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Drilling for data

**A pragmatic
perspective on
demystifying
digitization in
oil and gas**



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FOREWORD

The oil and gas sector is making significant strides in digitization. After a few years of carrying out small-scale pilots, a number of oil companies are now leading the way. They have recruited chief digital officers, have designed digital strategies and established business units to promote them, have partnered with technology firms, and are striving to create a culture that nurtures new ways of working. We are witnessing a proliferation of technologies being deployed in the field, whether it's the use of so-called digital twins to optimize production or drones carrying out offshore inspections.

However, some companies are still only at a very early stage of digital development. For them, taking the first steps on a digital transformation journey may seem daunting. These companies exist throughout the ecosystem. They may be operators; oil field service companies; original equipment manufacturers (OEMs); or companies lacking the financial resources, workforce, and other capabilities that are usually found at the so-called super majors.

As part of our ongoing series examining digitization in the energy sector, this report presents a number of examples of companies exploring digital solutions and analyzes how they have been transformed by new technologies. It also highlights lessons from those undertaking their own digitization journeys.

We are delighted to have produced this report in association with Cognite, a global software company that supports digital transformation of heavy-asset industries. We'd like to acknowledge the following contributors from Cognite: Petteri Vainikka, vice president of product marketing, and Anna Olsson, director of partners and alliances.

We hope this report will illustrate how to develop winning strategies and digitally transform organizations. If there are any aspects of it that you would like to discuss, please feel free to get in touch.

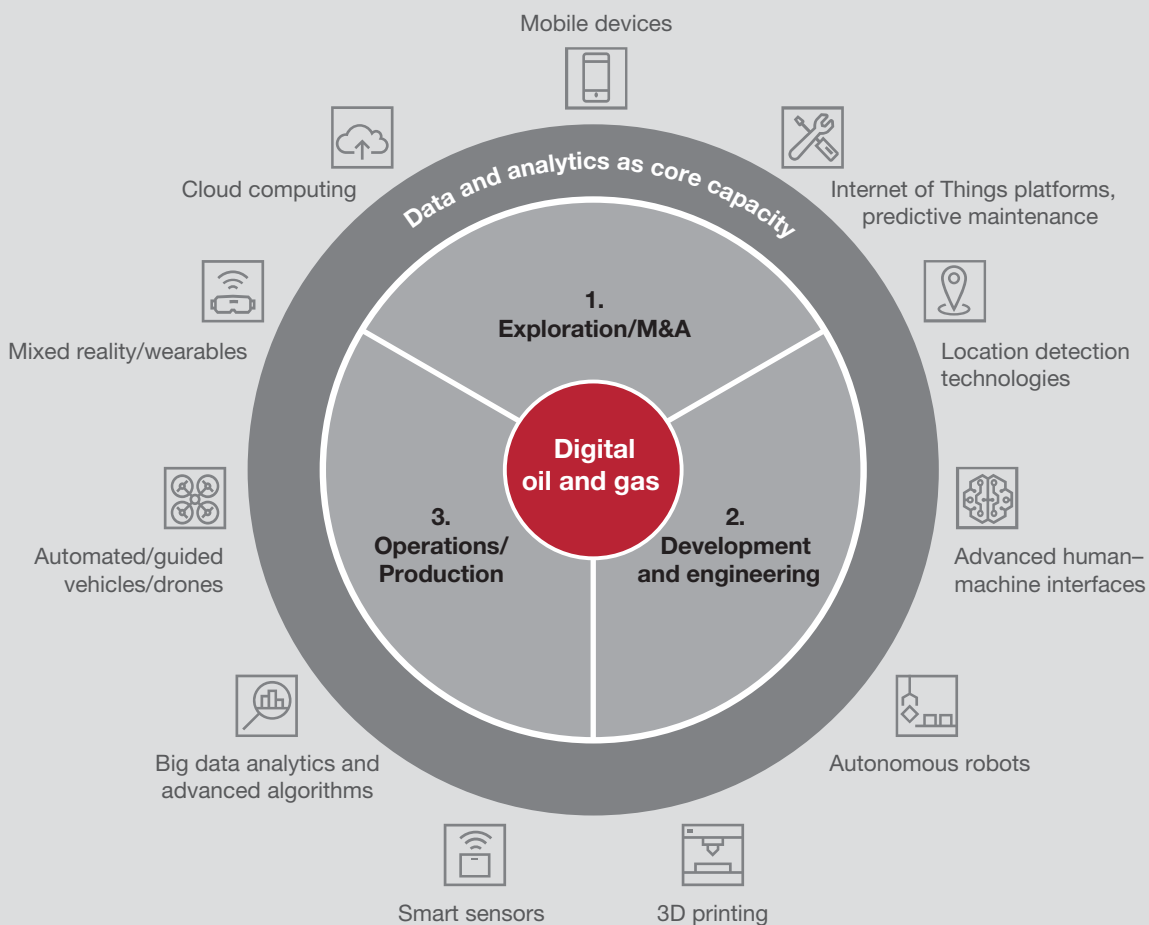
EIRIK RASMUSSEN
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Key digital technologies are taking hold

