



New technology can light the way, but do you know where you're going?

An in-depth view of the state
of digitalization in oil and gas



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Jeff Williams
EY Oil & Gas
Advisory Leader

Foreword

While the oil and gas industry has a long history of deploying advanced technology, in the past, the implementation has been slow to permeate organizations beyond operations. Now the industry is making up for lost time. Faced with the shift from scarcity to abundance, oil and gas companies are looking for ways to reimagine their business. While the future looks different for different companies, there is commonality – this quest will not be met by short-term cost cutting. Major changes in the way the industry operates are required.

There is broad recognition that digital is essential to success. Oil and gas companies are being pressured on both pricing and their ability to access new assets, and the potential for digitally enabled initiatives to yield growth in this environment is undisputed.

Instead, a different and arguably more challenging set of questions has emerged. For instance, which tools in particular will drive value creation going forward? Is incremental change the right approach, or is it a missed opportunity? And what approach to technology adoption will allow companies not just to remain part of the pack but to accelerate ahead of the competition?

It is clear that digital transformation will not come from an off-the-peg solution – it will take a bespoke model individual to each company. In larger organizations, this may mean multiple approaches make sense. There are no simple answers. In fact, one defining characteristic of the current digital revolution in oil and gas is the lack of simple solutions – and a crucial starting point for creating a new digital road map is to understand how companies are using technology now, and how they envision the future of exploration, extraction and refining technology going forward.

To gain an in-depth view of the state of digitalization in the industry, we conducted a survey of 100 executives at oil and gas companies across the value chain. We asked about their approaches to investment in new technology and the challenges they face when formulating their digital strategy. We explored the areas of consensus, as well as the main points of debate. We also examined which tools executives believe have the most potential for their businesses, and which carry the most significant risks.

The results of our survey reveal an industry beginning to comprehend the truly world-changing possibilities this new wave of technologies offers. Respondents touted the opportunities offered by autonomous machines, which can step into hazardous operating environments in place of human workers. They discussed new exploration tools that allow upstream companies to tap previously hidden energy deposits. They also expressed interest in promising technologies that remain in early stages of development, such as blockchain.

Ultimately, as the technology available to the sector matures, companies must adopt a critical gaze when developing and refining their approach to digital. Without doing so, they risk aiming too low and missing out on the transformative potential of new technologies. They must also address the organizational challenges that inevitably arise when taking a more ambitious approach. Perhaps most importantly, companies must ask the right questions at the very start of the journey in order to fully understand the art of the possible.



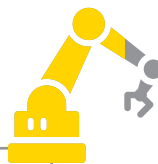
Key findings

Technology investment by oil and gas companies is set to surge

Nearly 9 in 10 respondents (89%) expect their investment in digital tools to increase over the next two years, with a quarter (25%) foreseeing a significant increase. The main motivation for a plurality of respondents is to find efficiencies (42%), suggesting that cost savings is the focus of their investments, while 23% said their primary aim is to add capabilities - implying a more ambitious approach.



89%
expect their
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next two years



75%
of respondents
are already
implementing
RPA

Robotics, advanced analytics and IIoT are expected to have an outsized impact

Over the next five years, our respondents predict that robotic process automation (RPA) (25%) and advanced analytics (25%) will have the most significant positive effect on their businesses. Notably, 75% of respondents are already implementing RPA and 87% are using advanced analytics. By far, the most high-risk-high-reward technology, according to respondents, is the Industrial internet of Things (IIoT): 70% said they plan to implement it in the next 18 months, and a plurality (20%) said it carries the most risk of investment of any new tool.



Operations are central focus in the value chain

A majority of our respondents (55%) said their priority when investing in new technology will be on the operations side of their business. Secondary priorities for respondents in the value chain are maintenance and reliability (named by 25% as most important) and logistics and supply chain (19%). But these two areas are also being almost universally targeted for investment, with 96% saying they would be committing at least some digital technology investment to them.



Integration of new tools represents a top challenge

One of the biggest challenges facing oil and gas companies is managing the formidable process of integrating the many new digital tools now available to them from service providers. On average, respondents said they allocate nearly half (48%) of their digital technology investment to outsourcing, and a plurality of respondents (30%) said the greatest operational challenge they face is working effectively with outside firms.

55%



said their priority when investing in new technology will be on the operations side of their business

Developing in-house capabilities can bring rewards

Our survey reveals that, on average, respondents devote just 17% of their digital technology investment to developing in-house capabilities, due to challenges such as long timelines to deliver results (24%) and a prohibitive cost of investment (22%). Personnel issues, such as building a high-quality infrastructure to support the digital team (35%), can also be a barrier. However, for companies that decide to develop internal resources, respondents said it can be a valuable opportunity to foster an internal culture of innovation (39%).



39%

of respondents said it can be a valuable opportunity to foster an internal culture of innovation

How do you extract insight from a hydrocarbon?

42%

of oil and gas executives say their top priority in digital technology investment is to find efficiencies.



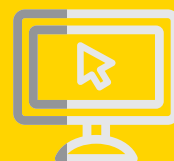
68%

say the return threshold for digital investment is larger than the invested amount.



32%

say that selecting the types of technologies to focus on poses the greatest strategic problem.





One of the keys to the oil and gas industry's growth ambitions lies in unleashing capital expenditures on technology. And our survey results reflect this reality - a majority of our respondents are eager to invest more in digital, with an urgent need to contain costs and deliver a bigger return on capital.

Nearly 9 in 10 respondents to our survey (89%) expect their investment in digital tools to increase over the next two years, with a quarter (25%) foreseeing a significant jump (see Figure 1). Just 11% see investment staying flat and, significantly, none see it declining.

In addition, a plurality of respondents (48%) said their companies invest more in digital innovation when they have available capital (see Figure 2). Given the recent period of higher energy prices, this may help explain respondents' stated intention to boost investment in the coming years.

Figure 1: How do you see your company's investment in digital technologies over the next two years?

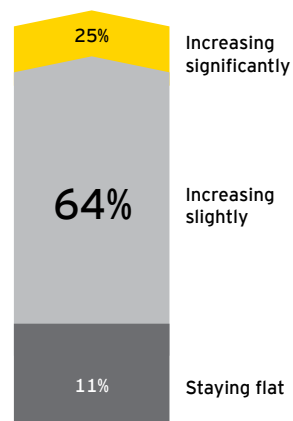
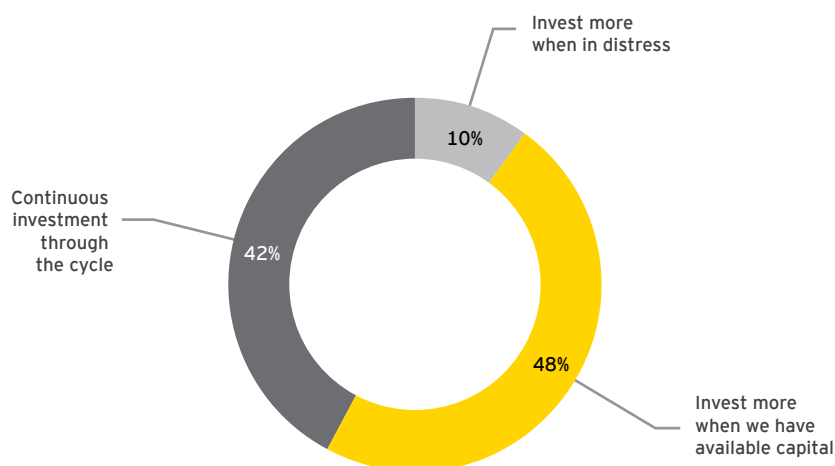


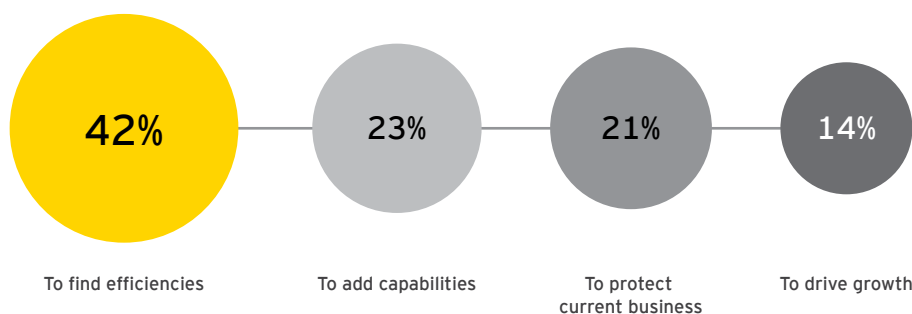
Figure 2: What effect do margins have on your company's pace of digital innovation?



When asked about their main motivation to increase spending on digital technology, roughly 42% of respondents cited the need to find efficiencies, suggesting that cost savings are the focus of investments (see Figure 3). By contrast, only 23% said their primary aim is to add capabilities - indicating that relatively few firms are taking a more ambitious approach to digital strategy.

