Extracting digital rewards

Digital Reinvention in petroleum

IBM Institute for Business Value

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Reimagining the enterprise

Digital technologies are altering petroleum companies' operations, including exploration, production, transportation, refining and retail. These technologies are also creating unprecedented levels of industry dislocation, with new entrants fundamentally changing the economics of the business. To thrive, petroleum companies need to conceive and offer compelling new customer and end-consumer experiences, advance operational efficiencies, launch new digital offerings and build innovation ecosystems. We call this process Digital Reinvention™. With input from 300 petroleum executives worldwide, we explore how the most successful or effective organizations are doing things differently, and what other organizations can learn from them.

Everyone-to-everyone economy

Pressure on the petroleum industry is increasing. With the "lower for longer" market, over capitalization, budget overruns and production oversupply have strained industry economics. Exploration and development investments made in remote and environmentally sensitive areas have further added to the cost and complexity of capital projects. The growth of renewables is affecting demand. More stringent regulations on emissions and low-carbon requirements are increasing industry constraints. And the emergence of "pure play" companies, which specialize in specific parts of the value chain, is driving changes in market dynamics.

In summary, petroleum markets have evolved from a state of organizational centricity, in which companies and service providers largely define what to produce and market to customers, to one of individual centricity, in which technology-savvy consumers demand customized engagement and experiences.

In 2017, the IBM Institute for Business Value (IBV), in collaboration with Oxford Economics, conducted a survey of 600 chemicals and petroleum executives, including 300 from the petroleum industry. (For more information, see the "Study approach" section.) A majority of the executives surveyed told us that digital technologies are critical to their business strategies in this new economic environment.

Today's global petroleum industry is best understood within what we call the everyone-to-everyone (E2E) economy. The E2E economy has four distinct elements. It is orchestrated, based on business ecosystems that are both collaborative and seamless. It is contextual, in that customer and partner experiences are calibrated and relevant to their specific actions and needs. It is symbiotic, in that everyone and everything, including customers and businesses, are mutually interdependent. And it is cognitive, characterized by data-enabled, self-supported learning and predictive capabilities (see Figure 1).

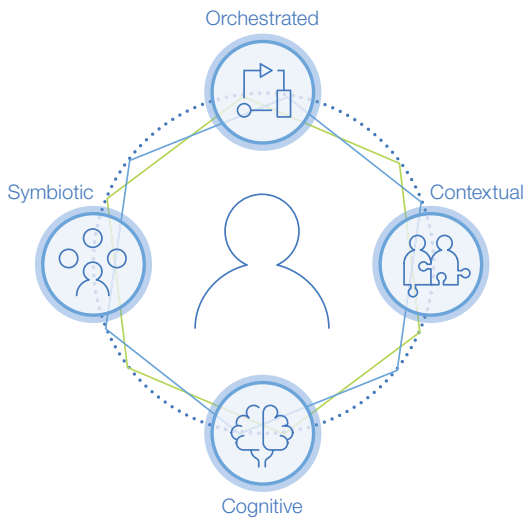
88% of surveyed petroleum executives say cloud computing is the technology most important to their organization's business strategies over the next 2 – 3 years

78% of surveyed petroleum executives from outperforming organizations say they have a transformational vision for using digital technologies

95% of surveyed petroleum executives from outperforming organizations report they have implemented digital technologies in the supply chain

Figure 1

The E2E economy is based on the interplay of four distinct elements



Source: IBV analysis.

The E2E economy initially impacted end-customer-centered sectors such as retail, automotive and consumer electronics. Now, the E2E economy is permeating business-to-business (B2B) industries, including petroleum. Digital technologies such as mobile, the Internet of Things (IoT) and adaptive robotics are altering how customers and petroleum businesses interact, fundamentally changing the business economics. The petroleum industry needs to digitally reinvent its enterprises to keep up with this technological change and the disruption it propagates.