Until relatively recently, there was significant hype at oil and gas industry conferences promoting digital transformation in the sector. Now the dust has settled, and some trends are emerging that show how digital is actually being applied. We focus on 11 technologies (see Exhibit 1) that we think are essential in this sector.

Energy group BP is trialing robots to inspect hydrocracker reactors in refineries as a way of improving safety and reducing inspection time, from more than 23 hours when done manually to just an hour. The group has also launched a new system of gas-cloud imaging supported by

EXHIBIT 1
Technologies essential to digitization in oil and gas



Source: PwC Strategy& analysis

aerial drones to identify and monitor (and ultimately help reduce) methane emissions. Equinor, a Norwegian energy group, is using sensor technology at its Johan Sverdrup oil field in the Norwegian North Sea to create a virtual, real-time version — a digital twin, in other words — of the whole installation. This will allow engineers to view the installation on smartphones and tablets and find relevant equipment information.

Smaller players are also digitizing. Austrian energy group OMV is working on an initiative it calls DigitUP, which aims to connect and centralize data from its international rig fleet to a single location. Aker BP, whose chief executive has described the group as more of a tech company than an oil and gas company, has developed an advanced data analytics capability that it claims could deliver annualized savings of US\$100 million over the next couple of years.

These examples illustrate another evolving theme: the importance of collaborative innovation. In 2019, OMV and Aker BP announced a digitization partnership to share learning and best practices, as well as collaborate on technology projects in operational efficiency, drilling, and subsurface. These projects will also involve agile ways of codeveloping use cases and advancing new technology solutions. Both oil companies are also working with Cognite to develop technology platforms that will better capture data and use it to optimize their operations.

The larger players are also forming partnerships with technology companies to deliver digital capabilities: U.S. energy group ExxonMobil is working with Microsoft, using cloud technology to enhance operations in the Permian Basin; Total of France is working with Google, using artificial intelligence (AI) to optimize subsurface image interpretation; and the U.S. oil services company Baker Hughes (formerly known as BHGE) has teamed up with C3.ai, an AI software provider, to use AI in order to improve productivity.

As these digital technologies mature and companies develop new ways of working, traditional value chains are being disrupted and new business models are emerging.

In Norway, digitization has transformed the traditional maintenance activities of pump supplier Framo, and has also created new metrics for service contracts with operators. Aker BP, working with Cognite over the past two years, has digitized the operations of its Ivar Aasen platform in the North Sea. This not only provided Framo with real-time access to data on its pumps but also allowed the company to predict the operational status of its equipment — including the degree of wear and tear on it. The result of this approach has been to replace unnecessary scheduled maintenance with needed maintenance only. Moreover, whereas in the past Framo's service agreements defined hourly rates as a performance metric, they now focus on "uptime," that is, tracking periods of smooth and uninterrupted operations.

A new focus on data analytics

In the aftermath of the oil price downturn of 2014, many companies explored digital solutions to enhance productivity. For several years, companies ran pilots experimenting with digital, but nearly always on a small scale. Recently, however, players have been scaling up solutions and trying to embed digital across their whole organization, often as part of a broader cultural transformation.

Data analytics is at the forefront of this effort. The oil and gas industry generates an enormous amount of data: According to U.S. software and data company Cisco, a typical offshore platform can generate between one and two terabytes of data daily. The need to process this data and generate insights from it is increasingly pressing.

Data and analytics capabilities are an important building block in enabling a data-driven approach that can transform businesses. Reliable “master data” (the core data a company holds on its operations) must underpin all data-driven initiatives, creating trust along the way. Decisions on capital expenditure; maintenance costs; mitigation of health, safety, and environmental risks; and minimization of inventory costs all depend on reliable data.

PwC has been working with clients across the value chain to address this imperative and help generate insights from data, develop differentiating capabilities, and drive operational efficiencies. Poor data quality can undermine not only the impact of transformational efforts but also the efficacy of day-to-day operations.