Ioana-Andreea Ene, a Norway-based partner at EY, attributes the emphasis on efficiency to years of lower oil prices, which resulted in reductions in personnel and work stoppages. "It's not surprising that the bottom line is about becoming more efficient," Ene said. "Efficiency is the top priority because that gives you access to investments and to the market."

Figure 3: Why are you investing in digital technology? (Select the most important.)



A focus on operational efficiency has been the industry's mantra since the period of oil-price declines began in 2014. Even with oil prices increasing early in 2018, companies continue to subject their investments to far more intensive scrutiny than before. With many oil companies needing to trim down their debt positions, there remains a clear incentive to double down on cost savings, and the recent return to pricing volatility seems to reinforce the calls for caution.

"If the goal is just to extract efficiency, the sun is going to set on that objective. If you ask the wrong question at the beginning of your journey, you're going to be aiming for the wrong target."

Keith Strier, EY Global and Americas Advisory Leader for Artificial Intelligence

Indeed, some oil and gas leaders have questioned whether the oil and gas investment cycle will ever reassert itself, and doubt a return to the spendthrift days of the plus-US\$100-per-barrel era. In the current landscape, companies have been looking for solutions that slim down the cost per barrel, boost recovery rates and reduce nonproductive time.

Breaking through to a higher plane

According to Keith Strier, EY Global and Americas Advisory Leader for Artificial Intelligence, digital technology has the potential to offer much more than better efficiency. And to achieve more ambitious targets, companies must be willing to aim higher. "If the goal is just to extract efficiency, the sun is going to set on that objective," he said. "If you ask the wrong question at the beginning of your journey, then you're going to be aiming for the wrong target."

Some companies are beginning to acknowledge that the argument for adding capabilities via digital tools is compelling. One executive at a US exploration and production (E&P) company said the ability to obtain more detailed information than ever before represents a definite competitive

advantage. Along with gaining the power for unprecedented and granular views into operations, digital technology provides access to better supporting information for strategic decision-making.

An example of the rewards offered by new tools, at BP's Wamsutter tight gas field in Wyoming, where the oil and gas giant launched a pilot program intended to find ways of reducing methane emissions. Typically, management of the field involves sending pumpers out in trucks to physically check on the health of the 2,500 wells. An estimated 180 wells were fit with sensors that collected and beamed a constant flow of data about part breakages and pipe blockages. Using AI-based algorithms developed by Silicon Valley start-up Kelvin, supercomputers processed the data to create optimization models.¹

The early results were promising: 74% less emissions of greenhouse gases, as well as a 22% decline in operating costs and a 20% increase in production from the wells involved.

BP has also been driving growth through advanced exploration techniques. The company recently utilized its massive supercomputer to determine whether a significant patch of oil lay thousands of feet down in the Gulf of Mexico. The process involved algorithms and a reported two weeks of monopolizing the powerful device on the task. It yielded the find of an oilfield containing an estimated 200 million barrels that had remained untapped within an area BP had previously spent years harvesting.²

1 <https://www.forbes.com/sites/christopherhelman/2018/05/08/how-silicon-valley-is-helping-bp-bring-a-i-to-the-oil-patch/>

2 <https://www.wsj.com/articles/big-oils-new-favorite-toy-supercomputers-1523358000>





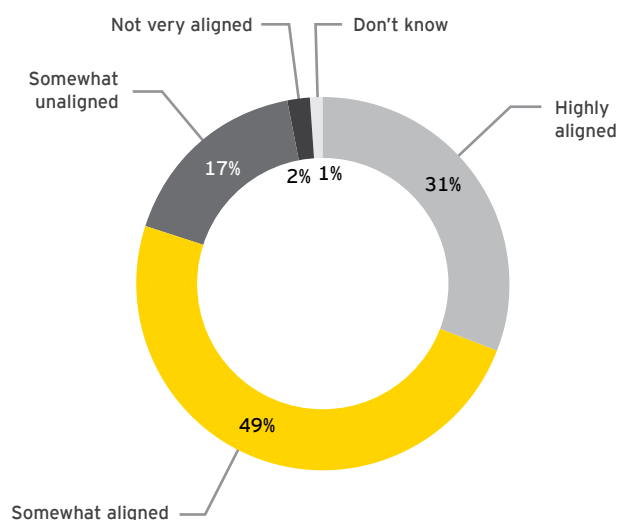
Aligning all parts of the business machine

For many firms, however, rising to new heights will require resolving internal conflicts regarding digital strategy. Only about one-third of survey respondents (31%) said their vision for digital technology investment was “highly aligned” with the views of other senior management team members. Meanwhile, a considerably higher proportion, 49%, said they were just “somewhat aligned” (see Figure 4).

This suggests that more often than not, there is some measure of disagreement among senior officials regarding digital strategy. About 32% of respondents said that selecting the right technologies to focus on was the biggest challenge they face in aligning strategic views (see Figure 5).

The results should perhaps come as little surprise - in large oil and gas companies, emerging technology is rarely owned by one individual and is not centralized. Few organizations in the sector have a chief digital officer (CDO), and while there may be a person whose role involves keeping abreast of cutting-edge technology, for the most part there is no single channel of decision-making. Silo mentalities endure, preventing faster uptake of digital tools. Companies may have one team working on 3D printing, while others pilot-test AI tools and put drones into use; none of the teams necessarily go through the same decision-maker.

Figure 4: In your opinion, how aligned is your vision for the company's digital technology investment with the views of other senior management?



Management teams also seem to suffer from not knowing which specific digital tools best meet their firms' needs. According to EY's Strier, there is sometimes confusion and a lack of confidence about choosing the types of digital technology to focus on – even though the number of emerging tools that are likely to be valuable is limited.

According to EY Senior Manager Kanishka Banerji, a major part of leveraging digital from a C-suite perspective is to introduce capabilities and unlock value in a way that may not have been possible in the past. "Digital typically allows you to unlock upwards of 30% of value within only a few years. When done right, a company is going to leapfrog what others are doing because of digital," he says. "It introduces new capabilities and allows you to work in new ways, unlocking significantly more value than you would get through traditional operational excellence or continuous improvement initiatives."

One principle is clear: ultimately, companies are seeking to improve their bottom line with their digital investments. When asked about their return threshold for capital commitments to technology, 68% of respondents said they required a return either greater than – and 30% said they required a return equal to – the cost of investment (see Figure 6).

Thankfully, the benefits of new technologies often extend beyond the balance sheet. Safety improvements, for instance, tend to make a positive financial impact as well, whether from reduced workers' compensation payouts thanks to a lower accident rate, or from avoiding the cost of repairs due to better monitoring of equipment, among other measures.

Figure 5: Which of the following issues pose the greatest challenge when it comes to aligning technology strategy with senior management? (Select the most challenging.)

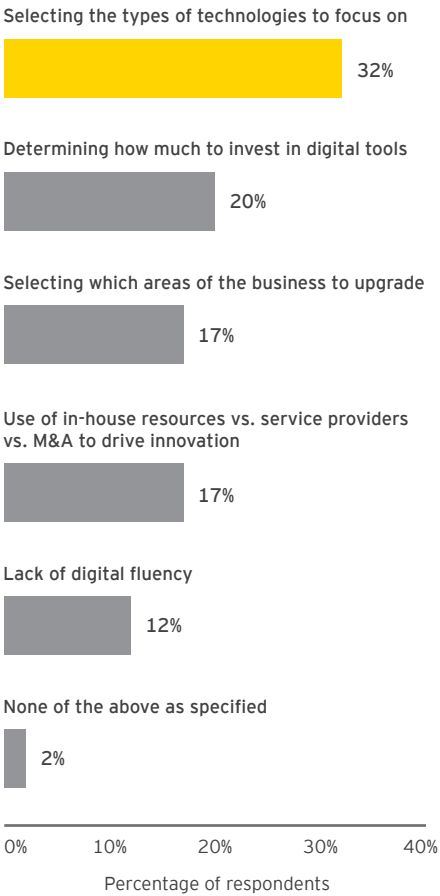
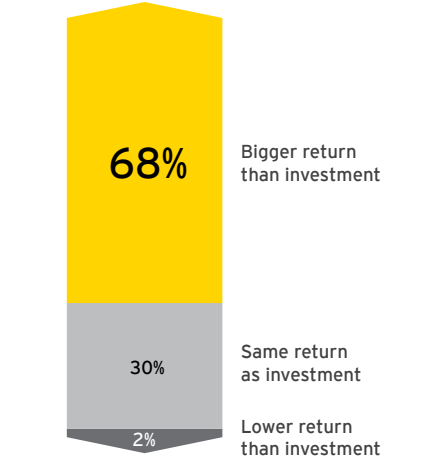


Figure 6: What is the return threshold for digital investments?



"Digital typically allows you to unlock upwards of 30% of value within only a few years. When done right, a company is going to leapfrog what others are doing because of digital."

Kanishka Banerji,
EY Senior Manager



Is technology your strategy or your starting point?

55%

of oil and
gas executives say
operations is their
top focus in the value
chain for digital
investment.



20%

say IIoT
is the
technology that
carries the highest risk
of investment.



