2017 Annual Report

Schlumberger Limited

Schlumberger

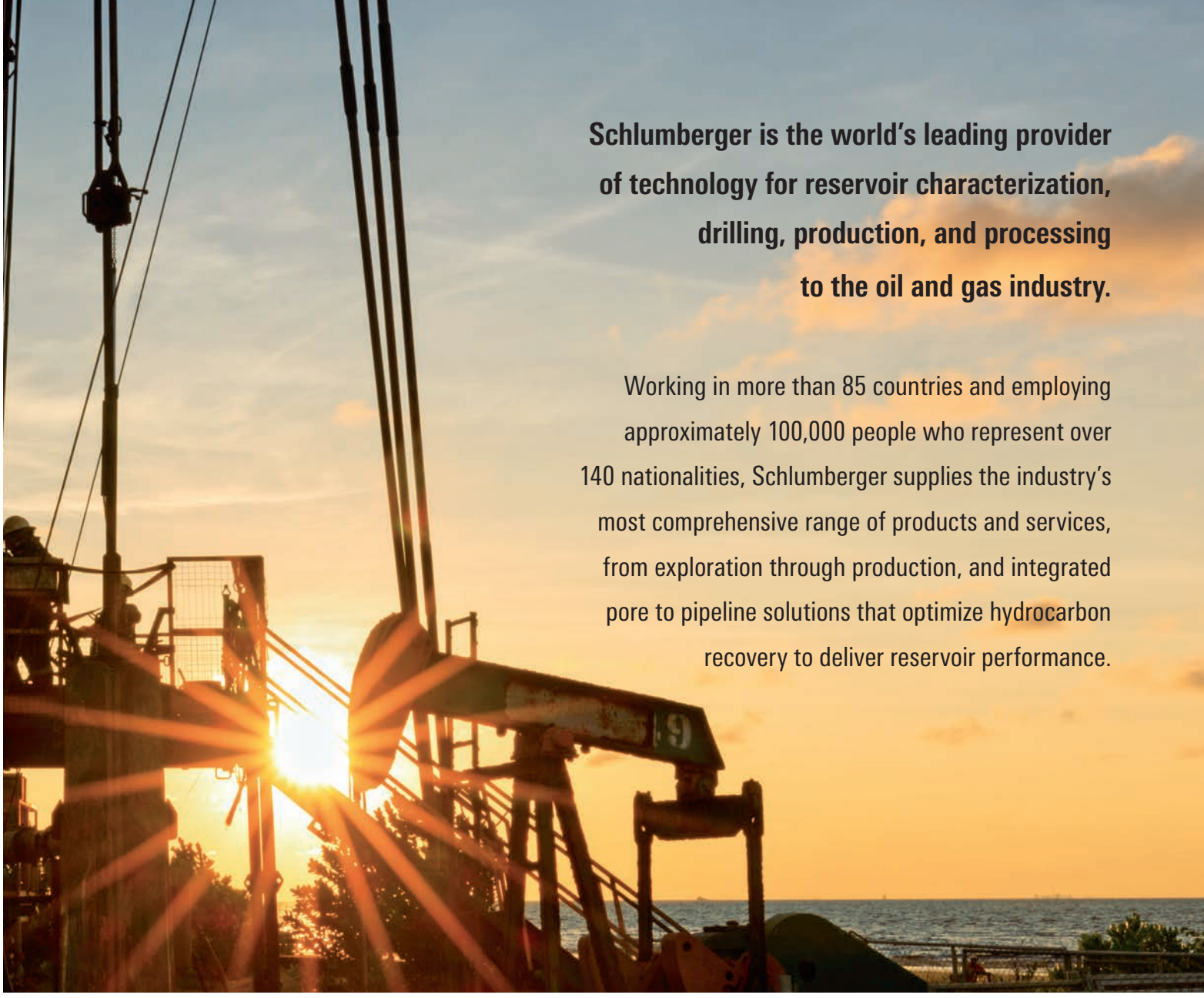
Financial Performance

(Stated in millions, except per-share amounts)

Year ended December 31	**2017**	2016	2015
Revenue	**$ 30,440**	$ 27,810	$ 35,475
Net income (loss) attributable to Schlumberger	**$ (1,505)**	$ (1,687)	$ 2,072
Diluted earnings (loss) per share	**$ (1.08)**	$ (1.24)	$ 1.63
Cash dividends per share	**$ 2.00**	$ 2.00	$ 2.00
Cash flow from operations	**$ 5,663**	$ 6,261	$ 8,805

Safety Performance

Year ended December 31	**2017**	2016	2015
Combined Lost Time Injury Frequency (CLTIF)—Industry Recognized	**0.90**	0.90	0.95
Auto Accident Rate mile (AARm)—Industry Recognized	**0.34**	0.25	0.21



Schlumberger is the world's leading provider of technology for reservoir characterization, drilling, production, and processing to the oil and gas industry.

Working in more than 85 countries and employing approximately 100,000 people who represent over 140 nationalities, Schlumberger supplies the industry's most comprehensive range of products and services, from exploration through production, and integrated pore to pipeline solutions that optimize hydrocarbon recovery to deliver reservoir performance.

Front Cover

Digital technology is helping the E&P industry make better use of all the data and expertise it possesses by getting the right information to the right people at the right time. Engineers will be able to use digital well construction planning and operations software in the DELFI* cognitive E&P environment to enhance collaboration and optimize the drilling process. For example, the DrillPlan* digital well construction planning solution provides a new way of working for drilling engineers in the field collaborating with domain experts at remote monitoring centers.

Inside Front Cover

The sun sets on an Integrated Production Services well intervention plug and abandonment operation in Brunei.