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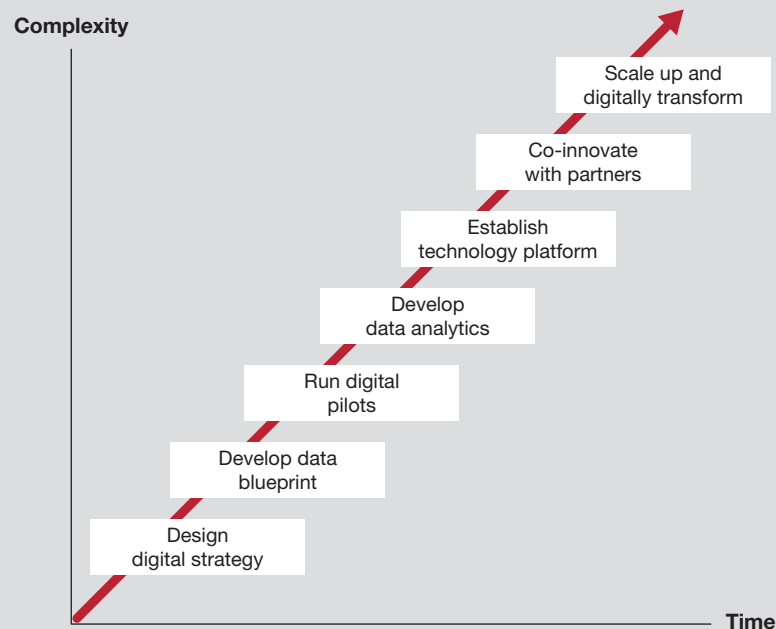
The road to digitization

Despite the progress that has been made, many senior executives are unsure what the first step toward digitization should be. In our project experience with companies beginning their digital journey, we typically see business leaders grappling with a common set of challenges:

- A business challenge has been identified, but the ability to use digital resources to address it is unclear and needs to be explored.
- The company generates a wealth of data, but there is no structure to manage the data and generate meaningful insights. In some cases, companies are not even sure what data they hold and how it can be accessed.
- The company is unclear on what digital solutions to develop in-house and how partnerships and co-innovation can be used to accelerate progress.
- The company is unsure how to manage the step between a digital proof of concept and full-scale deployment.

These challenges reflect the natural evolution of seven stages of digital maturity (see Exhibit 2).

EXHIBIT 2
Seven stages of digital maturity



Source: PwC Strategy& analysis

The case studies below illustrate how these types of challenges have been addressed.

1. Building a digital strategy from scratch

A medium-sized independent energy operator faced a range of challenges that it hoped could be addressed by adopting a digital strategy. These included accessing the data the company generated in its upstream business and finding ways to accelerate the interpretation of data in specific parts of the business, such as seismic surveying.

The company decided to develop its own digital strategy and become a leading adopter in digital technologies. But it was essentially starting from zero. There were no digital initiatives being explored, either in the company's head office or across its operating subsidiaries. It had no in-house capabilities in digital but was at least looking to establish a digital task force and starting to source talent from the in-house technical functions.

Strategy&, PwC's strategy consulting business, helped design a digital strategy for the operator and identify which of its business units globally had a strong need for digital solutions. This included identifying where the core data in the organization was located and how to make it readily available to users. The adoption of AI for specific technical areas was also pursued.

The operator identified key digital technologies and started testing these digital solutions in the field. Throughout the project, the operator adopted a mind-set of willingness to explore and "fail fast," and quickly pursued new initiatives while adhering to lessons learned.

Mini digital pilots were undertaken across a number of dimensions from front office to back office. These included leveraging real-time data from drilling rigs to improve drilling performance, promoting company-wide tools to share data, and developing software for technical and supporting functions.

The design and implementation of a digital strategy helped steer the operator to an appropriate focus for its digital investments. The strategy also raised internal awareness of the importance of digital and thereby generated greater buy-in from employees.

The early deployment of digital solutions was expected to help technical functions allocate more time to higher-value activities. For example, by using AI in reservoir modeling, geologists would spend less time collating the data and more time interpreting it. Finally, the implementation of the digital strategy was also pursued to help the operator engage more easily with its partners.



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2. Developing a data analytics solution

A European independent energy operator was concerned about the buildup of deposits in a platform oil pipeline that would hamper flow rates. It wanted to develop a solution that would allow the reservoir engineer to efficiently monitor flow rates and eventually predict when deposit buildup would become an issue. The objective was to minimize maintenance costs and downtime.

The operator was keen to develop a process to pilot solutions and expand them, if successful. It also had to deal with the fact that some operational data was scattered across the organization. PwC developed a model that could monitor flow rates and, by applying data analytics, could predict when the buildup of deposits might become problematic. The client was able to steer the project through a user-centric and agile management approach, thereby playing a central role in combining business understanding, technology, and user experience.