Oil and gas players are increasingly looking to digital technology as a means of boosting productivity and gaining competitive advantages. In order to gain a fuller picture of companies' strategies regarding these technologies, we asked them which ones they are in the process of implementing, as well as which ones they will implement in the near future. We also polled companies as to the perceived positive impacts and negative risks surrounding these tools.

The future will be automated

When it comes to the digital technologies expected to have the greatest positive impact on respondents' businesses over the next five years, RPA tied for the highest (see Figure 7). In addition, 75% of those polled regarding which technologies they are in the midst of implementing cited RPA (see Figure 8).

EY's Strier attributes the relatively high adoption score for robotics technology to management's pre-existing familiarity with it. However, Strier emphasized that the complexity can grow exponentially as the tasks become more challenging.

"When you start layering on more advanced forms of automation using AI, computer vision and natural language processing, then you're not using rules - you're aiming for human-like cognition. And that follows a completely different path than the traditional enterprise IT," he said.

Another form of digital technology predicted to have an outsized impact on businesses over the next five years is advanced analytics, with one quarter of respondents citing it as a tool expected to have the greatest positive impact on their business.

When asked about technologies they were currently putting into effect, advanced analytics garnered the second-highest ranking among respondents (87%).

Advanced analytics has been rolled out by firms such as US independent Anadarko, which recently paired petroleum engineers with data scientists in two-person teams.

The purpose of the teams, which are incorporated within the company's advanced analytics and emerging technologies group, is to find ways to improve operations through the utilization of data.

Recently, one such team worked on the problem of getting drilling data to Anadarko's corporate office from the field in a more timely fashion. Their efforts led to the creation of a real-time data-analytics system fit for the task.

Figure 7: Which of the following technologies do you expect to have the greatest positive impact on your business over the coming five years? (Select the most important.)

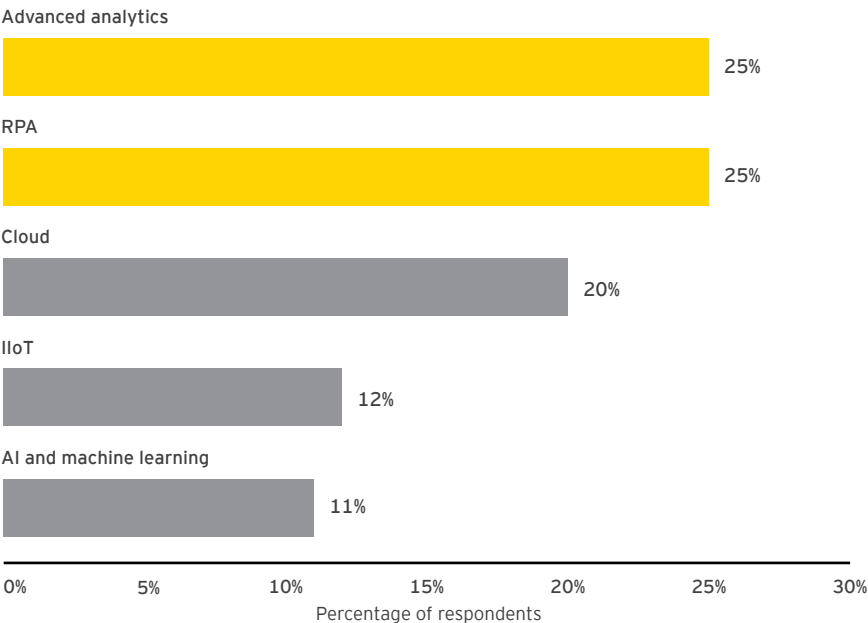
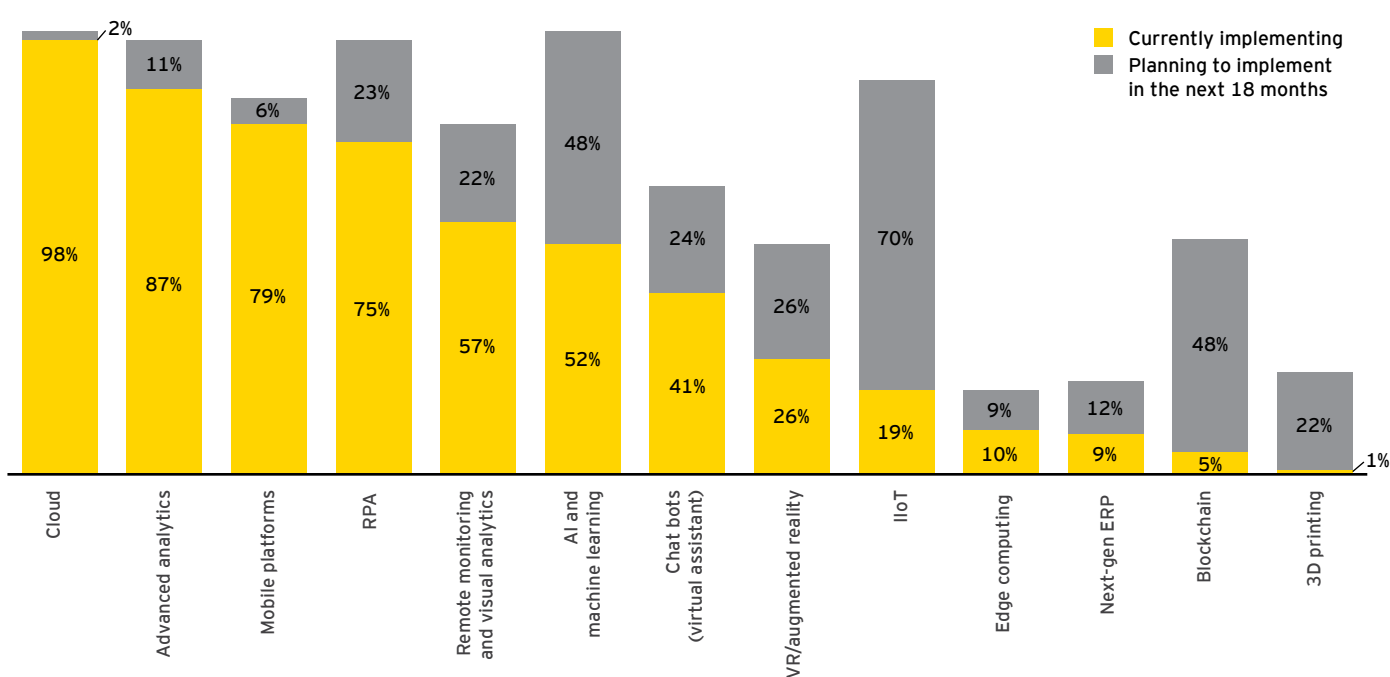


Figure 8: Which of the following technologies is your company currently implementing? And which do you plan to implement in the next 18 months?



Connected systems to bring rewards – and risks

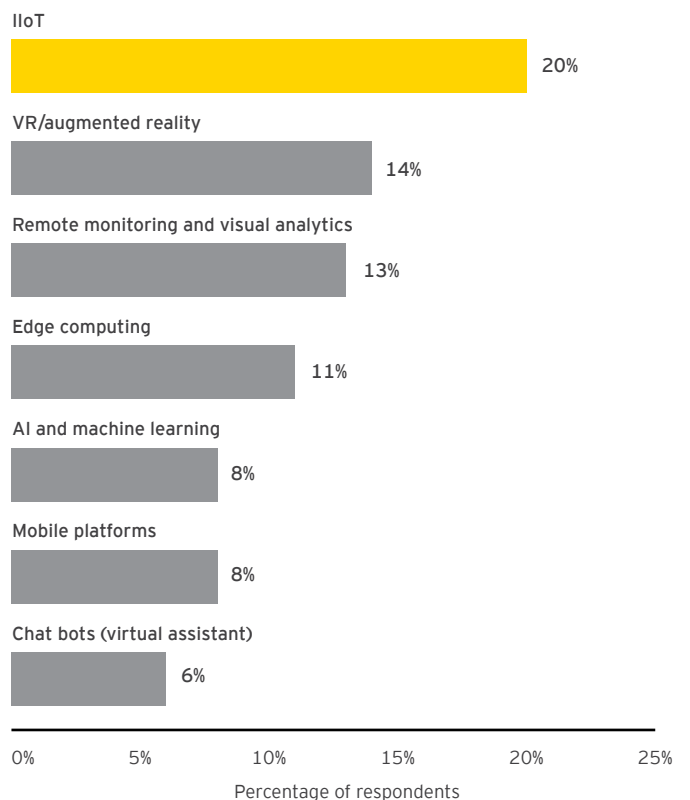
A significant plurality of respondents named the IIoT – which allows companies to transform their management of assets using predictive solutions deploying big data – as the riskiest of any technology (see Figure 9). According to EY's Ene, it is viewed in some quarters as a potential "Pandora's Box," due to the fact that it connects systems dating back to the 1980s and 1990s with newer ones.

While the older systems may have been initially secure because they were operating autonomously, Ene says tapping into that data now requires opening a data pipe that could raise cybersecurity issues. "When it was working in splendid isolation it was fine, but how are you going to build a wall around it so you're not jeopardizing the entire platform?" she said.