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Letter to Shareholders

In 2017, Schlumberger celebrated the 90th anniversary of the first well logging survey, which took place in the Pechelbronn oil field in France in September 1927. This log established the science of subsurface metrology and provided the impetus for the business venture that eventually became Schlumberger.

Paal Kibsgaard
Chairman and Chief Executive Officer

Schlumberger full-year 2017 revenue of $30.4 billion increased 9% year on year. This reflects a full year of activity from the acquired Cameron businesses compared with only three quarters of activity in 2016. In addition to the impact of Cameron, revenue growth was driven by unconventional land resource developments in North America due to the recovery in activity combined with market share gains and improved pricing as the oil and gas industry began to emerge from the longest and deepest downturn in 30 years.

Following two successive years of E&P investment cuts, operators increased their upstream spend in North America by more than 30% in 2017. The increase in oil price afforded by the OPEC agreement gave US producers a means to increase their investment in tight oil. However, apprehension related to growing US supply, and uncertainty surrounding the duration of OPEC- and Russia-led production cuts held international spending to a level 3% below 2016.

During 2017, the outlook improved for international markets, evidenced by a significant increase in the sanctioning of new projects. The number of final investment decisions tripled in 2017 compared with 2016, with 75% of the new projects planned for shallow and deepwater offshore environments.

After starting the year at $55 per barrel, Brent prices fell to $44 in June and then recovered to $67 by the end of the year. The price increase resulted from 2017 demand growth of 1.5 million barrels per day and strong adherence to a production agreement between OPEC and Russia, which served to reduce oil production by an average of 1.6 million barrels per day compared with the fourth quarter of 2016. Strong demand and restricted supply accelerated the depletion of stocks as the year progressed. By September, OECD crude and product stocks had returned to 2015 levels.

As the oil market began to rebalance in 2017, replacement of conventional oil reserves remained a challenge. In 2017, discoveries were at an all-time low due to lower exploration activity, and more than 60% of discovered resources were gas. Oil discoveries accounted for only 3.4 billion barrels—while about 30 billion barrels of conventional oil is produced each year—representing a reserves replacement ratio of only 11%.

In the natural gas markets, low Henry Hub prices and flat domestic consumption allowed the US to transition from importer to exporter of natural gas for the first time since 1957, and Liquefied Natural Gas was the enabler. Global LNG trading increased 11% year on year driven by demand in Asia. LNG supply growth was also strong, with the addition of six new liquefaction trains in 2017. In today's well-supplied market, both producers and consumers are reluctant to invest in new projects. While the short-term market outlook remains challenged, strong longer-term demand growth signals a future need for new LNG supply capacity.

Schlumberger financial performance in 2017 was driven by land activity in North America, where revenue increased over 80% in line with the average rig count increase. Continued expansion of the Schlumberger hydraulic fracturing presence in North America resulted in additional fleet redeployments, which benefited the Production Group. Drilling Group revenue in North America land increased due to the continuing high demand for longer horizontal lateral sections in shale oil wells. Increased Cameron Surface and Drilling Systems product sales and services also contributed to the strong financial performance in North America. North America revenue, including offshore, grew 42% year on year.

International revenue decreased 2% compared with 2016. This decline was driven by soft demand for exploration- and development-related products and services as E&P budgets remained tight. Activity in Latin America decreased due to the Schlumberger decision to align operations with cash collections in Venezuela. Robust activity in the Middle East and Russia, driven by integrated drilling and production projects, as well as an additional quarter of activity from the acquired Cameron businesses partially offset these decreases.

During the past three years of unprecedented market downturn, Schlumberger has proactively sought to strengthen its technology offering and presence in key markets around the world. The most recent example is the expansion of its hydraulic fracturing presence in North America land through the purchase of the US fracturing and pumpdown perforating businesses from Weatherford. In line with the challenging business environment, over the same period Schlumberger has restructured all relevant parts of the company in terms of both size and organizational structure to maximize its market competitiveness and operational agility.

With the significant changes seen in customer priorities and buying habits in recent years, Schlumberger has continued to evaluate the present and future return prospects for all of its product lines as it seeks to maximize its long-term financial performance. Based on this in-depth analysis, Schlumberger identified the seismic acquisition business as the only product line that does not meet Schlumberger return expectations going forward, even after factoring in an eventual market recovery. Schlumberger has, therefore, taken the difficult decision to exit the marine and land seismic acquisition market and instead operate the WesternGeco product line as an asset-light business, built on its leading position within multiclient, data processing, and geophysical interpretation.

Looking at the oil market, the strong growth in demand is projected to continue in 2018 on the back of a robust global economy. On the supply side, the extension of the OPEC- and Russia-led production

cuts is already translating into higher-than-expected inventory draws. In North America, 2018 shale oil production is set for another year of strong growth as the positive oil market sentiments will likely increase both investment appetite and availability of financing. At the same time, the production base in the rest of the world is showing fatigue after three years of unprecedented underinvestment. The underlying signs of weakness will likely become more evident in the coming year as the production additions from investments made in the previous upcycle start to noticeably fall off. Taken together, this means the oil market is now in balance and the previous over-supply discount is gradually being replaced by a market tightness premium, which makes Schlumberger increasingly positive on the global outlook for its business.

> “Schlumberger financial performance in 2017 was driven by land activity in North America, where revenue increased over 80% in line with the average rig count increase.”

This year, new technology sales from all Groups contributed to 24% of total sales, which is a 4% increase over the previous year. The Schlumberger commitment to developing innovative technology included commercialization of key technologies such as the DELFI cognitive E&P environment, which enables collaboration across E&P teams and leverages the full potential of all available data and science to optimize assets; DrillPlan digital well construction planning solution, the first application in the DELFI environment; and Lift IQ* production life cycle management service that provides monitoring, diagnostics, and optimization of artificial lift systems in real time.