Technological disruption and petroleum

Technological disruption in the petroleum industry has increased significantly. The growing maturity of analytics and IoT is leading petroleum businesses to interconnect products, value chains and business models. For example, General Electric (GE), the US-headquartered multinational conglomerate, is offering a tool it calls the SeaLytics Blowout Preventer (BOP) Advisor, which allows crews to monitor the health of BOP components and identifies what needs to be fixed and when.[1]

And the use of drones is replacing traditional methods for monitoring and inspection operations. BP, the British multinational oil and gas company, became the first company approved to use commercial drones over Alaska. The drones contain sophisticated electro-optical and infrared sensors for ground surveillance. BP is realizing increased efficiency and cost savings by using these drones to create 3D maps of the field's well pads, pipelines and roads.[2]

New entrants in the petroleum industry are employing digital technologies to conceive and realize bold new ideas and concepts – disintermediating traditional players. Many have already succeeded in disrupting established processes, a trend that will accelerate.

For example, Quantico Energy Solutions, a US-based data analytics company, provides the oil and gas industry with data-driven solutions that address challenges in the key aspects of finding and developing hydrocarbon resources.[3] MicroSeismic, Inc., an oilfield services company headquartered in the US, provides completions evaluation services and real-time

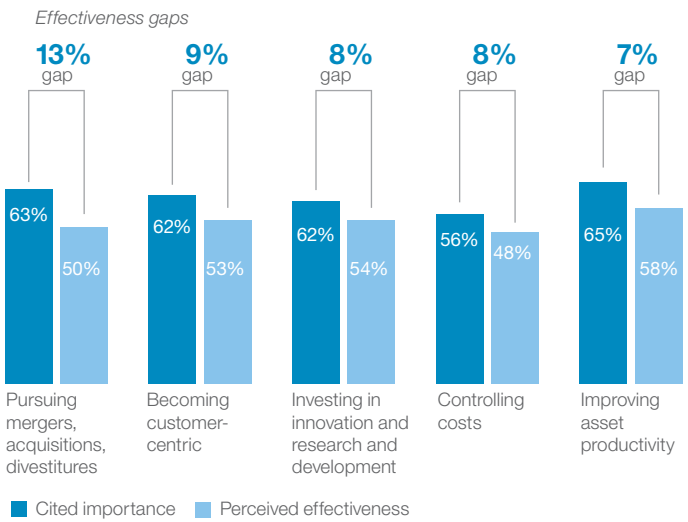
monitoring and mapping of hydraulic fracture operations in unconventional oil and gas plays. MicroSeismic helps oil and gas companies understand how the reservoir responds to stimulation and its impact on customer economics.[4]

As a consequence of this confluence of new digital technologies, half of the chemicals and petroleum executives who participated in the 2016 IBM Institute for Business Value Global Ecosystem Survey of more than 2,000 global business leaders, conducted in collaboration with the Economist Intelligence Unit, say that traditional value chains are being fragmented and replaced.[5] Fifty-five percent of chemicals and petroleum executives report that the boundaries between their industry and others are blurring.[6] And 42 percent say that competition from new and unexpected sources is beginning to impact their businesses.[7]

This disruption poses a significant threat to the industry (see Figure 2). Nearly two-thirds of the 300 petroleum industry respondents say it is vital that they pursue mergers, acquisitions and divestitures. Yet only half indicate that their employees are up to the job. Industry executives also identify significant gaps between the importance and the perceived proficiency of petroleum companies in becoming customer-centric, investing in innovation and research and development, and controlling costs.