Currently, the IIoT is only being implemented by around 19% of those surveyed, but it appears to be at the forefront of the oil and gas industry's digital agenda. Among respondents, 70% cited it as a technology they were planning to implement in the coming 18 months.

At the moment, the most common IIoT technology application in the oil and gas industry is data analytics or software systems, which analyze information gathered from connected devices and sensors in order to generate more informed decisions. Recently, engineering and design firm Aricent entered into a partnership with Amazon Web Services for its own analytics-based, asset-monitoring solution for use by clients that include oil and gas firms.³

Figure 9: Which of the following technologies will carry the highest risk of investment? (Select one.)



³ <https://globenewswire.com/news-release/2018/07/18/1538759/0/en/Aricent-Collaborates-with-Amazon-Web-Services-to-Develop-Intelligent-IoT-based-Asset-Monitoring.html>



Exploring the avenues of technology adoption: selecting the right route

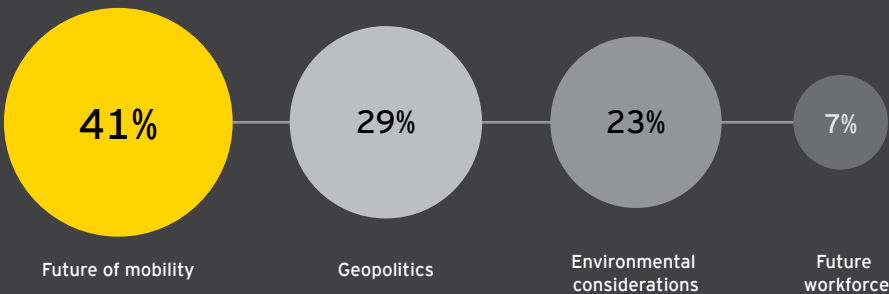
Oil and gas companies have different means of gauging the importance of digital tools, and many look to other industries for ideas on innovation. When asked which industries they look to in particular, 47% of respondents named technology, which ranked much higher than any other selection (see Figure 10).

Other respondents cited the manufacturing sector as a source of inspiration. One North American oil company executive lauded certain manufacturing firms that have leveraged data analytics in ways that contributed to year-on-year profit increases despite operating in a highly competitive space.

Meanwhile, a European downstream company executive pointed to the use of sensors by some large-scale manufacturing firms to regulate their energy use by transmitting real-time information. “These are companies that produce thousands of products a day,” the executive said. “Surely, our own industry could benefit from similar types of digital innovation.”

When asked to whom they look for digital guidance, a plurality of oil and gas company respondents (45%) said they reach out to consultants. By comparison, 31% of respondents said they turn to collaborators (see Figure 11).

Figure 12: What future trend outside of your industry is impacting your decisions around digital the most? (Select the most important.)



One US oil and gas executive said consultants’ industrial and technological expertise was particularly valuable. “In my opinion, they are the ones who have the clearest vision of what these types of technology can do for us, and can guide and channel our investments toward the best possible outcome.”

Guidance can also come from within an organization. Ten percent of respondents cited internal resources and IT departments as their main source of advice, with one US-based executive saying their organization has its own data solutions committee set up to share and discuss technology-related issues, including digital tool options.

With regard to trends currently impacting respondents’ decisions around digital strategy, a plurality (41%) view the future of mobility as the most influential, followed by geopolitics and environmental considerations at 29% and 23%, respectively (see Figure 12).

Figure 10: What other industries do you look at for digital innovation? (Select the most important.)

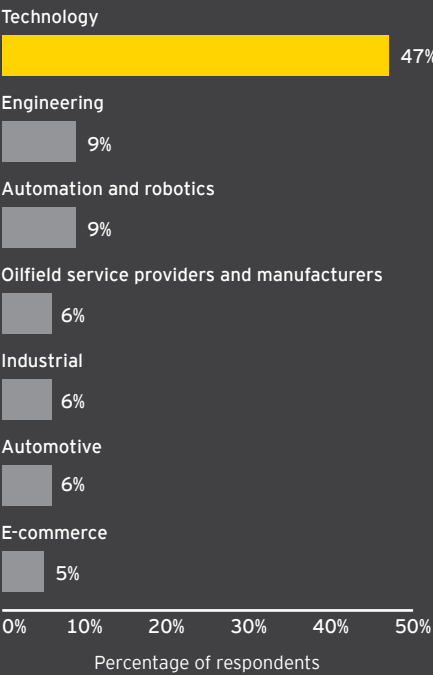
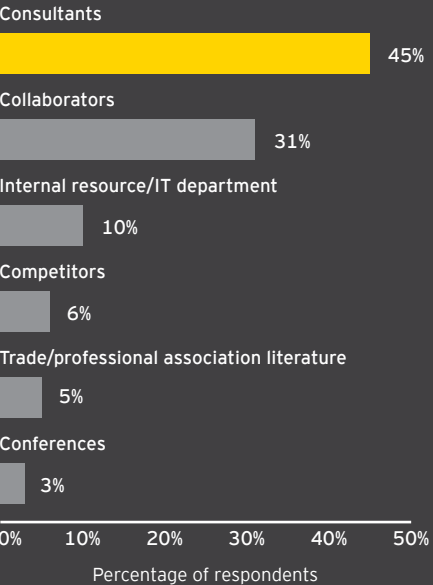


Figure 11: Where do you look for digital guidance? (Select the most important.)



The sky-high potential of the cloud

Among respondents, 20% predicted the cloud would have the greatest impact on their business over the next five years. The cloud also figures most strongly among all technology types that companies are currently implementing, with 98% citing it as a tool they already use.

Cloud applications have attracted considerable interest, with tech giants such as Google and Microsoft joining forces with oil and gas companies over the past year to deliver cloud solutions to the industry. For instance, Norwegian diversified energy company Equinor, formerly known as Statoil, announced a partnership with Microsoft in June 2018 with the stated goal of accelerating development of “fit for purpose” IT services.⁴

Above all, companies should be thinking about technologies holistically, according to EY’s Strier. “Value is attained by stitching tools together to solve specific business problems,” he said. “Inevitably, the right answer is not going to be a robot or an algorithm, it’s going to be a combination of the two. You’re going to have a few bots, some machine-learning algorithms, some data models, some machines, and they’re all going to be working together.”

“The narrative is beyond the tool,” Strier continued. “It’s really about the integration of the full spectrum of technology.”

EY Canada National Oil & Gas Strategy Services Leader Lance Mortlock agrees: “The question is less about which technology to use and more about how technology enables the business process and the people capabilities.”

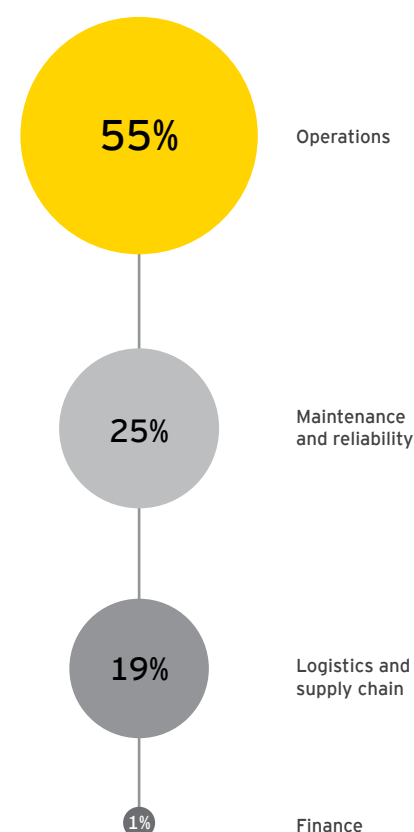
Upgrading key links in the value chain

For a majority (55%) of our survey respondents, the key priority for investment in the value chain is operations (see Figure 13). It should come as little surprise that operations are the main focus for companies in the industry – they represent the biggest cost center, and therefore a prime target for seeking efficiencies. Indeed, the key attraction of digital technology for many oil and gas firms is the opportunity to scale back their reliance on costly and time-consuming manual operations.

Take the unconventional oil sector. In traditional land-based operations in the US, operators spend an enormous number of man-hours at the well site. The time and expense associated with this manual activity has led some operators to use remote operation centers (ROCs), which utilize sensors to provide data about the operation of wells. Operational risk is also substantially reduced by ROCs, which can continuously monitor all of the locations to ensure that wells and facilities are operating smoothly without production problems or leaks.

Norwegian producer Equinor has launched a number of ROCs in recent years, and in November 2017 it opened its first control room for complete remote operation of an offshore rig, the Valemon platform in the North Sea. “In new field developments, oil and gas production will, to an increasing extent, be carried out from unmanned, robotized, standardized and remote-controlled installations,” said Equinor COO Jannicke Nilsson in announcing the opening of an integrated operations support center in Bergen in March 2018.⁵

Figure 13: Which part of your value chain are you prioritizing most for investing in digital technology?



Ultimately, a strategic approach is usually best when considering investment strategy in the value chain, since efforts at change often impact multiple areas of the business. For instance, those same ROCs can afford opportunities for oil and gas companies to improve their human resource development, given the reduced use of on-site labor. Fewer crews manning rigs equates to a better use of human resources to focus on value-added optimization activities.