One measure of our health and safety performance held steady as our combined lost time injury frequency was the same as 2016. Although Schlumberger maintains a constant focus on safety, our auto accident injury rate deteriorated slightly compared with 2016. Regretfully, we suffered one driving-related fatality in North America involving a contractor. We will continue to guard against the risks that road journeys present by seeking continuous improvement of the measures we have in place to keep our people safe through our global network of Journey Management Centers.

Over the last few years, our transformation efforts have resulted in the design of a new way of working through which our operational processes have been reengineered and our product lines and GeoMarket* organizations restructured. In 2017, we completed the first deployment phase of our SAP-based IT system in North America and continued to see service delivery efficiency gains due to improved resource planning and delivery and reliability-centered asset engineering, manufacturing, and maintenance. This new way of working at Schlumberger is a comprehensive program of change that is being systematically deployed around the globe.

This year also marked the third release of the Schlumberger Global Stewardship Report, the results of which are filed with seven major environmental, social, and governance (ESG) rating agencies. The report details our ESG program, the seeds of which began with initiatives launched nearly 20 years ago.

We believe that the oil market is now in balance as the previous oversupply discount is gradually being replaced by a market tightness premium. We expect to see increases in E&P investment in the main producing regions around the world to replace production that has been lost because of natural decline.

On behalf of Schlumberger people around the world, I want to thank our stakeholders for their confidence and support. I also want to personally thank our employees for their dedication and commitment.

Paal Kibsgaard
Chairman and Chief Executive Officer

Performed by Schlumberger

The Achieving Excellence: The Longest Well Ever team received the Performed by Schlumberger Award from Chairman and CEO Paal Kibsgaard (far left) and Senior VP of Marketing & Technology Justin Rounce (third from left). Also pictured, from the left, Jon Acquaviva, Dmitriy Kofman, Sheldon Rawlins, Jimmy Varughese, Danil Zazulya, Catherine MacGregor, and Richard Brown.

Schlumberger people have a steadfast commitment to customers, innovative technology, safety, and quality. We are people who thrive on the challenge to excel in our quest to exceed expectations. In 2001, the company established the Performed by Schlumberger program to recognize projects and their team members who have demonstrated exceptional levels of teamwork, innovation, and business impact for Schlumberger and its customers.

In 2017, 444 projects competed for the Chairman's Award. As the program's highest honor, the award recognizes one project as an outstanding example of the company's core values: our people, our commitment to technology, and our determination to produce superior profits.

The team for the Achieving Excellence: The Longest Well Ever project won this year's Chairman's Award for its work with the Sakhalin-1 Consortium to drill a 49,212-ft extended-reach well on the Orlan Platform offshore Sakhalin, Russia.

This set a new benchmark for extended-reach drilling that exceeds the previous record by 4,921 ft. Historically, new drilling records have been characterized by incremental gains in measured depth, and this new benchmark was achieved in a technically challenging subarctic, frontier environment.

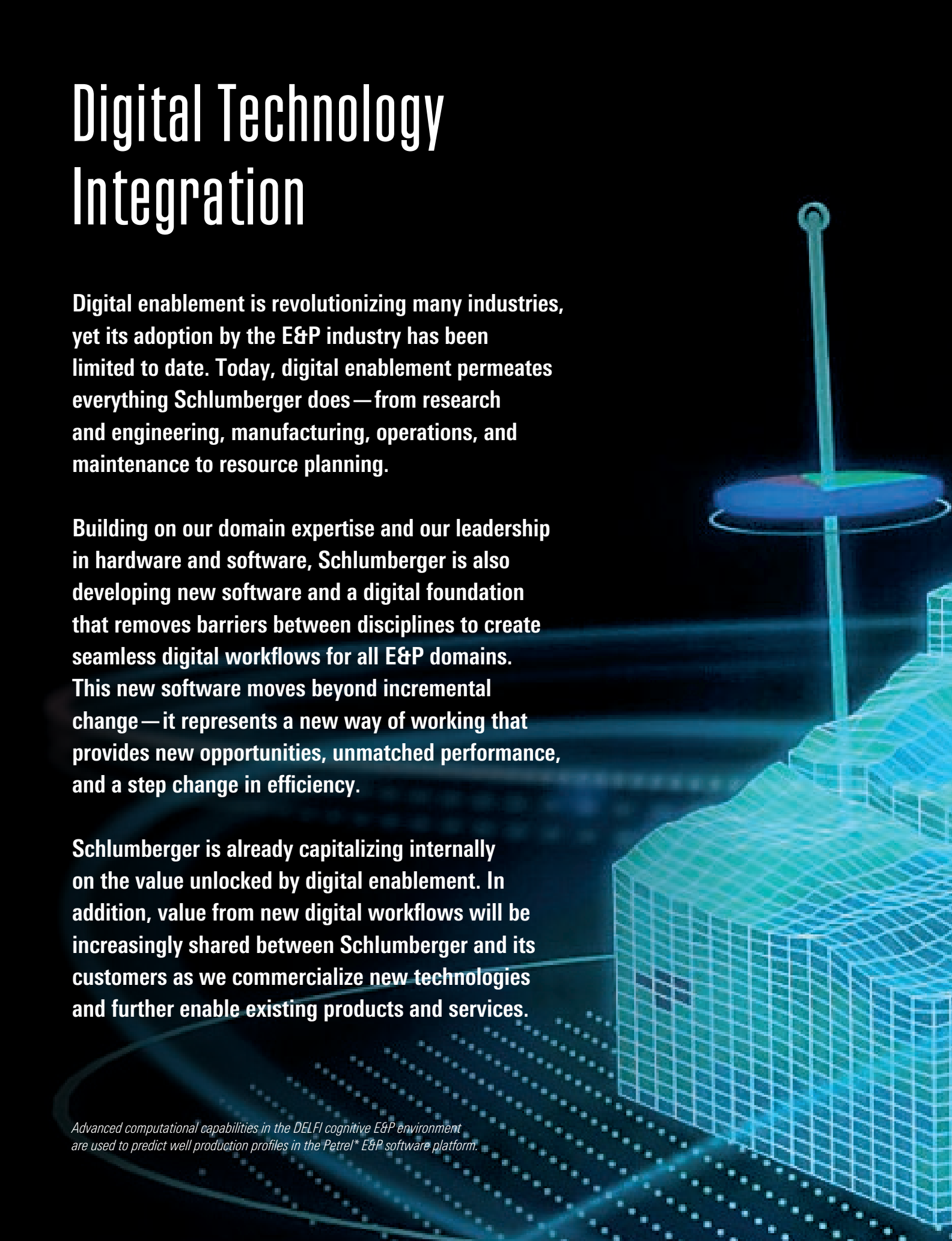
The Sakhalin Extended-Reach Drilling Center of Excellence integrated the domain expertise and technology from 10 Schlumberger product lines and worked closely with the Sakhalin-1 Consortium during the two years it took to plan and drill this well in the Chayvo field—with drilling completed in 103 days. This successful collaboration achieved a 37% increase in the rate of penetration compared with the previous extended-reach drilling record from 2015.

