Digital transformation is emerging as a driver of sweeping change in the world around us. Connectivity has shown the potential to empower millions of people, while providing businesses with unparalleled opportunities for value creation and capture.

Since the industrial revolution, the Oil & Gas industry has played a pivotal role in the economic transformation of the world, fuelling the need for heat, light and mobility of the world’s population. Today the Oil and Gas industry has the opportunity to redefine its boundaries through digitalization. After a period of falling crude prices and, frequent budget and schedule overruns, together with greater demands of climate change accountability and difficulties in attracting talent, the Oil & Gas industry can provide practical solutions. Digitalization can act as an enabler to tackle these challenges and provide value to all its stakeholders.

While digitalization could be a source of positive change, there are a number of challenges that need to be overcome to realize its full potential for both business and society. In some cases, the gains from digitalization have been inequitable with the benefits not reaching those who need it most. At the same time, the exponential increase in global information flows have created new risks around data privacy and security and businesses across sectors are grappling with challenges related to changing customer expectations, cultural transformation, outdated regulation, and skill shortages – to name a few.

Through the collaboration with the World Economic Forum, leaders gather to better understand the implications of these changes. The Digital Transformation of Industries (DTI) project, launched by the World Economic Forum in 2015, is an ongoing initiative that serves as the focal point for new opportunities and themes arising from latest developments and trends from the digitalization of business and society.

In 2015, DTI analysed the impact of digital transformation on 6 key industries – automotive, consumer industries, electricity, healthcare, logistics and media - as well 3 cross-industry topics focused on Digital Consumption, Digital Enterprise, and Societal Implications. In 2016, the initiative was extended to cover 7 additional industries, including oil and gas, and 2 new cross-industry themes – Platform Economy and Societal Value & Policy Imperatives. Through its broad focus, DTI has driven engagement on some of the most pressing topics facing industries and society today and provided business and policy leaders with an informed perspective to take action. This report does not only look into the challenges and opportunities digitalization creates for the Oil & Gas industry, but also how this potentially can be translated to societal value.

I would like to thank the Oil & Gas Community Steering Committee and the experts from industry partners, government and academia who were involved in shaping the insights and recommendations of this project. I am confident that the findings will contribute to improving the state of the world through digital transformation, both for business and society.
INTRODUCTION TO THE DIGITAL TRANSFORMATION INITIATIVE (DTI)

In a world where game-changing innovation has become the norm, DTI provides a unique insight into the impact of technology on business and society over the next decade.

The past 12 months have brought a series of exciting technological breakthroughs. Self-driving Tesla cars can now be seen on the road; Uber is testing autonomous taxis in Pittsburgh; Google DeepMind’s Alpha Go demonstrated a leap forward in artificial intelligence with a famous victory at the board game Go; and augmented reality hit the mainstream with the success of Pokémon Go. Game-changing innovation has become the norm.

Digital innovation is reshaping industries by disrupting existing business and operating models. But it is also having a profound impact on society, presenting a series of opportunities and challenges for businesses and policy-makers.

The Digital Transformation Initiative (DTI) is a project launched by the World Economic Forum in 2015 to serve as the focal point for new opportunities and themes arising from the latest developments in the digitalization of business and society. Over the past two years, DTI has analysed the impact of digital transformation across 13 industries and five cross-industry themes. We have also developed a unique value-at-stake framework to support a consistent approach to measuring the impact of technology on business and wider society. An overview of this framework is included on the next slide.

Our goal is for this framework to provide an evidence base and common language for public-private collaboration focused on ensuring that the benefits of digital transformation are fairly and widely shared.
This distinctive economic framework helps business leaders, regulators and policy-makers unlock the estimated $100 trillion of value that digitalization across all industries could generate over the next decade.

- We have developed a unique economic framework to quantify the impact of digital transformation on industry and broader society.
- Our framework is new and will be iterated further over the next year, but it can already be applied at all levels of government and business, helping stakeholders make the decisions that deliver the full potential of digital transformation.
- It provides a consistent evidence base and library of definitions for digital concepts, supporting a global, multistakeholder dialogue about digitalization and its implications.
- We have achieved proof of concept of the framework at an industry level (11 industries) and successfully piloted its application at a national/state level (in Denmark, India, the United Kingdom and the Indian state of Telangana).
There is growing consensus that the Oil and Gas industry is on the cusp of a new era, as a second wave of business and digital technologies looks set to reshape the sector, propelled by a series of macroeconomic, industry and technology trends.

