price of crude oil and the price of petroleum products extracted – for downstream companies. As a result, in the current oil and gas industry environment, downstream companies are expected to benefit from higher crack spreads in the near term, thus increasing their valuations. Another important factor affecting the crack spread is the relative proportion of various petroleum products produced by a refinery. The mix of refined products is also affected by the blend of crude oil feedstock processed by a refinery. As with downstream companies, conventional variations of the Income and Market approaches may be used to value oilfield services companies. As with E&P companies,

lower oil and gas commodity prices decrease oilfield services companies' valuations. Although volatility in commodity prices affects oilfield services companies' valuations in general, certain oilfield services companies may suffer more than others due to reductions in E&P capital expenditure budgets.

Since the oil price crash in 2014, the O&G sector is currently going through a challenging period. The forces of oversupply triggered partly by US shale oil revolution, and OPEC's decision to maintain market share, combined with weakening global demand, have converged to push global oil prices dramatically lower. With the ongoing emphasis on cost reduction and operational efficiency improvement of the O&G industry, demand for innovation in technology is consistently growing.^{xi} O&G companies found that greater efficiencies offered a certain path forward to maintaining competitiveness through the adoption of digital technology.

DIGITAL TRANSFORMATION PRACTICES IN O&G INDUSTRY

For every O&G company, digital transformation and sustainable success are inseparable.^{xii} As early as the 1980s, O&G companies began to adopt digital technologies, with a focus on better understanding about reservoir's resource and production potential, improving health and safety, and boosting marginal operational efficiencies at oil fields around the world.^{xiii} During this period, the adoption of digital technology by O&G companies has also experienced several obstacles. The O&G industry lost motivation for continual improvements and application of new technologies, and instead, became lazy during the time of high margins. Experimenting with new technologies was viewed as a distraction and possible delay in O&G production. This barrier to exploring digitation disappeared with the crash of crude oil price in November 2014.^{xiv}

Digital developments can now be considered with confidence for practical application right across the O&G operations to gain better rewards, as seen in Figure 2. O&G

operations throughout the value chain also carry environment risks that are existential to the organization, and compliance officers are increasingly dependent on data reliability and loss avoidance. Thus, O&G companies need to improve efficiency and money saving schemes by adopting progressively new technologies such as real-time analysis, smart drilling, smart labour, and automation.^{xv}

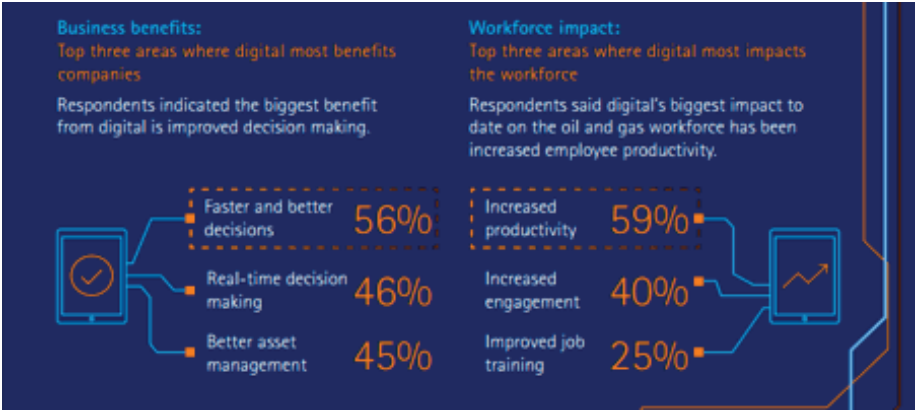


Figure 2 – Benefits and Impacts of The Digital Transformation in O&G Industry^{vi}



A real-time analysis optimizes the drilling process through numerical metrics. The necessary amount of oil can be extracted without either pumping too little and potentially losing customers to pumping too much and being left with excess that needs special storage. In addition to this technology is the possibility to have a centralized safety center that allows controllers to have the opportunity to automatically shut down equipment that could be malfunctioning or defaulting. By using this technology, accidents are less likely to happen, and reparations costs become unnecessary.^{xvii}

Smart drilling is increasingly being used to improve the efficiency of oil production process. Producers continue to become more efficient and precise in designing and operating wells. Advances in seismic technology are already making a big impact in hydraulic fracturing and more conventional drilling practices. Oil producers can now develop new wells and begin drilling quicker. It becomes possible to make drilling and



pumping more efficient. It can also make significant changes to the overall cost of a barrel when millions are being pumped. By driving down prices, companies can increase their profits.

Smart labour system is done through monitoring where work needs to be done and sending people there, while noticing where workers are not needed as frequently and redistributing their workforce accordingly. For many of the more expensive oil producers, labour costs form a large expenditure. Therefore, companies need to maximise the amount of labour activities to justify their wages, through optimizing their workforce to perform tasks that have the highest importance.

Automation can also lead to maximizing efficiency and to minimizing waste by monitoring pressures and other important metrics. Efficiencies through automatic technology have reduced the time to start production for a new well from weeks or months to only a few days. Improved speed of bringing new wells online reduces the financial risk of drilling and increases the chances for favourable Return on Investment (ROI).