Figure 2

Petroleum companies worry that their organizations are not ready to weather the disruption



Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

Digital Reinvention in the age of E2E

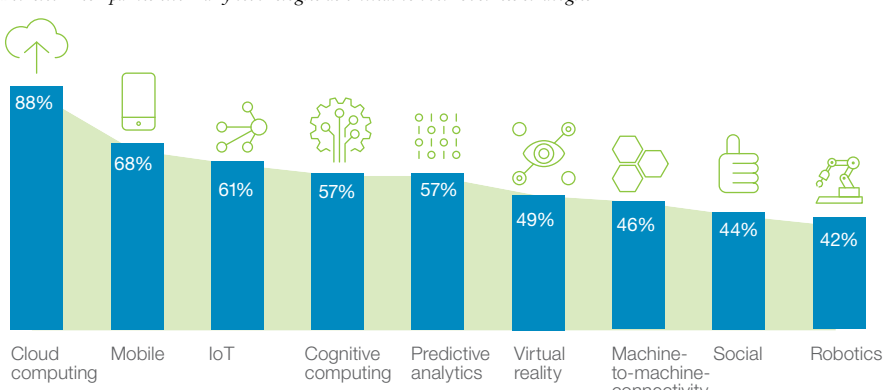
We found that the most successful petroleum businesses do indeed embrace new technologies to create compelling customer experiences and drive new efficiencies, opportunities and innovations. But to do so successfully, leading petroleum businesses need to develop new focus, build new expertise and devise new ways of working. In short, they need to digitally reinvent their enterprises.

Defining Digital Reinvention

Digital Reinvention combines multiple digital technologies – including cloud computing, cognitive computing, mobile and the IoT – to reconceive customer and partner relationships and operations. Petroleum companies see a collection of digital technologies as critical to their strategies (see Figure 3). Cloud computing can be used to run applications and store data anywhere. Mobile technologies allow ubiquitous access to information. And the IoT seamlessly connects sensors and devices to networks.

Figure 3

Petroleum companies cite many technologies as critical to their business strategies



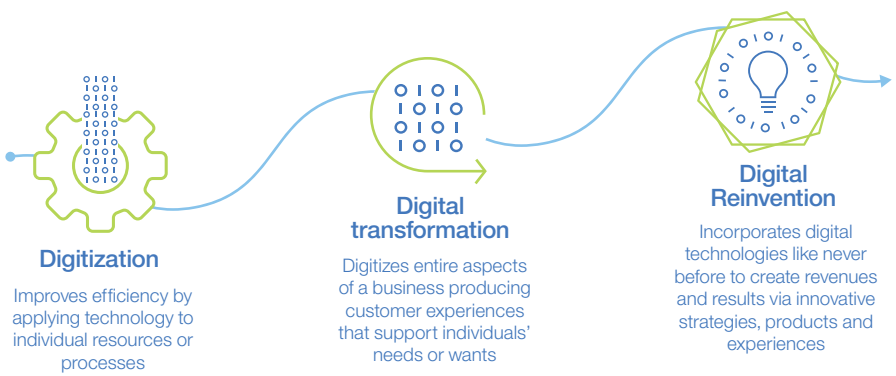
Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

Digital Reinvention involves creation and orchestration of unique, compelling experiences for customers and other stakeholders through business ecosystems. The most successful digitally reinvented businesses establish a platform of engagement, acting as enabler, conduit and partner.[8]

Digital Reinvention differs in concept from both digitization of individual capabilities or functions, and digital transformation (see Figure 4). For petroleum organizations, digitization involves digital automation of specific processes, such as maintenance, trading and risk management. For example, by deploying analytics and predictive models to forecast equipment failures, oil and gas companies can reduce unplanned downtime and optimize asset maintenance.

Figure 4

Digital Reinvention follows a path that starts with digitization and progresses through digital transformation



Source: IBV analysis.

Digital transformation involves integrating across multiple digital processes, such as the development of online marketplaces that are fully integrated into supply chains and distribution networks. Canada-based BizVibe, for example, a B2B networking platform for global B2B buyers and suppliers, has announced a networking platform for the oil and gas industry in the United Arab Emirates (UAE).[9] This platform helps companies find the top oil and gas producers, reliable and trusted oil and gas industry experts, and leading exporters of petroleum products in the UAE.

Digital Reinvention goes much further. It involves fundamentally reimagining the way a business operates and engages with its stakeholders. It relies on a range of digital applications and technologies supporting the construction of deep, collaborative relationships through fully integrated ecosystems in which customers and partners participate at will. Within that context, Digital Reinvention requires rethinking how petroleum organizations operate and engage with their partners, customers and the environment as a whole.