⁴ <https://www.equinor.com/en/news/20jun2018-microsoft-cloud-services.html>

⁵ <https://www.worldoil.com/news/2018/3/8/statoil-invests-in-offshore-digital-technology>

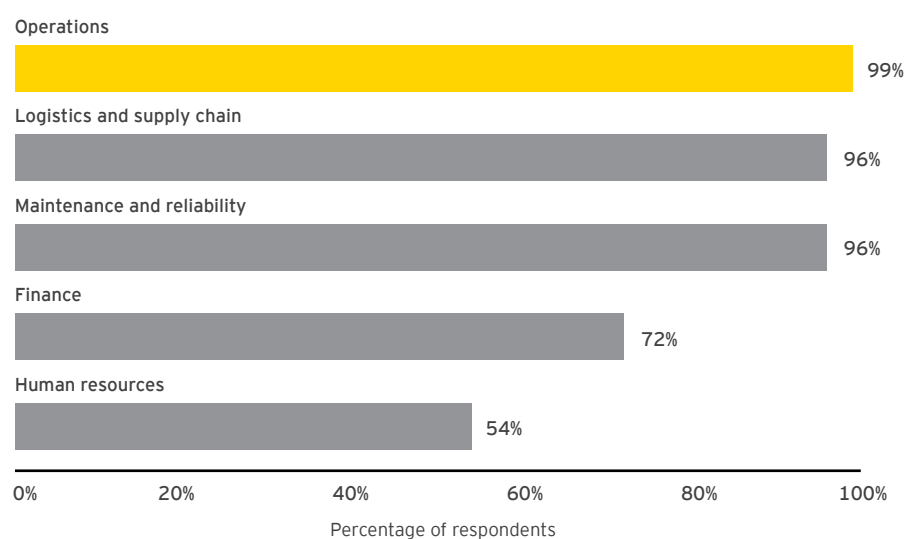


Moving beyond operations

Secondary priorities in the value chain are maintenance and reliability (25%) and logistics and supply chain (19%) – but 96% of respondents are planning to invest in these two areas as well (see Figure 14). Less attention is being paid to finance and human resources, though a majority said they would devote at least some capital to these areas.

Significant cost savings can be achieved through effective improvements to maintenance and reliability functions. One of the main digital tools used to this end is analytics software that leverages IIoT sensors to predict asset failures and model vulnerabilities, allowing companies to make repairs before they cause a major disruption.

Figure 14: In which parts of your value chain do you plan to invest in digital technology? (Select all that apply.)





When it comes to logistics and supply chain, blockchain technologies hold the potential for making a strong impact. In November 2017, a consortium led by BP and Royal Dutch Shell announced they would develop a digital platform based on blockchain for energy commodities trading, with the goal of streamlining cargo transfer and transaction settlement.⁶

According to EY's Ene, blockchain could give national oil companies (NOCs) genuine traceability of their goods. "NOCs want to develop their own countries, so local content is important. And by using blockchain, everything is visible to everybody," she said.

From production down to refining

Within the upstream value chain, the highest average proportion of respondents' spending on digital technology goes to exploration and appraisal (38%) (see Figure 15). Production was next highest at an average of 26% of respondents' total expenditures, followed by drilling completion at 19%.

As lucrative new fields have become increasingly difficult to find, oil and gas companies are devoting substantial digital resources to exploration. ExxonMobil, for example, began working with the National Center for Supercomputing Applications at the University of Illinois in 2017 to speed up reservoir simulations. The faster speeds allowed the company to improve its reservoir management, decreasing risk and improving decision-making around well placement.

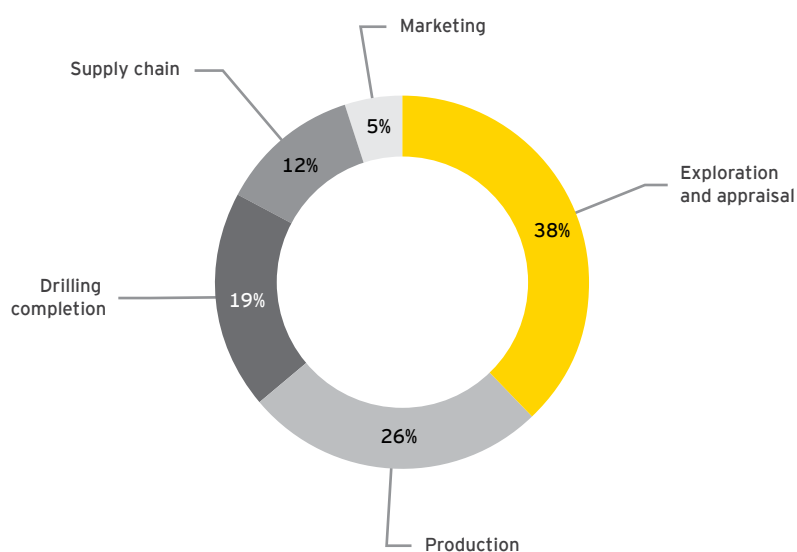
Innovation is also being seen in the area of completion, with companies seeking to maximize recovery rates and production from their wells. Earlier this year, UK-based service provider Tendeka field-tested its wireless completion technology, used to communicate reservoir pressure and temperature data.⁷

In the downstream value chain, refining and processing receives the highest average percentage of respondents' digital spending (35%), while marketing and distribution is next at 26% (see Figure 16). Refineries are being fitted with new sensors to constantly monitor vibration, chemistry changes and temperature. Smart software can analyze and identify any problems in the network, and predictive analytics can automate many refinery operators' daily tasks.

⁶ <https://uk.reuters.com/article/us-energy-blockchain/bp-shell-lead-plan-for-blockchain-based-platform-for-energy-trading-idUKKBN1D612I>

⁷ <http://www.tendeka.com/wp-content/uploads/PulseEight-Case-Study-4-First-Wireless-Completion-System-Deployed-in-the-Bakken.pdf>

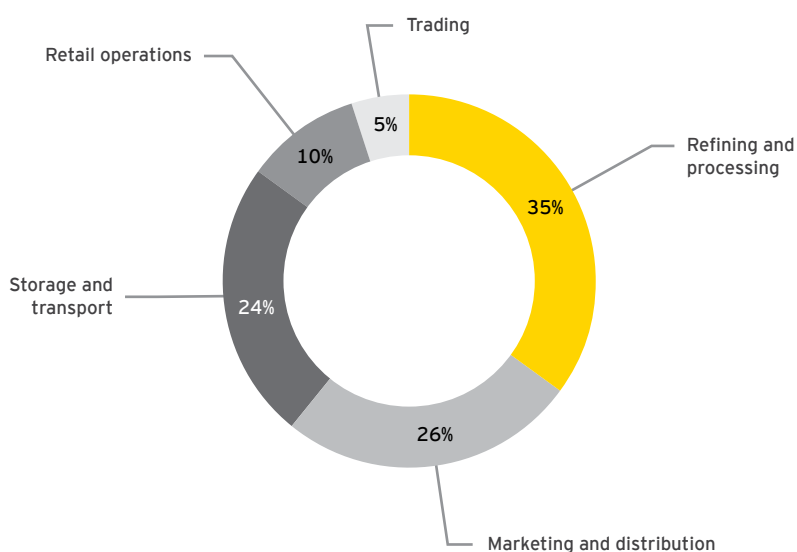
Figure 15: Percentage of respondents' digital technology spend devoted to different parts of the upstream value chain (average)