Finally, the client developed a stage-gate process whereby these technologies were tested and validated using a simple one-page business case. Each business summary explained the solution and the benefits derived for the business and end-users. If successful, a solution was expanded by employing the same stage-gate process.



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3. Innovating with a technology partner

Production optimization is an ongoing challenge for operators tackling complex wells in challenging reservoirs, as well as those producing oil from complex subsea tiebacks. (A subsea tieback is an engineering process connecting an untapped satellite oil field to an existing production center.)

One example of this is Aker BP's fractured chalk reservoir at the Valhall oil field in the North Sea. The high porosity and low permeability of the reservoir raised the risk of chalk influx, which caused significant production problems at Valhall. Sometimes large pressure fluctuations resulted in the Valhall chalk liquefying and flowing into the wells. This would lead to a partial or complete blockage of the oil flow. In response, Aker BP lost production and engaged third-party oil services firms to clean up the pipes. Though Aker BP had some sensor technology deployed, it had limited access to the real-time status of the flow.

Aker BP partnered with a Norwegian oil services technology provider, Turbulent Flux, to deploy the latter's Virtual Flow Meter (VFM), a software simulator. VFM simulates fluid flows and combines this with data from sensors monitoring actual flows from a field. By using live sensor data, the simulator monitored changes in inflow conditions from the reservoir to the well.

Aker BP then complemented Turbulent Flux's solution with Cognite Data Fusion (CDF). CDF is a collection of microservices that gather and contextualize data to support recommendation tools and applications for the production staff.

Turbulent Flux took only a few days to set up and deploy its solution, providing Aker BP's crew with 24-hour access to more granular insights about the flow. As a result of these two solutions, Aker BP was able to detect chalk influx events in Valhall wells in the early stages, enabling the company to take faster remedial measures and optimize production. Annual savings using these solutions have been estimated to range from \$600,000 to \$1 million.



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4. Enabling the “connected worker” in the field

An international oil company recognized the potential of digital technology to help upstream and downstream field engineers contribute toward a drive for improved productivity. The company had mobilized a program to exploit digital capabilities that could address pain points experienced by the engineers, primarily focused on practical solutions that reduced time spent “off-tools” — that is, not actually undertaking engineering tasks.

The program included digitizing the recording of completed work and initiating new jobs. However, the company was struggling to craft a transformational narrative and strategy to fully exploit digital capabilities for the field and align with other digital programs underway across the organization. In the absence of a clear route forward, the business’s desire for new solutions was outstripping IT’s ability to deliver solutions.

The company hired PwC to work across its business and IT departments to help shape thinking, understand the role of the field worker in a digitally enabled operation, and share examples from oil and gas and other industries. PwC’s Connected Field Worker (CFW) framework was used to explore best practices in which digital technology enables upstream and downstream operatives.

The framework helped the client align business and IT stakeholders with a vision for how digital technology could be leveraged to increase field worker and asset productivity. The client was also able to develop a strategy and business case for investment in digital solutions, centered on a platform that enabled the rapid development and introduction of field mobility solutions and collaboration to enable engineers to maintain equipment.



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5. Transforming into a data-driven culture

A midsized global exploration and production company undertook a strategic initiative to transform itself into an organization focused on improved use of data and analytics. The company soon understood there were challenges resulting from a lack of trust in the quality and consistency of data across the enterprise.

PwC was able to help the company establish and implement data-enabled solutions by developing an approach to capture and analyze key data across the business. It started with the creation of data blueprints — cataloging information from activities encompassing more than 80 critical technical data sets from operations, subsurface, land, and facilities to third-party industry sources. Technical information models were defined for more than 20 engineering and technical functions to support data foundation initiatives. Then, life-cycle maps, definitions, data standards, data models, and processes were developed for critical master data sets, including wells, facilities, equipment, assets, and completion networks.

The data blueprints, technical information models, and master data solutions enabled the data science and engineering and technical functions to spend more time developing models, prototypes, and analysis, and less time locating and scrubbing data to support the models.