For example, blockchain is a disruptive technology that can help address multiple inefficiencies and associated lost productivity while increasing operating transparency across an ecosystem. BP, Shell and Statoil have joined forces to develop a blockchain-based trading platform.[10]

Petroleum leaders with digital advantages

How can petroleum companies best respond to disruption through Digital Reinvention? To help answer this question, we identified a small group of petroleum outperformers, consisting of 24 percent of our sample. This group was more effective than its peers, on average, across ten activities:

- Improving asset productivity
- Recruiting, retaining and training talent
- Investing in innovation and research and development
- Capturing real-time, accurate performance and maintenance data at the point of occurrence (for example, platform, rig or field)
- Controlling costs
- Monitoring and remediating health, safety and environmental risks
- Finding new sources of energy
- Becoming customer-centric
- Pursuing mergers, acquisitions and divestitures
- Addressing competition from new technologies.

Petroleum outperformers also report that they delivered 150 percent better revenue growth, 121 percent higher profitability and 131 percent greater efficiency than their industry peers. When compared to their peers, 36 percent more of these outperformers develop digital strategies and execution plans – and say they are better prepared to implement digital technologies. For example:

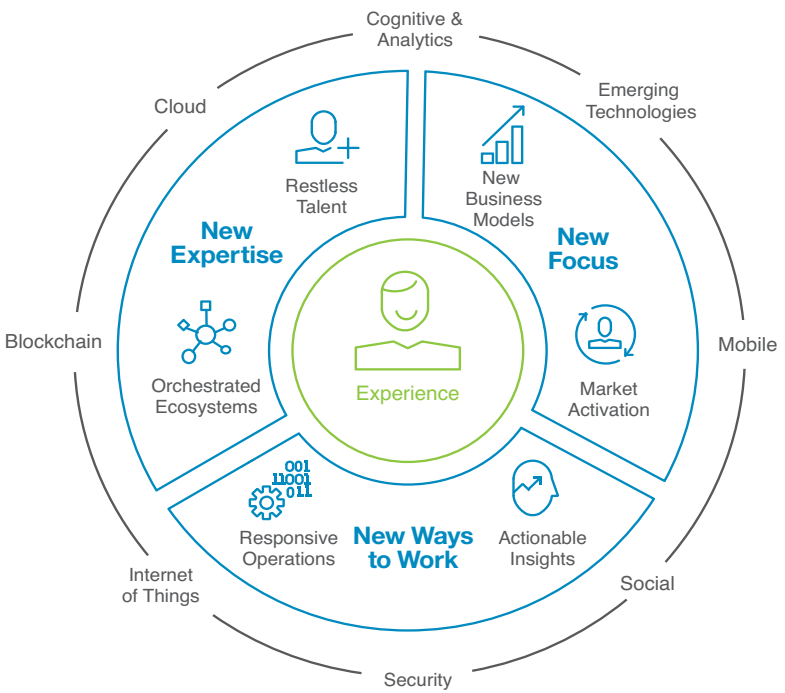
- 78 percent have a transformational vision for the use of digital technologies
- 74 percent support the shift to digital technologies with change management
- 84 percent have identified which business processes can be augmented with digital technologies
- 88 percent track the impact of digital technologies across their businesses.

Readying for reinvention

For successful Digital Reinvention, organizations need to pursue a new strategic focus, establish new ways of working and build new expertise (see Figure 5).

Figure 5

Digital Reinvention framework



Source: IBV analysis.

Pursue a new focus

Petroleum businesses need to develop new ways of realizing and monetizing value. Initiatives might include spawning new business models, accelerating innovation and new product development, and developing better, more holistic ways of conducting risk assessments. Leaders will also need to create strategies and execution plans to deliver deep, contextual experiences, for both B2B clients and end consumers.

The outperforming group sees cloud computing, the IoT and cognitive computing as essential for new business models and innovation (see Figure 6). And, when compared to their peers, 94 percent more of them have integrated their front and back offices.