Digital Technology Integration

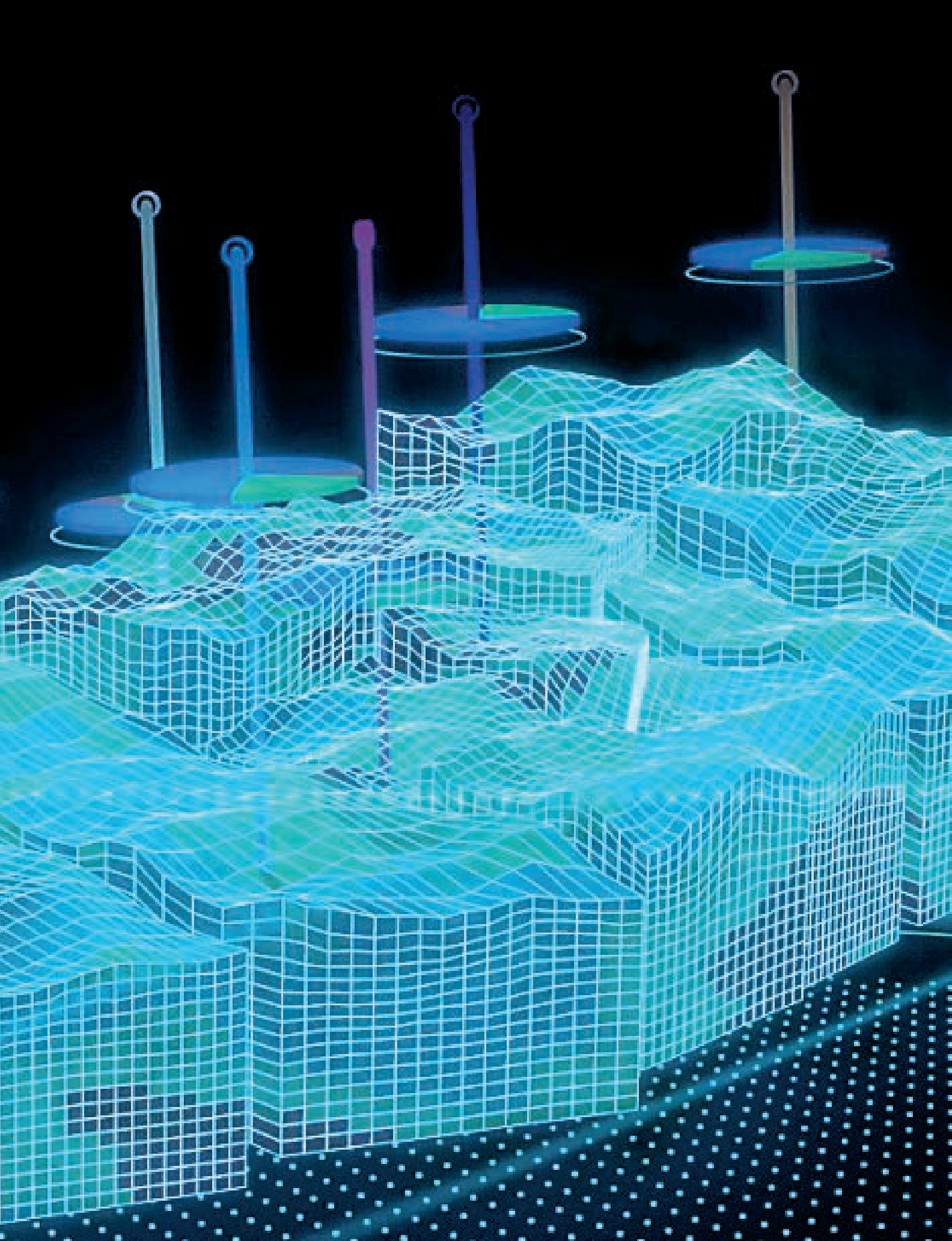
Digital enablement is revolutionizing many industries, yet its adoption by the E&P industry has been limited to date. Today, digital enablement permeates everything Schlumberger does—from research and engineering, manufacturing, operations, and maintenance to resource planning.

Building on our domain expertise and our leadership in hardware and software, Schlumberger is also developing new software and a digital foundation that removes barriers between disciplines to create seamless digital workflows for all E&P domains. This new software moves beyond incremental change—it represents a new way of working that provides new opportunities, unmatched performance, and a step change in efficiency.