The Oil and Gas industry is no stranger to big data, technology, and digital innovation. As early as the 1980s, Oil and Gas companies began to adopt digital technologies, with a focus on better understanding a reservoir’s resource and production potential, improving health and safety, and boosting marginal operational efficiencies at oilfields around the world. A wave of digital oilfield initiatives swept through most of the industry in the 1990s and the early part of this century.

However, for most of this decade, the industry has not taken advantage of the opportunities that derive from meaningfully using data and technology. A single drilling rig at an oilfield, for example, can generate terabytes of data every day, but only a small fraction of it is used for decision-making. As other capital-intensive industries (such as aviation and automotive) have pushed ahead with revolutionizing their business and operating models through a holistic application of digital technologies, the opportunity for the Oil and Gas industry to leverage the transformational impact of digitalization has become more evident.

At present, the traditional approach of selectively adopting a set of technologies and implementing digitalization unsystematically might not be suitable; the industry could instead benefit more by pursuing a revolutionary agenda with digital as a backbone. Digital transformation has the potential to create tremendous value for both the industry and society as a whole.
The Oil and Gas industry and the broader energy value chain are being shaped by several powerful supply and demand forces.

Disruption in supply, demand and commodity prices

The industry is witnessing one of its worst downturns, driven by a supply-side disruption. Commodity prices had, at one point, fallen by more than 70% compared with June 2014 levels and, just as some early signs of recovery emerge, another disruption may be on the horizon, driven, on this occasion, by peak demand for oil. Technological advances such as horizontal drilling and hydraulic fracturing are unlocking shale resources – and playing an important role in creating the oversupply responsible for persistently low crude prices. This disruption will maintain pressure on hydrocarbon prices and prompt energy companies to focus more intensely on reforming their portfolio and taking a greater role in the energy transition.

Changing consumer needs and expectations

Across industries, consumers expect increased engagement, personalization and speed. They are also paying more attention to environmental issues, which influences their energy choices; seeking transparency from companies in different areas (e.g. emissions or hydrocarbon sources); and are growing in technical sophistication by being connected to multiple technology and digital platforms. Other factors, such as the growing interest in electric vehicles in developed markets, are also affecting demand.
Disruption in supply, demand and commodity prices, combined with persistent market volatility, has made investors appear wary of the industry, with lower total return to shareholders (TRS) compared to other industries.
OIL AND GAS: DIGITAL TRENDS

Developments in technologies such as cloud, social media, big data and analytics are driving trends that have immense potential for Oil and Gas.

**Investment in digital technologies**

![Investment in digital technologies](chart.png)

**Big data and analytics**

Around 36% of Oil and Gas companies are already investing in big data and analytics. However, only 13% use the insights to drive their approach towards the market and their competitors. This discrepancy highlights the fact that these companies have not always embedded big data and analytics completely in their systems, but are just applying them piecemeal. Full-scale deployment can have far-reaching impacts on productivity and operations.

**The Industrial Internet of Things (IIoT)**

Within upstream, IIoT can help with optimization by enabling new operational insights through analysing diverse sets of operational data (such as drilling parameters), and cross-disciplinary data (such as geological models). Midstream companies (e.g. transportation, including pipelines and storage) aiming for higher network integrity and new commercial opportunities are expected to benefit significantly from building data-enabled infrastructure. Downstream players (e.g. petroleum product refiners and retailers) could see promising opportunities in the form of new revenue opportunities, from expanding visibility of the hydrocarbon supply chain and targeting digital consumers through new forms of connected marketing.

**Mobile devices**

The major benefits of integrating mobile devices into everyday operations include workflow improvements from better group communication, increased worker productivity and better recording of field data. Mobile technology also enables real-time data monitoring via specialized software installed on smartphones, and can have a positive impact on health, safety and the environment (HSE). Companies have improved the safety of employees by using the GPS coordinates of smartphones to track workers in hazardous situations. Deploying mobile applications in combination with radio frequency identification (RFID) tags is making assets smart and their movements visible.

Source: Accenture Digital Energy Trends
Four themes are expected to play a crucial role in the digital transformation of the oil and gas industry over the next decade.

**Digital Asset Life Cycle Management**

New digital technologies combined with data-driven insights can transform operations, boosting agility and strategic decision-making ability, resulting in new operating models.