THE ADOPTION OF DIGITAL TECHNOLOGY TO RE-CONCEPTUALIZE THE VALUATION OF O&G INDUSTRY POST OIL PRICE CRASH OF 2014



The opportunity for the O&G industry to leverage the transformational impact of digitalization has become more evident post oil price crash of 2014.^{xxi} Much of the O&G industry has survived tough few years with weak demand and low prices. Global O&G companies slashed capital expenditures by about 40 percent between 2014 and 2016. As part of this cost-cutting campaign, some 400,000 workers were let go, and major projects that did not meet profitability criteria were either cancelled or deferred.^{xxii} According to Houston energy consultancy Graves & Co., O&G companies worldwide, including large companies such as Baker Hughes, Halliburton and Weatherford International that supply services and equipment to drillers have publicly announced plans to cut more than 319,000 jobs since late 2014 (Figure 3).^{xxiii}

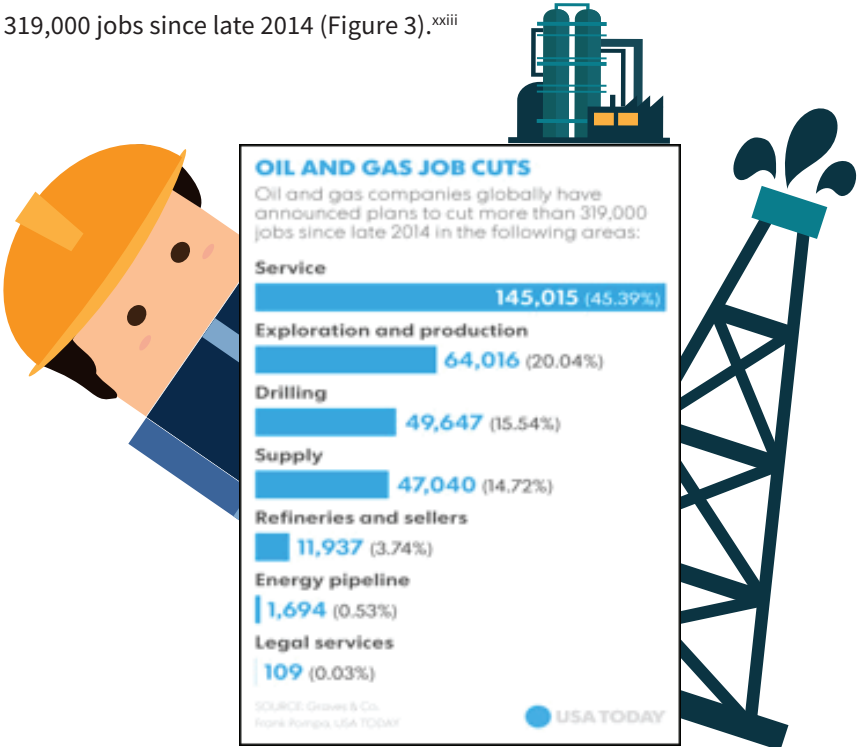


Figure 3 – O&G Job Cuts

Many O&G companies are responding oil price crash of 2014 by adjusting spending. A critical tool that can accelerate operational efficiency and drive margins is the use of digital technology. There has been a shift in focus from exploration drilling to production optimization, incentivizing investments in digitization to maximize the recovery of existing wells. As seen in Figure 4, O&G CEOs concern about the adoption of digital technologies as a measure to create several opportunities such as improve asset reliability, boost throughput, and optimize field recovery.^{xxiv} O&G CEOs believe that companies that make Internet of Everything (IoE) investments enjoy direct productivity and efficiency gains, but they are probably also able to ensure their survival in an environment where oil prices could stay depressed for a long time.^{xxv}

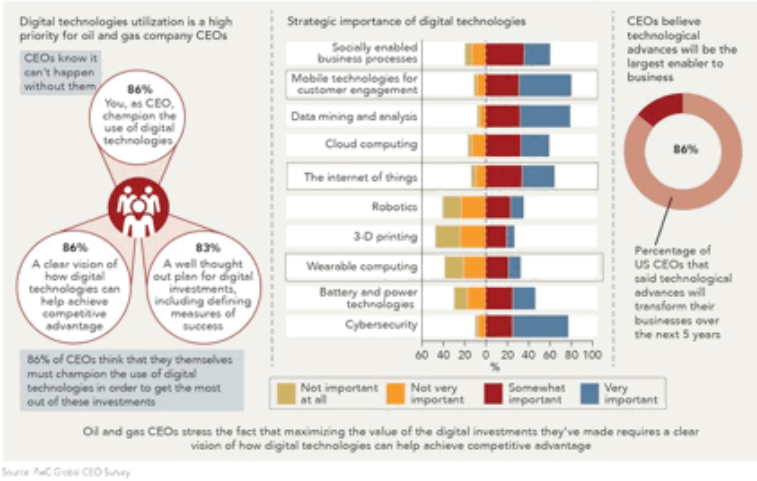


Figure 4 – O&G CEOs Survey on The Utilization of Digital Technologies

The O&G industry needs an end-to-end digitization platform, or ecosystem, where silos do not exist – one in which anyone can develop value-add applications and services. This is increasingly possible with falling digitization costs, and the existential imperative exists for evolution due to market/ industry drivers. Many influential technologies are already available and in broad use (Figure 5), while others will take years of testing and refinement.^{xxvi}