Schlumberger is already capitalizing internally on the value unlocked by digital enablement. In addition, value from new digital workflows will be increasingly shared between Schlumberger and its customers as we commercialize new technologies and further enable existing products and services.



Advanced computational capabilities in the DELFI cognitive E&P environment are used to predict well production profiles in the Petrel E&P software platform.*



Establish a New Way of Working

In a medium-for-longer oil price environment, increased demand for oil requires investment in technology and business models that will improve efficiency and enable unprecedented levels of integration and collaboration. The development of digital technology is disrupting the traditional way of working in the oil and gas industry and creating a step change in operational and business performance for both Schlumberger and its customers.

Although digital technology has been integrated into nearly every facet of our personal lives, its adoption in the E&P industry has been limited. The industry's traditional way of working presents barriers to the sharing of data and technical knowledge among the domain experts who make important decisions directing the discovery and development of oil and gas resources. Integrating digital technology into E&P workflows requires extensive domain expertise about the entire system—from hardware and software technologies to the complexity of the data and numerous systems involved. To tackle this challenge, Schlumberger has the domain expertise and global experience in every step of the E&P process, a knowledge that stems from our focus on the science of subsurface measurement since the company's foundation.

In addition, the current medium-for-longer oil price environment demands a new approach for the E&P industry. This new approach requires a system-level view to fully optimize the finding, development, and production of new oil and gas resources as well as the operation of existing oil and gas fields. Innovation around a single element of the E&P development chain cannot maximize efficiency if done in isolation. The new approach requires a complete understanding of what each element contributes to the entire chain. Schlumberger believes that achieving this will require a profound change in the way the industry operates and interacts—changing the way we work and yet also changing the very nature of that work.

Achieving change entails a new collaborative mindset, end-to-end systems knowledge, and redesigned business models that firmly establish and support new ways of working based on innovative technology and domain expertise.

> "Over the last three years, Schlumberger has created technology centers that innovate within the rapidly evolving world of digital technology and automation."

Over the last three years, Schlumberger has created technology centers that innovate within the rapidly evolving world of digital technology and automation. In line with our long history of working with research and engineering partners, these centers have formed strong relationships with an extensive network of leading digital technology companies, creating building blocks of expertise in areas such as cloud technology, data analytics, machine learning, artificial intelligence, robotics, and automation.

Through this ecosystem of extended knowledge, Schlumberger now has deeper access to the best and most advanced digital technologies and capabilities available today. Together with our partners, we are developing the solutions we believe will meet the industry's needs.

System-Level Optimization

Although data is at the center of E&P development, some exploration wells fall short of their objectives as a result of unexpected geology or unanticipated hazards. Increasing the volume and quality of accessible data equips the E&P industry to make better-informed decisions that reduce subsurface risk, optimize production, and maximize recovery—but only if that data is efficiently managed.

Petrotechnical experts working on exploration projects spend more than half of their time finding and preparing the data they need to make their decisions. The subsequent data interpretation is also very time consuming, and these interpretations drive important decisions for the reservoir's development plan.

Changing the way the industry works begins with a critical assessment of how the data is used across reservoir characterization, well construction, and field production. During the development process as it is practiced today, different types of data exist in silos, making holistic analysis impossible. Without a system approach, precious information and time are lost because the lack of interface among different systems makes it difficult to share localized knowledge.

The DELFI cognitive E&P environment was developed to enable a new way of working. As the first of its kind in the oil and gas industry, this secure, cloud-based environment harnesses data, scientific knowledge, and domain expertise to fundamentally change the industry's way of working. The new DELFI environment makes applications and workflows accessible to every user. Gone are the impenetrable silos, because in the DELFI environment, every stakeholder can build common workspaces for data, models, and interpretations while respecting proprietary information boundaries.

A geophysicist working in the DELFI environment selects data from different sources in the E&P Data Lake by searching its global multiclient library. By visualizing integrated data models, the geophysicist can enhance his understanding of the subsurface in a specific area of interest.

The DELFI environment provides the best possible representation of the surface and subsurface, including existing wells and facilities, plus those that are planned. The outcome is shared insight among all users and among all stakeholders to eliminate the silos of today. Performance is boosted as time cycles are compressed across the business, uncertainty in planning is reduced through greater understanding, and new opportunities are created to extend domain science into drilling and production operations. Everything working together enhances business value for both Schlumberger and its customers.

When Schlumberger launched the DELFI environment, the company deployed an E&P Data Lake on the Google Cloud Platform, which includes more than 1,000 3D seismic surveys, 5 million wells, 1 million well logs, and 400 million production records from around the world. This Data Lake makes data from different sources available through a common interface, making it easier for users to discover what the data is, have access to it, and use it to maximum advantage. As they work with this vast amount of information in the cloud, the result is a step change in scalability and performance.

The DELFI environment leverages data analytics, machine learning, high performance computing (HPC), and the Internet of things (IoT), all of which work together to maximize operational efficiency and deliver optimized production at the lowest cost per barrel. This environment facilitates a new level of integration among the geophysics, geology, reservoir engineering, drilling, and production domains. There are many workflows throughout exploration and production, and a digital approach accelerates access to all the available data. For that reason, the DELFI environment is also an open and extensible system in which Schlumberger customers and software partners can add their own intellectual property and workflows.

Schlumberger is an early adopter of HPC, and the teams at its technology centers—Menlo Park, California; Houston, Texas; Gatwick, UK; and Mumbai, India—have been leading the application of HPC for seismic processing. Today, Schlumberger has a state-of-the-art HPC infrastructure on the cloud that runs thousands of central processing unit (CPU) and graphics processing unit (GPU) nodes, and it is the largest cloud computer cluster of its kind in the oil and gas industry. Cloud-based HPC creates new opportunities for advanced visualization and machine learning to enhance the value of oil and gas data assets.