<table>
<thead>
<tr>
<th>Total value at stake</th>
<th>Industry</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>$745 billion</td>
<td>$110 billion</td>
<td></td>
</tr>
</tbody>
</table>

**Circular Collaborative Ecosystem**

The application of integrated digital platforms enhances collaboration among ecosystem participants, helping fast-track innovation, reduce costs and provide operational transparency.

<table>
<thead>
<tr>
<th>Total value at stake</th>
<th>Industry</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>$30 billion</td>
<td>$0.5 billion</td>
<td></td>
</tr>
</tbody>
</table>

**Beyond the Barrel**

Innovative customer engagement models offer flexibility and a personalized experience, opening up new opportunities for oil and gas operators, and services for customers.

<table>
<thead>
<tr>
<th>Total value at stake</th>
<th>Industry</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>$100 billion</td>
<td>$26 billion</td>
<td></td>
</tr>
</tbody>
</table>

**Energizing New Energies**

The digitalization of energy systems promotes new energy sources and carriers, and supports innovative models for energy optimization and marketing.

<table>
<thead>
<tr>
<th>Total value at stake</th>
<th>Industry</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>$70 billion</td>
<td>$500 billion</td>
<td></td>
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</tbody>
</table>
Digitalization could unlock up to $1.5 trillion of industry and societal value. Societal benefits include reduced emissions and $170 billion in cost savings for customers.

Digitalization in the Oil and Gas sector has the potential to unlock greater value for industry ($945 billion) than wider society ($637 billion) over the next 10 years. The themes that create the largest impact are Digital Asset Life Cycle Management and Energizing New Energies, which together account for 90% of the value at stake.

**Oil and gas: value at stake for industry and wider society (by digital theme)**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Potential Business Impact ($ billion)</th>
<th>Potential Societal Impact ($ billion)</th>
<th>Total Value at Stake ($ billion)</th>
<th>Emission Reduction (million tonnes CO₂e)</th>
<th>Net Impact on Jobs (1000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Asset Life Cycle Management</td>
<td>745</td>
<td>110</td>
<td>855</td>
<td>370</td>
<td>(114)</td>
</tr>
<tr>
<td>Circular Collaborative Ecosystem</td>
<td>30</td>
<td>0.5</td>
<td>31</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Beyond the Barrel</td>
<td>100</td>
<td>27</td>
<td>126</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>Energizing New Energies</td>
<td>70</td>
<td>500</td>
<td>570</td>
<td>900</td>
<td>35</td>
</tr>
<tr>
<td>Cumulative Total</td>
<td>945</td>
<td>637</td>
<td>1582</td>
<td>1284</td>
<td>(57)</td>
</tr>
</tbody>
</table>

Source: World Economic Forum / Accenture analysis
FOCUS ON DIGITAL ASSET LIFE CYCLE MANAGEMENT: DIGITAL INITIATIVES

New digital technologies combined with data-driven insights can transform operations, boosting agility and strategic decision-making ability.

New Era of Automation

Automation, robotics and the development of remote operating capabilities will transform how Oil and Gas companies operate. Leveraging IIoT could connect end-to-end operations across the life cycle of a well and ensure that all systems are communicating across the industry. This initiative could generate approximately $220 billion of value for the industry and also reduce emissions of CO₂ equivalents (CO₂e) by around 20 million tonnes.

Advanced Analytics and Modelling

This initiative enables companies to quickly and automatically produce analytical models (e.g. reservoir models, drilling plans and production profiles) that can analyse bigger, more complex data, and deliver faster, more accurate results, even at a very large scale. The potential value for the industry is $425 billion, while it could also deliver benefits worth $100 billion to society, including a reduction of 350 million tonnes of CO₂e emissions.

Connected Worker

Providing workers with on-demand real-time push and pull information through mobility apps and wearable technology can give them access to the right information at the right time, so they can make more proactive decisions, enhancing productivity and reducing costs. This initiative has the potential value of $100 billion for industry through improvements in employee productivity. Connected worker technologies can also boost workforce safety.

Illustrative case studies:

- Columbia Pipeline Group
- Schlumberger
- Robotic Drilling Systems
- Shell
- bp
- REPSOL
Integrated digital platforms can enhance collaboration among different participants in the Oil and Gas ecosystem, while also accelerating innovation, reducing costs and making operations transparent.