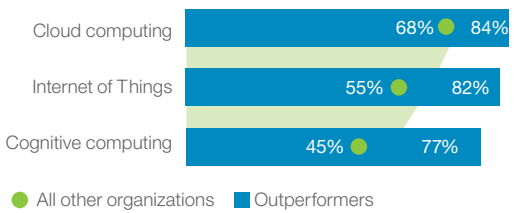
Establish new ways of working

Petroleum businesses need to digitize products, services and processes that redefine customer experiences. They should augment these steps with digital technologies to create fully integrated, flexible and agile operating environments. Outperformers report embracing these digital technologies at higher rates than their peers, including:

- Cloud computing (18 percent more)
- The IoT (105 percent more)
- Mobile (80 percent more)
- Predictive analytics (78 percent more).

Figure 6

Outperformers expect several technologies to help them create new business models

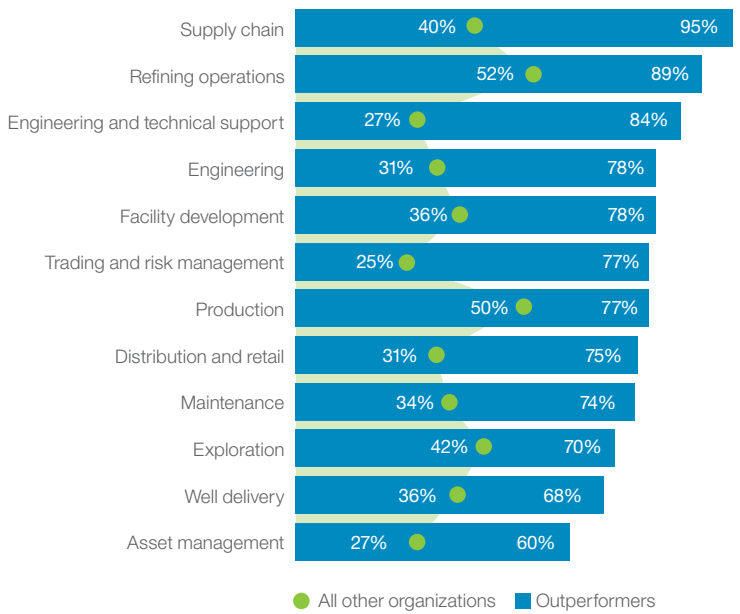


Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

And outperformers are applying digital technologies across their value chains (see Figure 7). For example, cognitive systems help enhance maintenance operations by recognizing failing assets and using augmented reality devices to demonstrate the “next best action” to

Figure 7

Outperformers apply digital technologies holistically across their value chains



Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

engineers. Petroleum companies can use predictive analytics to spot anomalies in the data flow before thresholds are reached. Cognitive computing takes this further by learning new behaviors and trends, and then developing more effective mitigation actions in real time.

In terms of priorities, outperformers deem it most important to apply a combination of cloud, cognitive computing and the IoT to production, supply chain and refining operations. These technologies can help companies explore operational data, reports and lessons learned to detect root causes of production shortfalls and propose best actions to remedy. Cognitive, autonomous supply chains can improve transparency, mitigate risks and disruption, and accelerate decision making using real-time advanced analytics. Digital technologies can improve refining operations by helping to determine whether expensive assets are being used in the right place at the right time, and by helping to deliver the right product mix.

Outperformers have also established data management and governance to support Digital Reinvention by employing a Chief Data Officer (CDO) or equivalent. This CDO defines, develops and implements strategy and methods to acquire, manage, analyze and govern data.

More than twice as many outperformers have a CDO relative to their peers (37 percent versus 16 percent). And 64 percent supplement their CDO with a business-driven information governance committee, compared to just 44 percent of peers. Forty-eight percent of outperformers have also implemented an enterprise data warehouse to manage the deluge of data, versus 34 percent of peers.