But how exactly does the DELFI environment change not just the way of working but also the nature of work? The answer is by enabling working in a common environment as well as creating accessibility and augmented intelligence for information sharing. Data is delivered to the right people at the right time so all recipients can maximize use of the latest information based

on their role and expertise. Barriers to effective communication are eliminated, improving efficiency during the process so domain experts can spend more time on high-level solutions to the unique challenges every reservoir presents. Decisions that used to take days can now be completed in minutes.

The advancement of digital technology enablement within the oil and gas industry sets new demands in terms of cybersecurity. Schlumberger has been providing secure commercial software, information management, and IT infrastructure across the entire E&P life cycle for 35 years. In 2015, Schlumberger obtained Service Organization Controls 2 (SOC 2®) Type 1 and 2 accreditations for cybersecurity through an external audit. The SOC 2 accreditation provides detailed information about the controls Schlumberger has implemented in regard to security, availability, and integrity of the systems the company uses to process customer data as well as the confidentiality and privacy of the information that these systems process.

By working in the DELFI environment, oil and gas experts will be able to connect in a different way to complete shared work goals and expand their sphere of contact to other intellectually challenging domains. They will have access to tools and technologies that relieve them of routine, repetitive tasks, effectively freeing up their valuable time to focus on innovative solutions.

“Schlumberger has been providing secure commercial software, information management, and IT infrastructure across the entire E&P life cycle for 35 years.”

This new way of working is possible only by combining the latest offerings in digital technology with the domain know-how and hardware and software technology leadership that can optimize workflows, increase the efficiency of operations, and ultimately decrease the cost per barrel.

Schlumberger Software Technology Innovation Center

Schlumberger Software Technology Innovation Center (STIC) was established in 2014 with a goal of leading the oilfield digital transformation by taking advantage of technology trends driven by Silicon Valley companies. The center team consists of a highly technical workforce, including Schlumberger experts and recent university graduates. The technical staff includes cloud and big data engineers, user experience (UX) designers, front-end web developers, data scientists, and machine learning experts.

The primary focus of STIC is to deliver technology proof points—working code that leverages new technology applied to oilfield challenges. The center regularly aligns its priorities with stakeholders from the Schlumberger product lines. STIC is closely connected with the Schlumberger software community, hosting hackathons and design sprints to bring engineers, stakeholders, and end users together to accelerate the software-development process.

The center maintains affiliations with earth science, computer science, and computational mathematics departments of Bay Area universities, most notably Stanford. It also partners with companies in Silicon Valley to gain knowledge about how digital technology and infrastructure are applied in other industries. STIC has become a focal point for Schlumberger to communicate its digital vision with customers, with the center frequently hosting meetings and workshops that provide in-depth technical engagement.

Subsurface expert Sergey Doronichev (left) and Data Scientist Vishakh Hegde explore the capabilities of virtual reality for the visualization of 3D seismic surveys at the Schlumberger Software Technology Innovation Center in Menlo Park, California.

Over the past three years, STIC has worked with and evaluated more than 400 companies and pursued projects with over 70 of them. By working together with partners, we continuously learn about new capabilities and opportunities while integrating with the Silicon Valley ecosystem. Through close collaboration with these digital technology partners, Schlumberger is able to develop digital technology solutions in less time, thus reducing the development lead time. This is our new way of working for technology development.

Reduce Uncertainty, Accelerate Decision Making

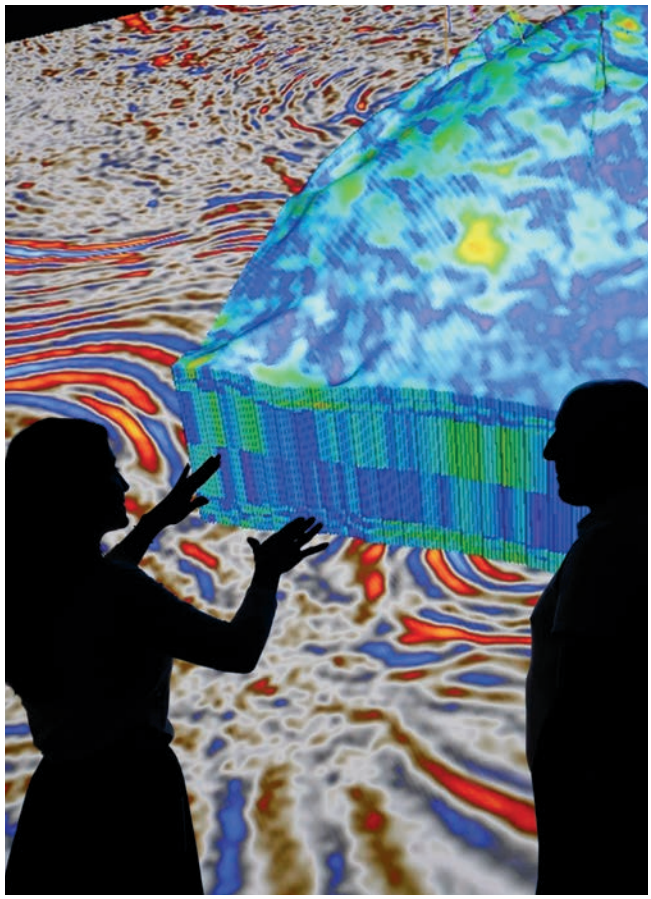
The first step in the E&P development process is to create a digital representation of what is hidden below the Earth's surface. To accomplish that, measurements and data from multiple sources are combined to create a model of the subsurface. Experts from multiple technical domains—geology, geophysics, and petrophysics as well as reservoir, drilling, and production engineering—use their knowledge to further refine the model. This initial combination of measurements and data, along with expert interpretation, are fundamental to some of the most critical decisions about the reservoir—decisions that will affect its entire life cycle.