**Real-Time Supply / Demand Balancing through 3D Printing**

3D printing could transform today’s supply chain into a globally connected, yet still local supply chain, creating a close relationship between design, engineering, marketing and manufacturing. For example, for upstream operators, 3D printing could revolutionize the supply of replacement parts. Across the industry, this initiative could unlock $30 billion of value for Oil and Gas companies, and $0.5 billion for society.

**Digital Information Sharing and Operational Transparency: Blockchain and Smart Contracts**

Blockchain offers an easy way to transfer information and automatically tracks each transaction. It enables some accounting, finance and compliance tasks to be automated, reducing operating expenses and the frequency of transactional errors. Blockchain also lend itself easily to the cross-border transactions that are common in the highly globalized Oil and Gas industry. The value at stake for this initiative has not been quantified.

Illustrative case studies:
Digital Customer Services

Digital services such as hyperlocal mobile fuel offerings aim to bring the fuel station to the customer. Additional services such as tyre pumps and maintenance check-ups can be bundled with the mobile fuel station to enhance safety and raise vehicle mileage for customers. This initiative could cause profits of around $1 billion to shift to new start-ups offering these services and early adopters. It could also lead to reduction in profits of fuel retailers by $2 billion from reduction in sales, but it could unlock $7 billion of value to society through time savings and emissions reductions.

Omnichannel Retail and Experiential Services

Omnichannel retail aims to capitalize on the time spent by customers at petrol stations by helping fuel retailers learn more about their customers so that they can develop personalized offerings. To capitalize on omnichannel opportunities, petrol stations can offer additional services, such as digital banking or allowing customers to pick up parcels bought online. We expect $95 billion to migrate from traditional fuel retailers to omnichannel retailers. Moreover, specialized offers will also lead to additional profits of $6 billion from increase in same store sales.
Digitalization is promoting new energy sources and carriers, as well as innovative models for the optimization and marketing of energy. To remain relevant to customers, the Oil and Gas industry needs to understand the full impact of these changes on the broader energy system.

**Consumer Energy Choices**

Oil and gas companies can position themselves at the leading edge of digital transformation by partnering with their B2B customers to develop digital platforms and by engaging with the end consumers ‘beyond the meter’. Companies can start developing innovative digital consumer platforms which gives them the freedom to choose their energy source. These platforms could unlock $500 billion of value for society, as it will provide consumers with an option to shift to new energy sources and reduce CO$_2$e emissions by up to 900 million tonnes.

Illustrative case studies:
Here are just three of the many case studies that can be found in our white paper on digital transformation in the oil and gas industry.

**Shell:**
*Screwing up prototyping with 3D printing*
Shell has used 3D printers to prototype its Stones Oil and Gas station in the Gulf of Mexico – the deepest drilling station in the world. The team used a 3D printer to produce a scaled-down plastic version, including all components, in only four weeks. It showed the team exactly how to improve components before building the real-life buoy in the construction yard. It even helped them work out the most efficient assembly sequence for the buoy and saved Shell $40 million by highlighting design flaws at an early stage. The 3D-printed prototype also showed US authorities exactly how the finished design would function in a rough sea environment and helped Shell secure government approval.

**Booster Fuels:**
*Providing mobile refuelling services for employees*
Booster Fuels has a mobile fuel business model, which offers corporate programmes that provide its mobile refuelling services to the enterprise clients’ employees. The start-up says it eliminates the need for drivers to visit the petrol station. Instead, users can book a refuelling time via Booster Fuels for a tanker to come to them and fill up their car. Booster is focusing its marketing efforts on attracting clients at corporate campuses, where employees’ vehicles can be refuelled while they work. In early 2016, the start-up raised $9 million of funding.

**Tesla:**
*Storing electricity with Powerwall*
Tesla, a US automotive and energy storage company, has launched Powerwall, an automated, compact and simple-to-install domestic battery that stores electricity generated by solar panels at a customer’s home during the day and makes it available in the evening. This bridges the time gap between peak solar generation and peak demand, allowing customers to use the energy when they need it the most. It also reduces the risk of power outages at the customer’s home by acting as a backup electricity supply. Tesla has also launched Powerpack, a larger version designed for commercial use.
To unlock the full potential of digital transformation, the Oil and Gas industry needs to tackle a series of historic and structural inhibitors.

**Outdated regulatory frameworks**

Data security regulations are no longer fit for purpose. Intellectual property frameworks have not yet adapted to a new era of data sharing along value chains, in which companies must feel confident that, by dispersing their data, they are not compromising it.