Outperformers have also made changes to their operating model. Compared to their peers, 42 percent more of them report creating service scalability by forming centers of excellence for analytics and cognitive computing.

Build new expertise

Petroleum businesses need to identify, retain and build the necessary talent to create and sustain a digital organization. The most successful among these will perpetuate innovation-infused cultures incorporating design thinking, agile working and fearless experimentation. Leaders should also contextualize organizational priorities within business ecosystems, seeking new forms of partnering and new ways to build value within new systems of engagement.

Outperformers recognize that employee roles and skills need to evolve, and they have taken concrete steps to improve talent, including:

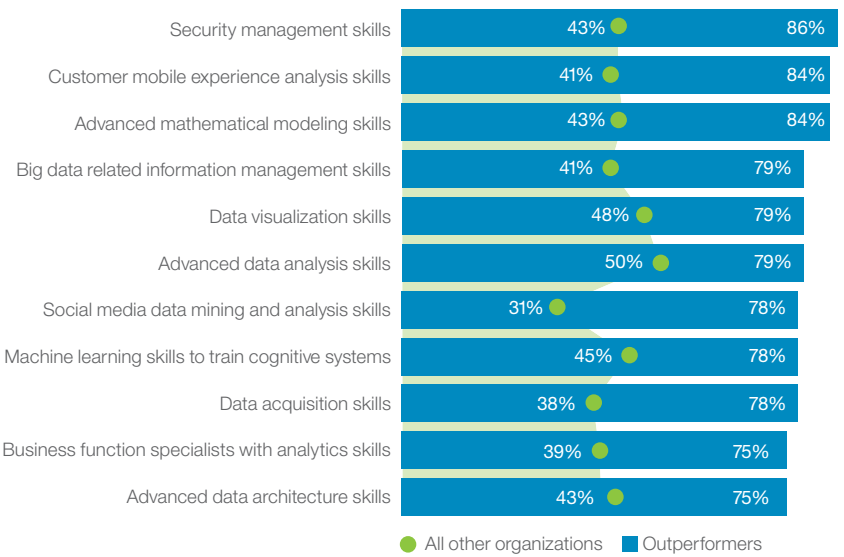
- Committing to driving a digital culture (88 percent)
- Training employees on engaging with digital technologies (85 percent)
- Incubating startups to gain access to external digital talent (79 percent)
- Targeting acquisitions for digital skills (78 percent)
- Implementing development programs, such as reverse mentoring with millennial employees (78 percent).

With the transition to digital technologies, outperformers also recognize the need to acquire talent that can move initiatives forward, including “new collar” skills that may not require a traditional college degree. As such, 103 percent more of them report digitizing the recruitment process compared to their peers. And they established new centers in talent 37 percent more frequently.

Outperformers also recognize the need for specialized skills (see Figure 8).

Figure 8

Outperformers have the new skills to support Digital Reinvention



Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

Schlumberger creates a cognitive exploration and production environment

With offices in Paris, Houston, London and The Hague, Schlumberger, a provider of technology for reservoir characterization, drilling, production and processing to the oil and gas industry, has established a cognitive explorations and production (E&P) environment named DELFI. This environment enables collaboration and leverages the potential of all available data and science to optimize E&P assets. The DELFI environment encompasses digital technologies such as security, analytics and machine learning, high performance computing and the IoT to improve operational efficiency and deliver optimized production at the lowest cost per barrel. The environment also provides a new way of working for asset teams by strengthening integration between geophysics, geology, reservoir engineering, drilling and production domains.[11]

Finally, outperformers collaborate more frequently to employ digital technologies. Ecosystem partners provide a pipeline to technology, data and skills. Outperformers often partner with technology firms (85 percent versus 33 percent for peers) and create other new partnerships to improve operational efficiency (59 percent versus 37 percent for peers). They share people with their partners 89 percent more frequently, and share physical assets such as rigs or spare parts with partners 107 percent more often.