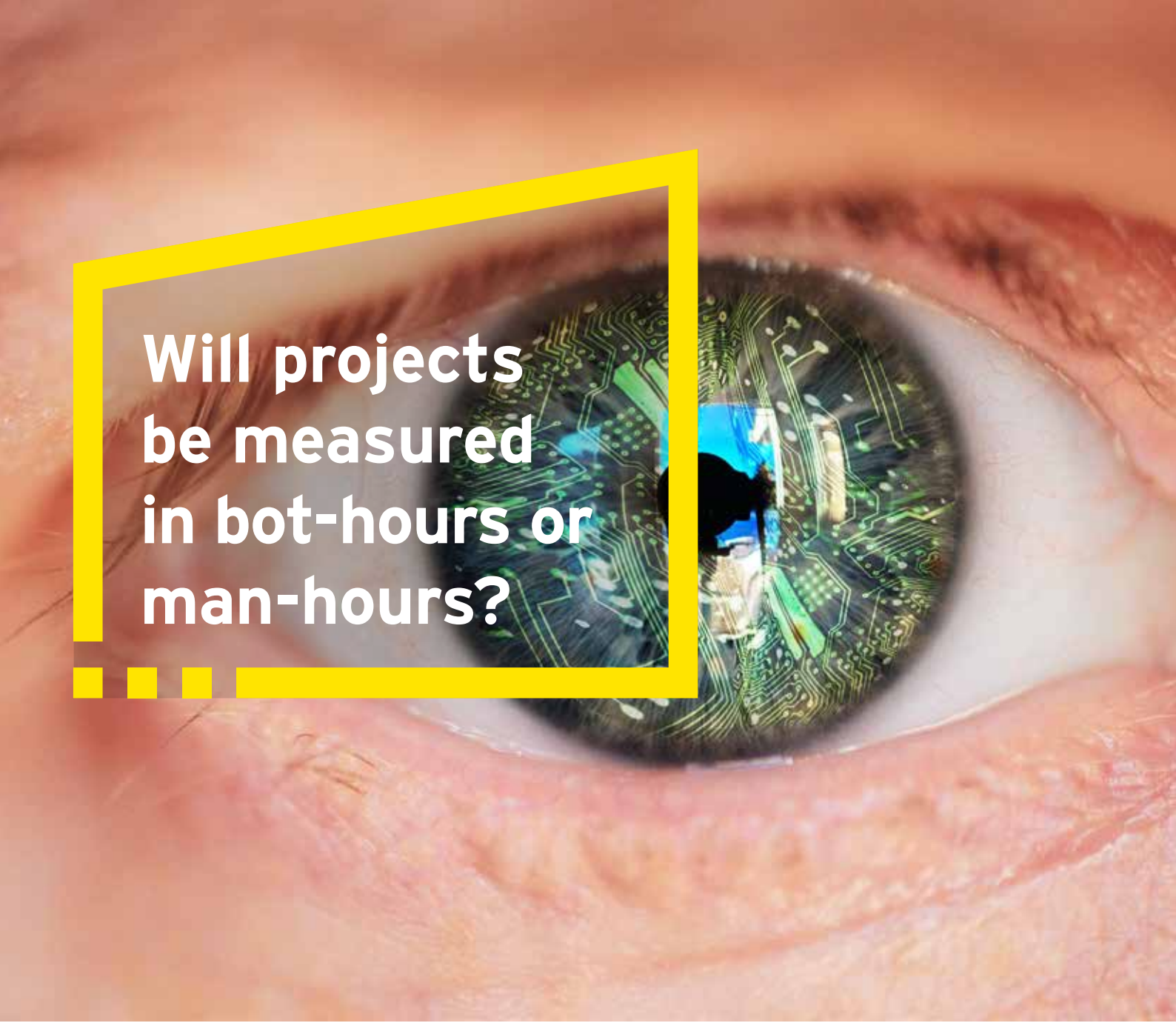
One executive at a Canadian integrated oil company said they were focused on upgrading areas that had received less capital historically. "Activities like trading, marketing and retail are already supported by digital tools, such as automated data analytics. Now we need to prioritize investments for refining, processing, storage and transport activities, where the coming crop of technologies can address key issues."

"The question is less about which technology to use and more about how technology enables the business process and the people capabilities."

Figure 16: Percentage of respondents' digital technology spend devoted to different parts of the downstream value chain (average)

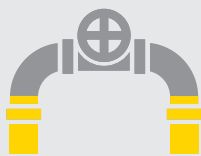


Lance Mortlock, EY Canada
National Oil & Gas Strategy
Services Leader



**Will projects
be measured
in bot-hours or
man-hours?**

39%



of oil and gas executives
say developing
technology in-house
fosters an internal
culture of innovation.

50%



say balancing internal
development, using
service providers and
making acquisitions is
a top challenge.

35%



say building a high-
quality infrastructure
is the biggest hurdle
to establishing an
in-house digital team.



One crucial part of creating a digital road map in oil and gas is choosing the means of transport – that is, how exactly you will travel the path to an advanced future. The types of investment chosen by companies play an important role in navigating this path.

Our survey shows that the main method respondents use to access new technologies is through service providers: on average, 48% of their spending goes to outsourcing, compared to 25% for acquisitions, 17% to developing capabilities in-house and 9% to working with start-up companies (see Figure 17).

The largest incumbents in the oilfield services industry offer powerful technology suites. Perhaps equally important in recent times has been the proliferation of more niche providers of software and other tools. Dozens of companies have emerged to offer solutions such as software that leverages AI to improve decision-making, advanced control systems, remote automation and mobile capabilities.

Figure 17: Percentage of respondents' digital technology spend devoted to different types of investment (average)

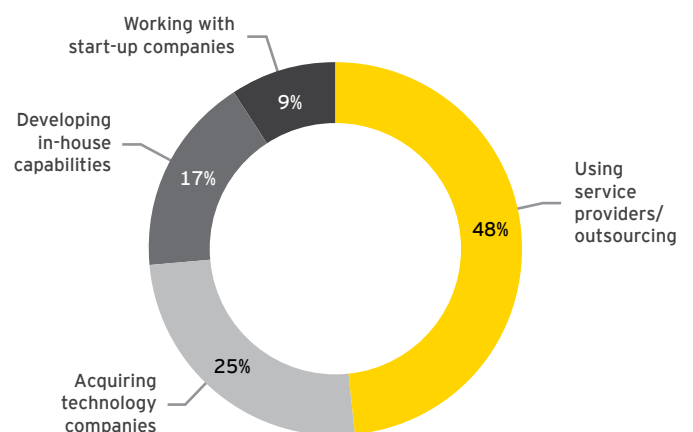
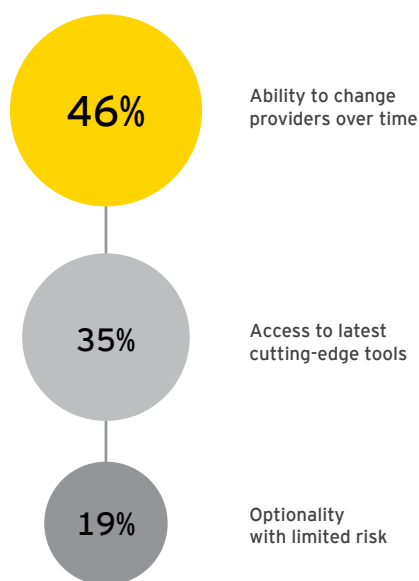


Figure 18: What do you think is the main advantage of leveraging external service providers for digital capability? (Select the most important.)



One of the main advantages presented by the appearance of this new ecosystem of technology providers is flexibility. Of our respondents, 46% cited the ability to change providers over time as the most important benefit of outsourcing technology functions (see Figure 18).

"I believe it's a healthy sign that companies recognize they don't need to develop everything in-house," said EY's Ene. "The beauty of the new digital wave is that nobody is going to lose their job because they tried a certain technology for a project. The tools are much, much cheaper than they used to be, so it's okay to try something and have it fail. You just move on and try another technology for your project."

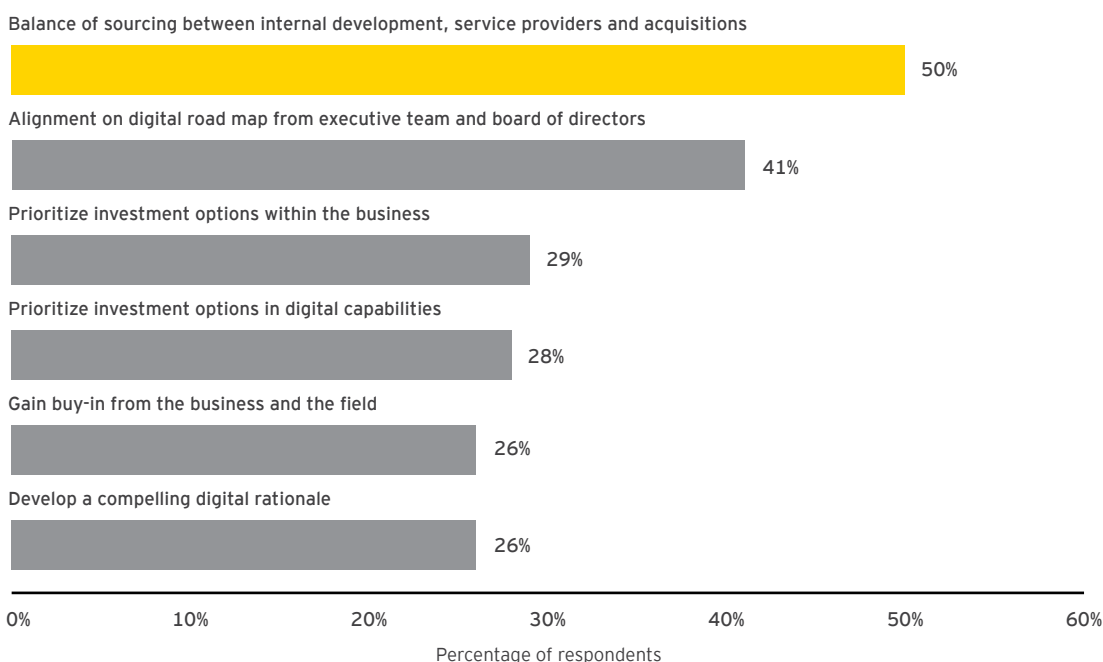
In this new environment, one of the bigger challenges becomes deciding when to make a more significant investment in a given

area. In our survey, 41% said obtaining alignment on the digital road map from the executive team and the board of directors was another key problem (see Figure 19).