The Petrel E&P software platform, which has become an industry standard and was introduced in 2003, is also now available in the DELFI environment. The Petrel platform uses a shared-earth approach that enables standardized workflows from exploration to production. Every decision is an informed one that is made with a clear understanding of both opportunities and risks.

Repeatable and automated workflows enable users to capture best practices and share them throughout the organization. Petrotechnical experts and asset teams can analyze, interpret, and model the subsurface in real time in a highly collaborative manner. All of this works together to decrease uncertainty and accelerate the decision-making process, thereby accelerating the time to first oil.

Numerous applications are also available in the DELFI environment for access as required. The Techlog* wellbore software platform for the analysis and validation of wellbore data, the ECLIPSE* industry-reference reservoir simulator, and INTERSECT* high-resolution reservoir simulator for accurate, efficient simulation of reservoir behavior over time are just a few examples. Having global access to applications, instead of the conventional siloed approach, further helps to optimize field development plans and facilities design.

Working in the cloud within the DELFI environment also enables users to take advantage of high performance computing to process large volumes of data during the construction and maintenance of evergreen reservoir models. This includes higher-resolution seismic data, wireline logging of wells, and the testing and characterization of reservoir fluids. Key benefits to working in the cloud environment are fast access to data visualization, interpretation, and application to refine the model during different phases of the E&P life cycle.



Geoscientists review petrophysical measurements and 3D seismic data in the Petrel E&P platform to improve modeling of a complex formation.

Increase Efficiency, Minimize Risks

The software and systems used to drill and complete a well are some of the most complex technologies in the world, crucial to making both the few major development decisions and the millions of small but critical ones that are made daily. Every well drilled comes with a unique set of conditions that also vary during the construction process. The DrillPlan digital well construction planning solution is the first cloud-native application to be launched in the DELFI cognitive E&P environment, providing a radically new way of working to deliver higher-quality drilling programs faster. This is achieved through the automation of repetitive tasks and validation of end-to-end workflows to ensure that the entire plan is coherent.

The DrillPlan solution employs an iterative workflow. As new data is added, the plans improve and future programs can learn from prior experience. This iterative process also improves planning efficiency because any changes to the plan, such as recalculating

the path that the well should follow, can be completed in minutes rather than days. The DrillPlan solution in the DELFI environment enables seamless collaboration between experts, from the geologist to the drilling engineer and production engineer.

The resulting digital drilling plan integrates activities, processes, and people, placing the right information in the right hands at the right time. The DrillPlan solution also monitors deviations from the original plan for continuous improvement via machine learning. When domain experts make dynamic changes to the plan, the software immediately updates the shared-earth model, which also augments learning for the next well plan. By automating repetitive tasks, domain experts have more time to use their advanced skills to create new insights. The result is a drilling program that maximizes accuracy, efficiency, and value at the same time as minimizing risks.

The DrillPlan solution leverages the digital technologies of the Microsoft Azure and the Azure Stack hybrid cloud solution. Interoperability with Microsoft Office 365 and Microsoft Teams empowers new levels of collaboration among teams and stakeholders, significantly improving productivity.

After more than a year of testing by oil and gas companies in the United States and Canada, the DrillPlan solution has proved to be comprehensive and powerful, delivering well planning programs in days rather than weeks. The DrillPlan solution has been available in North America land operations since the fourth quarter of 2017, and Schlumberger continues to develop its functionalities to meet the needs of the global exploration and development market in 2018 and beyond.

In a future that requires increasing production to meet global demand for oil and gas resources, the Schlumberger goal is to reduce the planning process from weeks to days. The digital way of working, such as the DrillPlan solution in the DELFI environment, facilitates that goal by enabling iterative collaboration among team members working on the latest model. This is one example of how Schlumberger is using digital technology to improve collaboration within the industry.

> “The DrillPlan solution has proved to be comprehensive and powerful, delivering well planning programs in days rather than weeks.”

Schlumberger Limited Industrial Internet Center

Located in Sugar Land, Texas, the Schlumberger Limited Industrial Internet Center focuses on architecture and infrastructure development for the cloud, data, industrial Internet of things (IoT), automation, and cybersecurity across multiple platforms. Established in 2016, the center comprises experienced IoT professionals with knowledge of other industries, recent graduates, and personnel from other Schlumberger hardware and software technology centers.

Today, consumer technologies that tap into the IoT include products such as wearable health monitors and smart home appliances. This gives us the ability to connect different types of devices, gather relevant data, and apply analytical techniques to gain valuable insights.

Adopting the IoT in the E&P industry, however, presents several unique challenges. First, there is the nature of oil and gas equipment as well as the broad global footprint of where these operations occur. Then there is the need for data integrity and the highest level of cybersecurity.

Based on a thorough understanding of equipment design, performance factors, and domain use, the center’s team of experts collaborates with other Schlumberger software teams around the globe to establish the infrastructure for a scalable, accessible, and flexible data store—where all the data is shared in a common ecosystem—to enable improved business intelligence.

Internet of Things Production Systems Engineer Miguel Lopez and Automation Engineer Mona El Hares inspect a scanner device used in an application at the Schlumberger Limited Industrial Internet Center in Sugar Land, Texas.