**Lack of standardization**

A lot of data coming from sensors is not standardized or integrated across platforms. Moreover, ownership of or access to data among suppliers, operators and contractors is often uncertain. Even when data is accessible, it is often too complex or large – obscuring any clear insights.

**Lack of ecosystem collaboration**

For digitalization to deliver all its potential benefits, it must be integrated in an industry from end to end. In the case of Oil and Gas, efficiency, productivity, health and safety will only be maximized if systems, equipment and sensors from across the industry value chain are sharing data and learning from one another. As things stand, that ‘top layer’ of information sharing has not been fully realized.
OIL AND GAS: OVERCOMING KEY INHIBITORS

To unlock the full potential of digital transformation, the Oil and Gas industry needs to tackle a series of historic and structural inhibitors.

**Talent gaps**
Ahead of the 'big crew change', young workers need to be actively pulled into the industry, but millennials – who are projected to constitute a majority of the US workforce by the early 2020s – currently favour working in industries perceived to be 'greener' than Oil and Gas.

**Culture and mindset**
Oil and Gas companies are very people-centric, so some leaders are not prioritizing opportunities to automate. Furthermore, the industry is inherently unable to take more of an experimental, "fail- fast" approach because of its conservative nature and concern about the potential consequences of change.

**Cybersecurity**
Companies and their assets will be at increased risk of cyberattack as the Oil and Gas cyber environment expands to include connected computing devices, personnel, equipment infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information.
OIL AND GAS: RECOMMENDATIONS

Incremental change alone is no longer sufficient to unlock the full potential of digitalization and to prepare for the challenges it is likely to bring. Here are our recommendations for the industry to keep up with – and stay ahead of – digital transformation.

**Recommendations for industry**

**Make digital a priority for the C-suite**
- The C-suite needs to set a clear vision, commit funding and resources, and champion change management efforts to ensure that digital is fully integrated into the company’s core business.

**Drive a culture of innovation and technology adoption**
- Create an open channel for ideas and encourage new ways of working by using technology to enhance the firm’s capabilities to create a more fluid, multidisciplinary team.

**Invest in human capital and development programmes**
- Assess current personnel capabilities and build a digital strategic workforce plan to address any shortage of skills.

**Reform the company’s data architecture**
- Harmonization, integration and interoperability of data platforms is critical to support effective decision-making.

**Continue to invest, build, buy or partner to develop digital capabilities**
- Evaluate the investment necessary to digitize the company’s core activities or capabilities.

**Invest in the collaborative ecosystem**
- Partner with peers and competitors to innovate, develop digital capabilities fast, and leverage new business models.

**Recommendations for policy-makers**

**Globalize standards**
- Develop global data standards and policies related to data sharing and security, and encourage transparency of operations.

**Foster an ecosystem of innovation**
- Help build on the innovation ecosystem and innovate within their own organizations to unlock value and meet the ever-changing and diverse needs of their constituents.

**Promote shift towards low carbon economy**
- Promote a more inclusive society that can contribute to a broader reform agenda for greener, more resilient and inclusive growth.
Over the past two years, DTI research has focused on understanding the impact of digital transformation in 13 industries and drawing insights from the cross-industry themes that came out of that analysis.

We have covered five cross-industry themes. Digital Consumption explains how the rapidly changing expectations of digital customers are forcing enterprises to reinvent themselves. Digital Enterprise looks at how companies can respond by rethinking every aspect of their business. Platform Economy focuses on the immense impact of one type of digitally enabled business model – B2B platforms. The adoption of new digital business and operating models is having a profound impact on society, a theme we analyse in Societal Implications. We then introduce our quantitative analysis of the impact of digitalization on business and wider society in our final cross-industry theme, Societal Value and Policy Imperatives.

Our industry deep dives have covered 13 industries: Automotive; Aviation, Travel and Tourism; Chemistry and Advanced Materials; Consumer; Electricity; Logistics; Media; Mining and Metals; Oil and Gas; Professional Services; Retail and Telecommunications. White papers, SlideShares, articles, an overall executive summary for the DTI project, and a library of video interviews can be found on our website.

Key features
- Mobile-responsive, platform-agnostic site
- 13 industry white papers
- 5 cross-industry white papers
- 13 SlideShare summaries of white papers
- 60+ video snippets and mini documentaries
- Online case study repository
- 4 animations on digital challenges
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- Shell
- Statoil
- Suncor
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