Statoil and GE, for example, launched the Powering Collaboration initiative in 2016 to accelerate development of more environmentally and economically sustainable energy solutions. The joint program blends expertise and resources of both companies to develop new industry solutions. Progress has been made in projects that reduce carbon dioxide and methane emissions from oil and gas production and improve water management.[12]

Adopt a self-funding approach

Leaders deploy technology to drive optimization, support scalable growth and maintain market share. They typically pursue digital investments related to their previous successes, which can fund future innovation – in a virtuous cycle of innovation, return and investment.

Surfing the digital wave

To advance Digital Reinvention, petroleum companies can take four initial steps.

Step 1: Envision possibilities
Conduct envisioning sessions based on design thinking to produce a definitive reinvention blueprint. For example, through deep conversations and in-depth marketing analysis, develop a better understanding of customer needs, aspirations and desires; brainstorm new ideas to enhance engagement; and visualize unexpected customer scenarios. Incorporate external stakeholders in sessions, including customers, to encourage thinking beyond business-as-usual.

Step 2: Create pilots
Develop prototypes using agile development, test them with customers and go to market quickly to elicit feedback and iteration. Establish communities of interest to create "safe" environments to beta test innovations, and incorporate them as a central part of design and development processes. For example, petroleum companies could evaluate pilots that focus on personalized customer experiences, improved asset management or wearables to improve field safety.

Step 3: Deepen capabilities
Augment digital capabilities with strategic initiatives. Continue to build and deploy necessary applications aligned to the target Digital Reinvention operating models and ecosystem strategies. As pilots evolve, adopt a continuous, iterative strategy to address limitations by building new or extending existing capabilities.

Step 4: Orchestrate ecosystems
Embrace a strategy based on holistic reinvention rather than a series of point solutions, maintaining a clear focus on deep needs, aspirations, or desires of customers, partners and others, such as service providers. Use ecosystems to expand and align broad sets of capabilities to help deliver on customer promises.

Woodside Energy uses analytics to dramatically improve facilities construction

Australia's Woodside Energy is using sophisticated data analytics and cognitive computing based on more than 30 years of knowledge and data to design, fabricate and construct major oil and gas facilities. Instead of combing through technical evaluations, reports and decision logs, employees use cognitive systems to source answers and critical information as required. Woodside is able to digitally combine information from millions of reports and the best advice of thousands of engineers in a contextually relevant manner, enabling employees to quickly obtain the right advice in any situation.[13]

Key questions

- How can you create an ambitious digital strategy to deal with disruption?
- In what ways can your organization become more agile in its response to unexpected challenges and opportunities?
- How can your workforce better embrace new ways of working and new strategic priorities?
- Which actions can help your leadership become more visionary, conceiving what customers want before they know it themselves?
- How will you use automation, wearables, IoT and robotics to improve operational efficiency?

Related reports

Lin, Spencer, Santosh Mulayath, David M. Womack and Ash Zaheer. "Turning data into chemicals and petroleum insights: How the industry is becoming cognitive." IBM Institute for Business Value. May 2017. https://www-935.ibm.com/services/us/gbs/thoughtleadership/chempetrocog/

Womack, David, Richard Cave, Mike Foden and Matthew Stent. "Exploring the power of cognitive IoT: Generating timely action in oil and gas." IBM Chemicals & Petroleum. October 2016. https://www-935.ibm.com/industries/chemicalspetroleum/assets/IBM_Whitepaper_Exploring_the_power_of_cognitive_IoT.pdf

Marshall, Anthony, Cor van der Struijf and David M. Womack. "Innovating chemicals and petroleum: Revenue and efficiency in a volatile age." IBM Institute for Business Value. May 2016. https://www-935.ibm.com/services/us/gbs/thoughtleadership/innovatingchemicals/

Berman, Saul J., Peter J. Korsten and Anthony Marshall. "Digital Reinvention in action: What to do and how to make it happen." IBM Institute for Business Value. May 2016. https://www-935.ibm.com/services/us/gbs/thoughtleadership/draction/