	Upstream	Midstream	Downstream
High-impact solutions	- End-to-end digitization enabled by IoT - Workflow-enabled processes (inclusive of smart advisers) - Self-optimizing equipment/assets - Virtual and augmented reality - wDrill floor and bit robotics/automation - In-fit well planning Reservoir IT depletion strategy - Unconventional gas extraction technologies	- Remote surveillance or monitoring of pipelines, plants, and storage facilities/ drones - Fleet optimization through tracking technologies	- Biometric monitoring - Automated control-loop systems - Real-time dynamic quantitative risk assessments - Remote plant, value, and pressure controls via mobile technology - Predictive maintenance monitoring system inputs on device
Medium-impact solutions	- Analytics in the cloud for issue detection - Wearable computing - Simulation - Advanced materials	- Drone monitoring of contractors - Monitor control with a centralized maintenance and operations system	- Fire Protection digital video surveillance - Computational fluid dynamics for monitoring flow and heat transfer in pipes - Aspen Plus Separator Simulator 3D visualization (Augmented Reality)

Figure 5 – Digitization in O&G Industry's Value Chain

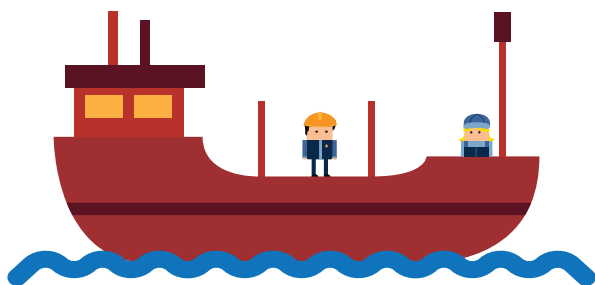
Most O&G companies view digital technologies as activities peripheral to the core business. The ecosystem needs to be set up so that it can accept these technologies into the fold to provide full realization of the original digital vision, as well as overcome some of the challenges companies face when undertaking enterprise-wide transformation initiatives. Siloed digitization does not provide the cross-functional, cross-asset insights needed to drive efficiency at the enterprise level. Companies should approach digitization as a measure to build out capabilities by utilizing technology across key aspects of the value chain, as seen in Figure 6.^{xxvii}



Figure 6 – Capability Approach to Digitization

In the long term, digital transformation offers to increase operating efficiencies and revenues, also to reduce operating costs. As it applies to O&G pipelines, digital transformation principles promise to improve fault isolation and outages, optimise performance, and more effectively integrate distributes assets. Advanced analytics and integration with asset management tools, increasingly available through cloud-based technologies, enable operators to more effectively manage real-time challenges, as well as to provide more insight in market demand and to predict actions appropriate to improve productivity, identify fault causes and locations. One last area focuses on the long-term planning and investment of O&G industry assets, such as refineries and oilfields in the oil and gas industry or power generation and transmission in the Utilities industry. In this area, there are two dimensions of transformation that have the potential to yield significant benefit.^{xviii}

1. Digital Asset Management - This allows for more effective use asset information, data, and analytics to predict asset performance, identify changing conditions, and evaluate investment options through real-time monitoring and data aggregation.
2. Digital Field Workers - This takes advantage of the more effective management of work requirements, improved planning and scheduling, and logistics optimization. Work order and information management solutions are critical to enabling these efficiencies and reducing the ad hoc and tribal knowledge that most operations still rely upon today.



CONCLUSION

O&G companies have long depended on rich pools of data to discover and better understand the potential in their reservoirs and other production opportunities. Most O&G companies are closely focused on preserving price margins, while many of them are also looking ahead to how digital technologies and data analytics can help transforming their industry. Since the oil price crash in 2014, key takeaways that have been pretty much learned by the industry lie on the optimization of productivity, and the digital technology has played such important roles in keeping the setbacks from the oil price crash at bay.

Moreover, related to their industrial transformation, every O&G company needs to develop a strategic plan for how it will use digital technology to gain a competitive advantage over the next three to five years. This plan should include initiatives that offer short-term gains and build capabilities to develop a long-term competitive advantage. The utility of technology is such a major force in O&G industry transformation as the most fundamental solution to reconceptualize O&G business operations. Digital Transformation is not just about being able to see what is happening across an organization but also to create the ability to control and predictively respond to operating environment factors to maximise operational efficiency. Investments in information technology enable the connection of physical assets with the virtual environment through business solutions, enabling O&G companies to create transparency across their daily operations.



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Center for Digital Society

Faculty of Social and Political Sciences
Universitas Gadjah Mada
Room BC 201-202, BC Building 2nd Floor,
Jalan Sosio Yustisia 1
Bulaksumur, Yogyakarta, 55281, Indonesia

Phone: (0274) 563362, ext. 116
Email: cfds.fisipol@ugm.ac.id
Website: cfds.fisipol.ugm.ac.id

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