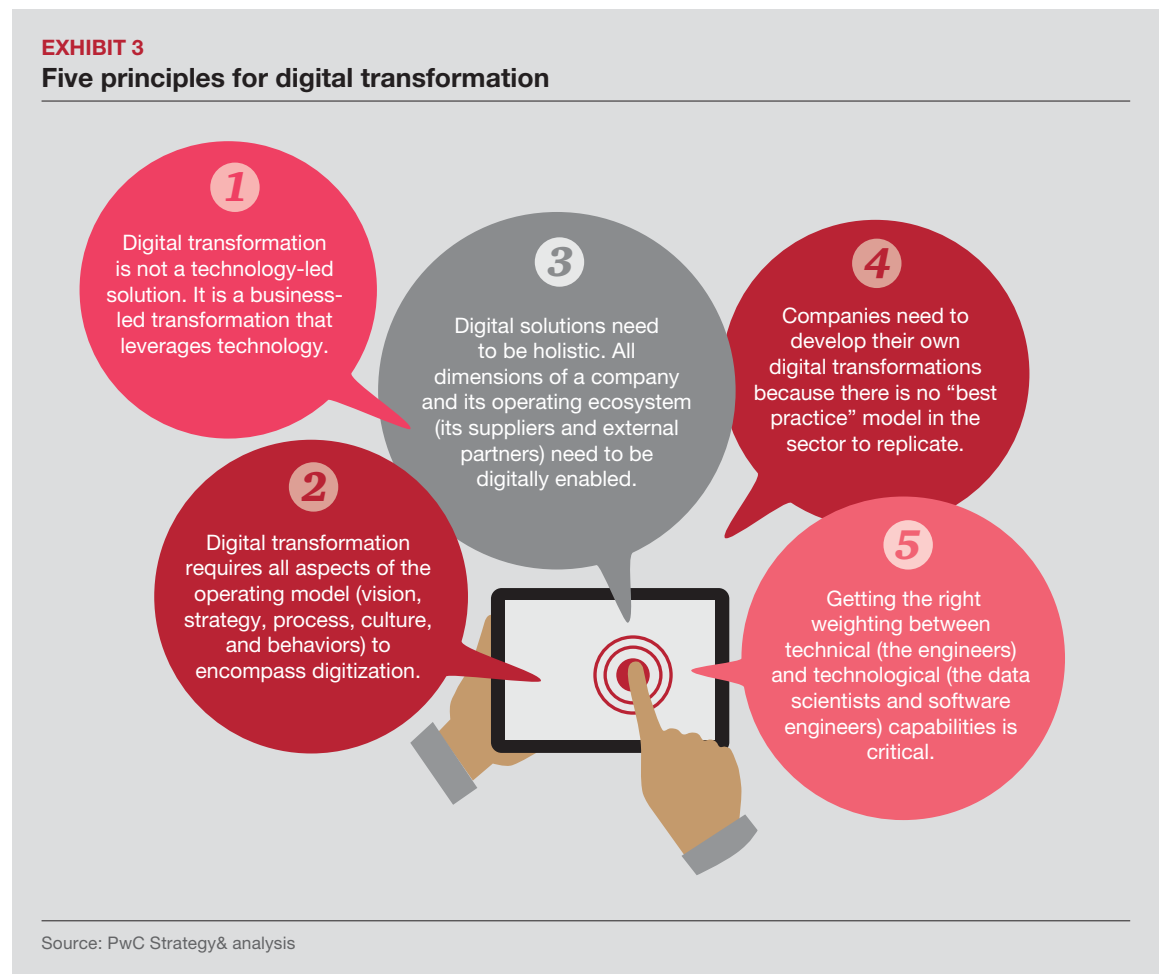


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Conclusion

In our previous report, we highlighted five principles for digital transformation (see Exhibit 3).¹

The below principles provide a good framework to help steer a company's thinking. And there is no doubt that digital solutions can deliver significant benefits to a sector that is under pressure to continuously improve operational efficiency. However, where to focus initial digital efforts, who to partner with, and just how broad the aspirations for transformation should be are all critical decisions.



1. Strategy&, *Drilling for Data: The race to digitise upstream oil and gas*, 2018.

We suggest that companies thinking about digitizing their operations² should consider five key steps:

1. Establish the business problem that needs to be addressed and how digitization technology can help resolve the issue.
2. Know that whatever the objective, a strategy will be required to deliver this ambition.
3. Decide which part of the organization to digitize first, and then consider how to keep track of lessons learned that can inform the broader process of enterprise-wide transformation.
4. Assess how the operating model, processes, and culture of an organization will be affected by these changes.
5. Identify the partners that will support the delivery of this ambition. These partners will be critical to providing the technology, fostering innovation, designing the digital strategy, and helping implement the operating model.

By following these steps, oil companies starting out on their digital journey will be more likely to reach their destination — a destination that delivers significant business innovation and improvement.

2. For a broader energy perspective on digital operations, please refer to the Strategy& [2019 Digital operations study for energy](#).

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