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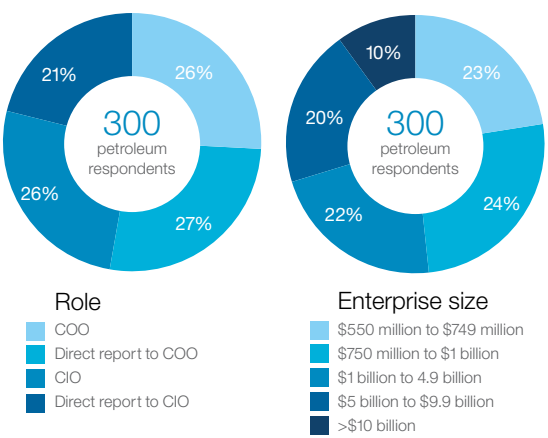
Study approach

In cooperation with Oxford Economics, the IBM Institute for Business Value surveyed 600 global executives in the chemicals and petroleum industries in the IBM Chemicals and Petroleum Digital Transformation Study. Responding executive roles included COOs and CIOs, and their direct reports. In total, 300 petroleum respondents participated in the study – 26 percent from North America, 5 percent from South America, 33 percent from Europe, 11 percent from the Middle East and Africa, and 25 percent from Asia Pacific.



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Notes and sources

1 Kellner, Tomas. "This Software Can Read the Minds of Giant Subsea Machines." General Electric website. May 2014. http://www.gereports.com/post/85022863645/this-software-can-read-the-minds-of-giant-subsea

2 Ungerleider, Neal. "Oil Giant BP Is First Company Approved to Use Commercial Drones." Fast Company. June 10, 2014. http://www.fastcompany.com/3031725/fast-feed/oil-giant-bp-is-first-company-approved-to-use-commercial-drones

3 "Quantico Energy Solutions." Quantico Energy website. October 2017. http://www.quanticoenergy.com/

4 "About Us." MicroSeismic website. October 2017. http://www.microseismic.com/about/

5 "Global Ecosystem Survey." IBM Institute for Business Value in collaboration with the Economist Intelligence Unit. 2016. Unpublished data.

6 Ibid.

7 Ibid.

8 Berman, Saul J., Peter J. Korsten and Anthony Marshall. "Digital Reinvention in action: What to do and how to make it happen." IBM Institute for Business Value. December 2016. https://www-935.ibm.com/services/us/gbs/thoughtleadership/draction/; Berman, Saul J., Nadia Leonelli and Anthony Marshall. "Digital Reinvention: Preparing for a very different tomorrow." IBM Institute for Business Value. December 2013. https://www-935.ibm.com/services/us/gbs/thoughtleadership/digitalreinvention/

9 "BizVibe's Latest B2B Networking Platform Creates a Global Community for Petroleum Suppliers in the UAE." Business Wire website. October 2017. http://www.businesswire.com/news/home/20171011006331/en/

10 Edwardes-Evans, Henry. "BP, Shell, Statoil join forces to develop blockchain-based trading platform." S&P Global Platts. November 6, 2017. https://www.platts.com/latest-news/oil/london/bp-shell-statoil-join-forces-to-develop-blockchain-27885836

11 "Schlumberger Announces DELFI Cognitive E&P Environment." Schlumberger website. September 2017. http://www.slb.com/news/press_releases/2017/2017_0913_delfi_pr.aspx

12 Sundararajan, Kishore. "When the going gets tough, the tough collaborate." GE website. May 2016. https://www.geoilandgas.com/our-voice/when-going-gets-tough-tough-collaborate; "Powering collaboration with GE." Statoil website. October 2017. https://www.statoil.com/en/how-and-why/powering-collaboration-with-ge.html

13 "Tap into tribal knowledge: How Woodside Energy outthinks uncertainty with Watson." Medium website. August 2016. https://medium.com/cognitivebusiness/tap-into-your-tribal-knowledge-48a3786df081; Crozier, Ry. "Inside Woodside's business case for Watson." IT News. October 2016. https://www.itnews.com.au/feature/inside-woodsides-business-case-for-watson-440186

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