"I think there is still a lack of confidence at various senior executive levels about which technologies deserve the most attention," said EY's Strier. "Early adopters that like to be out front will take the plunge, but if you're a more cautious company and you've been in the business for decades, management wants to make sure they will achieve value with a given investment."

EY Oil & Gas Advisory Leader, Jeff Williams feels that outsourcing can work in the beginning, but, ultimately, companies need to build in-house capabilities. "Service providers are good to get started, but you need to own your own model," he says. "Digitalization at the end of the day will become a top-line priority."

Figure 19: What are the greatest strategic challenges your company faces in adopting new digital technologies? (Select the top two.)



Maintaining speed on a steep learning curve

There are also significant hurdles to bringing in outside providers. According to our survey, the biggest barrier is the difficulty in integrating new tools with existing solutions and systems, cited by 36% of respondents (see Figure 20). What's more, a plurality of our respondent pool (30%) said the greatest operational challenge their company faces in adopting new technologies is working effectively with external service providers (see Figure 21).

Indeed, there can be a markedly steeper learning curve than in the past when confronting the new constellation of options. "The supply chain opportunity teams are mostly used to the same types of contracts they have been using for the past 25 years," said EY's Ene.

A US E&P executive said it was crucial for their IT team to maintain precision in their communications with service providers in order to avoid integration issues.

A central theme emerging in the industry is the drive toward standardization as firms compete to become the leading purveyor of a given suite of tools. In the past, fights over platforms and a lack of open standards arguably cost the oil and gas sector more than a decade's worth of technology development and adoption.

"I believe it's a healthy sign that companies recognize they don't need to develop everything in-house. The tools are much, much cheaper than they used to be, so it's okay to try something and have it fail. You just move on and try another technology for your project."

Ioana-Andreea Ene, EY Partner based in Norway

Figure 20: What is the biggest challenge of or barrier to using service providers for digital technology applications? (Select the most important.)

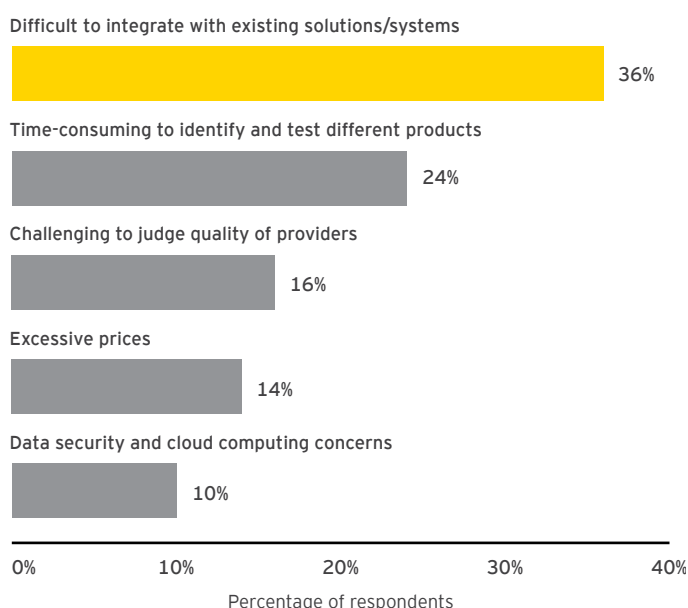


Figure 21: What is the greatest operational challenge your company faces in adopting new digital technologies? (Select the most difficult.)

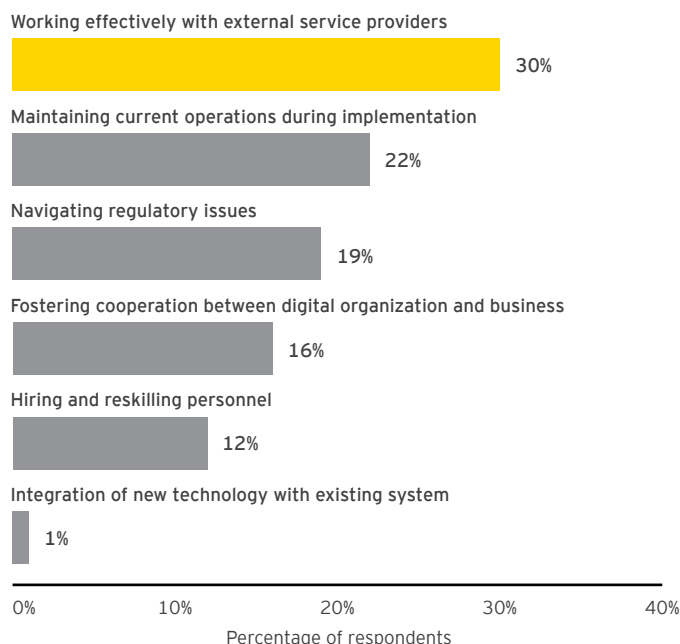
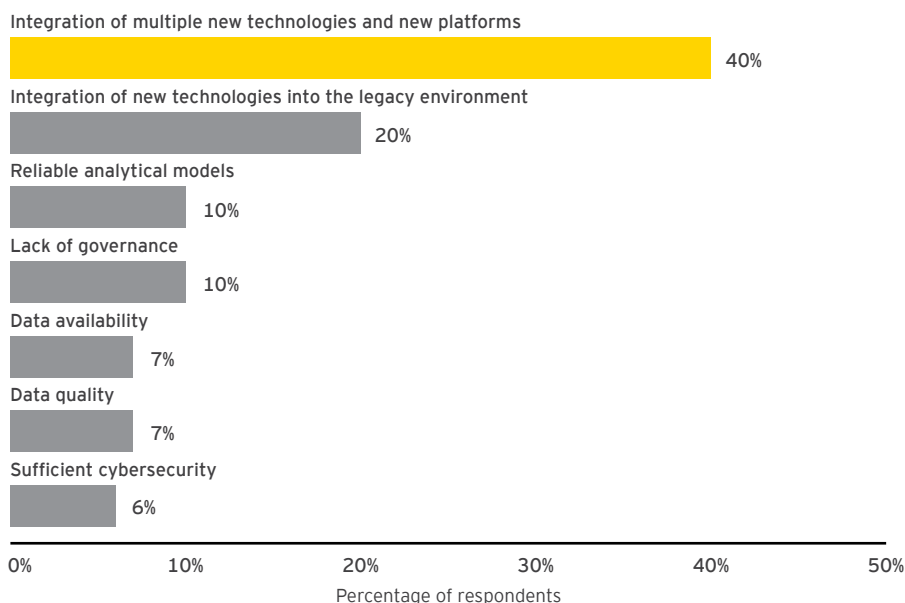


Figure 22: What is the greatest technical challenge your company faces in adopting new digital technologies? (Select the most difficult.)



Without clear winners having taken the lead yet with all-in-one solutions, companies are forced to grapple with integration challenges. In our survey, a plurality of respondents (40%) said the greatest technical difficulty they faced in adopting new digital technologies was that of integrating multiple new tools and platforms (see Figure 22). Half that percentage (20%) highlighted the related issue of integrating new technologies into the legacy environment.

The "aggregators" of new technology

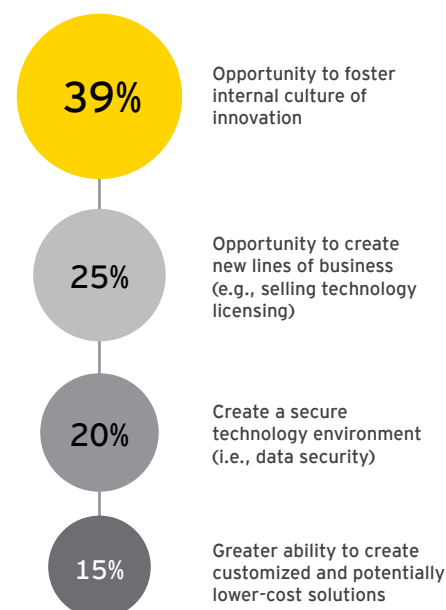
Service providers are not the whole story when it comes to adopting new technology, however – and splitting up the investment pie is no easy task. A plurality of our respondents (50%) said that finding the right balance between different types of investment represented one of the top two strategic challenges they face in adopting new technologies.

On average, our survey participants said they devote 25% of their technology investment to acquisitions, and some companies – especially the majors – certainly are using M&A to expand their capabilities. Oilfield services and industrial giants such as Halliburton, Schlumberger and ABB Group in particular have been determined buyers, acting as “aggregators” of emerging technology.

In July 2018, Schlumberger acquired Norway-based Wellbarrier, a privately owned software company that uses a patented tool to create illustrations of well barriers, for an undisclosed sum. Integrated oil and gas companies are making transactions as well – for instance, French major Total announced in June 2018 its acquisition of WayKonec, a French developer of fleet management software.

Service providers are not the whole story when it comes to adopting new technology, however – and splitting up the investment pie is no easy task. A plurality of our respondents (50%) said that finding the right balance between different types of investment represented one of the top two strategic challenges they face.

Figure 23: What is the biggest advantage of developing in-house digital technology capabilities? (Select the most important.)



For the majors, developing in-house capabilities is also a realistic endeavor, and can pay serious dividends. The greatest advantage our respondents cited in developing in-house technology is fostering an internal culture of innovation (39%) (see Figure 23).

For example, Anglo-Dutch major Shell sees innovation and technology as vital to providing a wider, more sustainable mix of energy resources for the world's growing population. Shell currently spends around US\$1b a year in R&D to turn ideas into commercially viable technologies. The majority of Shell's research focuses on the near term, to help their existing businesses to reduce capital and operating costs, to enhance customer products and services and to commercialize technologies for the transition to a low-carbon energy future. Shell operates a global network of technology centers, with major hubs in Houston, Amsterdam and Bangalore.⁸

In some cases, however, the costs of creating new tools in-house outweigh the potential benefits. Specifically, our survey respondents cited downsides such as long delivery timelines (24%) and a prohibitive cost of investment (22%) (see Figure 24).

The all-important human factor

Whether a company focuses on building relationships with service providers or creating technologies from the ground up, human resource issues are key. When respondents were asked about the biggest challenge they faced in establishing a team of digital technology experts, 35% said the largest hurdle was building a high-quality infrastructure to support the digital team (see Figure 25).

"For all these brilliant technologies, it's really about how you engage your existing employees and how you make yourself attractive for the newer generations coming in," said EY's Ene. "In plain words, how are you going to make oil and gas attractive for recent graduates? How are you engaged in recruiting the young population?"

EY's Williams agrees. "A digital company starts with the people. They have to not only be digital, but they have to work digitally."

This reinforces the fact that despite the rise of automation, the human factor remains crucial to digitization in the industry.

Figure 24: What is the biggest challenge of/barrier to developing in-house digital technology capabilities? (Select the most important.)

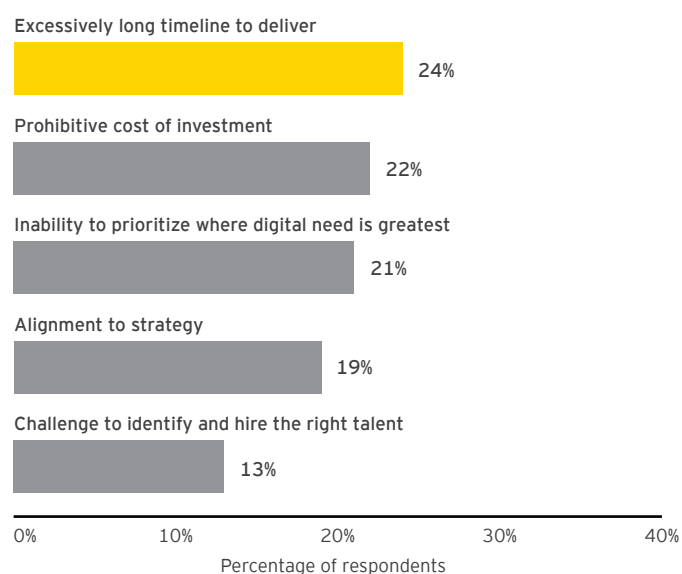
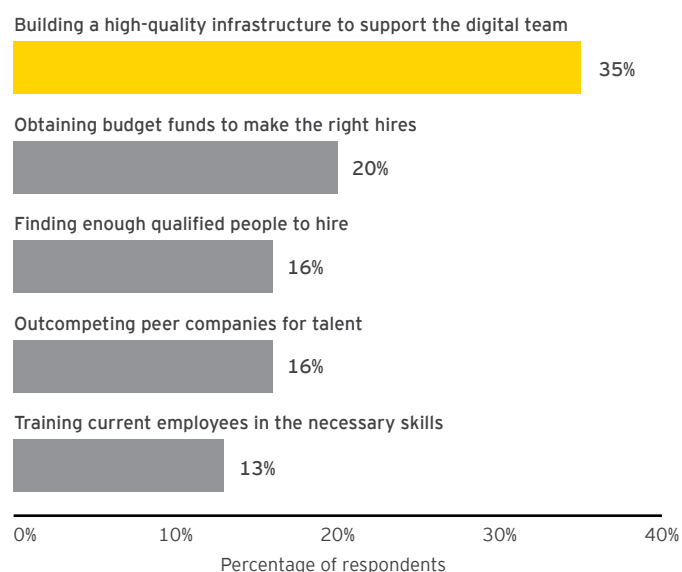


Figure 25: What is the biggest challenge you currently face in establishing a team of digital technology experts at your company? (Select the most important.)



8 <https://www.shell.com/energy-and-innovation/overcoming-technology-challenges/innovation-through-research-and-development.html>





Conclusion

The oil and gas industry's ardent pursuit of efficiency is not about to recede, especially as we see a return to volatility in commodity pricing. The focus on cost is hard-wired into corporate DNA after more than three years of low prices forced executives to take a scalpel to spending commitments. The efficiency agenda is shaping how the industry views technology investment, and what potential application it should have.

For example, more than half of our respondents said their top priority when investing in new technology will be on the operations side of the business, which would fit with the stronger emphasis on finding efficiencies.

The survey reveals that one of the main challenges facing companies is integrating new digital tools hitting the market. That suggests further work is needed in order to come to terms with the full range of possibilities that this new technology wave can offer, and how oil and gas companies can fully avail themselves of the opportunities.

All of this is sensible enough. One of digitalization's major boasts is that it enables organizations to do things quicker, more efficiently and cheaper. And yet, there is clearly more to this data-driven revolution than boosting the bottom line. There are clear signs in our survey results that companies may be missing the bigger picture; there is an argument that they ought to be thinking more holistically about technology, and how various applications could be welded together more effectively to really deliver growth opportunities and environmental benefits.

It may mean applying a basket of technologies in different ways; not just looking at standardization or process automation or efficiency, but to think in much bigger terms, and more transformation, over a longer time horizon.

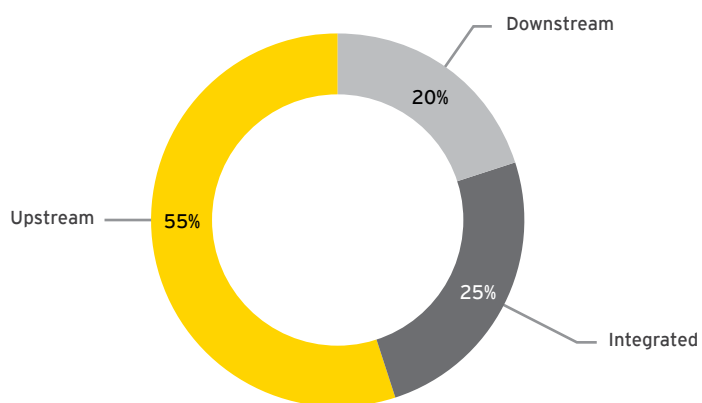
In the final analysis, business is about decision-making – and digital facilitates better decision-making. Ernst & Young LLP's Banerji explains: "Digital is about improved, more effective, faster decision-making. To be able to get to that faster, improved decision-making, you need to leverage technology, connectivity and data in an effective way ... breaking silos across the value chain so that you're able to make those integrated, better informed, value-added decisions."

"A digital company starts with the people. They have to not only be digital, but they have to work digitally."

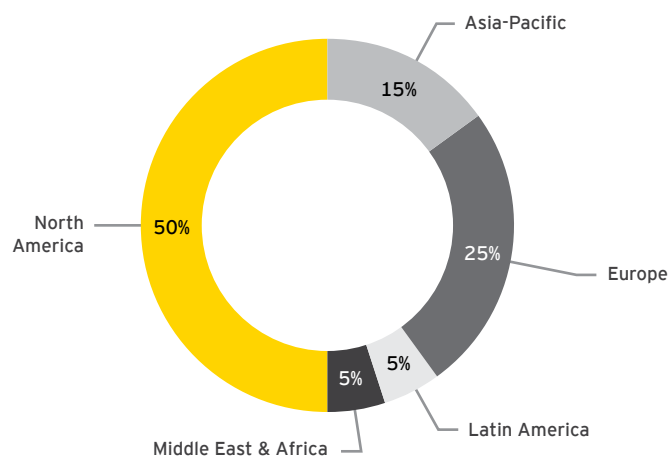
Jeff Williams, EY Oil & Gas Advisory Leader

Demographics and methodology

Which of the following best describes your company?



Region





About the research

In H2 2018, Acuris Studios, the market research division of Acuris, surveyed 100 senior oil and gas executives on behalf of EY. Those surveyed occupy a range of senior roles, such as chief information officer, chief operating officer and VP of technology. To be eligible for the survey, companies required annual revenues greater than US\$2b.

The survey included a combination of qualitative and quantitative questions, and all interviews were conducted over the telephone by appointment, with the results analyzed and collated by Acuris Studios. All responses are anonymized and presented in aggregate.

About Acuris Studios

Acuris Studios, the events and publications arm of Acuris, offers a range of publishing, research and events services that enable clients to enhance their own profile and to develop new business opportunities with their target audience.

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