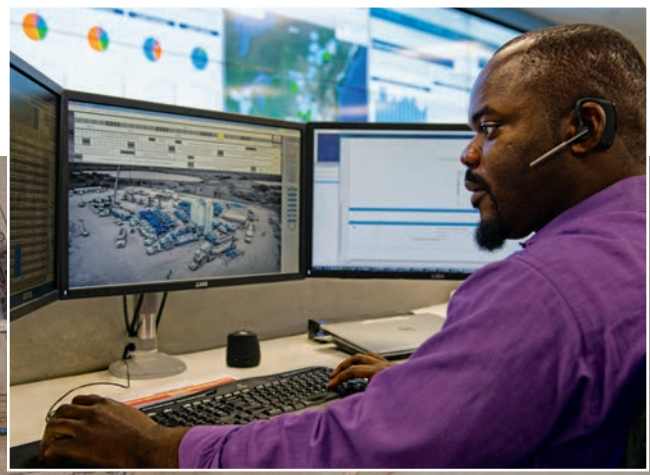
Decrease Cost per Barrel

Schlumberger is committed to technology and processes that enhance efficiency and decrease the cost per barrel. An ongoing consideration is that about 85% of the total cost of ownership (TCO) of tools and equipment accumulates from the moment they are deployed until the day they are retired. Therefore, improving the management of assets throughout their life cycle is a primary concern for Schlumberger and its customers.

The extent of the Schlumberger global footprint provides the scale to take on any size project and the reach to quickly respond to customer needs in any corner of the world. To properly maintain the global fleet of assets that is the basis of these capabilities, Schlumberger relies on its Technology Lifecycle Management (TLM) organization. The organization acts as a bridge between Engineering and Manufacturing and field operations. The TLM organization uses industry-leading maintenance processes and ensures that sustaining activities are aligned with the specific demands that vary among GeoMarket regions.

The goal of the TLM organization is to reduce the TCO of every asset while providing the most reliable tools and equipment to field operations in a timely manner. Monitoring and surveillance use software engines and data science to improve operations reliability and efficiency, which together improve our customers' performance.

One example of how Schlumberger is using TLM to improve asset utilization and reduce TCO is in the deployment of OneStim[SM] products and services on land in North America for unconventional reservoir completions. Fracturing fleets are akin to a high-volume factory where each fleet consists of more than 40 pieces of equipment and 4,000 replaceable components to be maintained on location by a team of 11 crew members. Each well requires four to seven million pounds of sand, which is transported as 140 truckloads or in 35 railroad cars. The equipment and personnel at a fracturing operation are part of a changing worksite environment that needs to move and scale in size for a new location every few weeks.



A maintenance supervisor at the Denton Center of Reliability and Efficiency in Texas oversees remote hydraulic fracturing operations.

A semiautonomous drone hovering over a hydraulic fracturing fleet scans objects to detect fluid levels on equipment that is difficult to access.

Schlumberger manages all of this through distribution control towers and global equipment traceability that tap into streamlined digital supply chain capabilities. Vertical integration of the supply chain adds another dimension through the ability to balance, for instance, our internal supply of sand against external suppliers.

Since 2014, these processes have generated approximately 10% of year-on-year savings in both capital expenditures and maintenance costs. This represents only one example of how digitizing planning and logistics across all functions and product lines can improve efficiency and lower the cost per barrel.

During hydraulic fracturing operations, different types of sensors placed on the high-pressure pumps enable Schlumberger to use data analytics to predict the onset of major component failures before they occur. The data is collected by a remote monitoring center where experts alert field personnel to remove a pump from operations and perform the necessary maintenance before it fails, which significantly reduces maintenance costs as well as the need for backup equipment on location.

This type of predictive health monitoring applied to automatic surveillance further improves equipment reliability. Rather than waiting to resolve an offline pump, Schlumberger can now shorten the time it is offline by performing what is needed to keep it running efficiently.

Another aspect of TLM is a suite of maintenance applications that are part of the Schlumberger Maintenance Tool Ecosystem. For example, at a fracturing wellsite in North America land, two shifts of crew members perform thousands of checks per day. Historically, all the data was recorded by hand. Today, using a highly visual mobile app, maintenance crew members can perform these checks with significant improvement in their productivity.

Data from the mobile app is shared in the cloud along with information from equipment sensors, remote monitoring sites, and maintenance centers. Inventory tracking and reliability data also feed into the cloud to facilitate predictive health maintenance. This ecosystem was deployed globally in 2017 for Well Services but is also being used in other product lines.

Schlumberger-Doll Research Center

Schlumberger has always held the conviction that research is an investment in its future and an essential part of the company's culture. The first Schlumberger research laboratory, founded in 1948 in Ridgefield, Connecticut, focused on a scientific research program assembled by scientist Henri-Georges Doll. The objective of the program was to invent new subsurface measurements that would expand the growing Schlumberger wireline business.

In 1967, the laboratory was renamed the Schlumberger-Doll Research Center in honor of Henri-Georges, who was then the retiring chairman and had been the foremost technical contributor at Schlumberger. In 2007, the center moved to a new facility in Cambridge, Massachusetts, to be closer to a major research hub, including world-renowned universities such as the Massachusetts Institute of Technology (MIT) and Harvard University.

In January 2017, the Schlumberger-Doll Research Center added a robotics department that leverages digital technologies to address the challenges of oilfield operations—from subsea and surface to flexible manufacturing. The rise of robotics and artificial intelligence has sparked a remarkable industrial transformation, and adopting the use of robotics in the oil and gas industry provides another opportunity to reduce operational costs while further improving service quality and safety.

Roboticist Anastasia Mavrommati, Research Scientist Gavin Strunk, and Intelligent Manipulation Program Manager Chris Bogath implement path planning and grasping software changes in a flexible manufacturing demonstrator at the Schlumberger-Doll Research Center in Cambridge, Massachusetts.

The Schlumberger robotics department works closely with academic institutions in Boston and industrial partners around the globe to adapt emerging robotics technology, such as perception, reasoning, communication, and manipulation, to enable system automation for oilfield applications.

OneSubsea Pore to Process Optimization

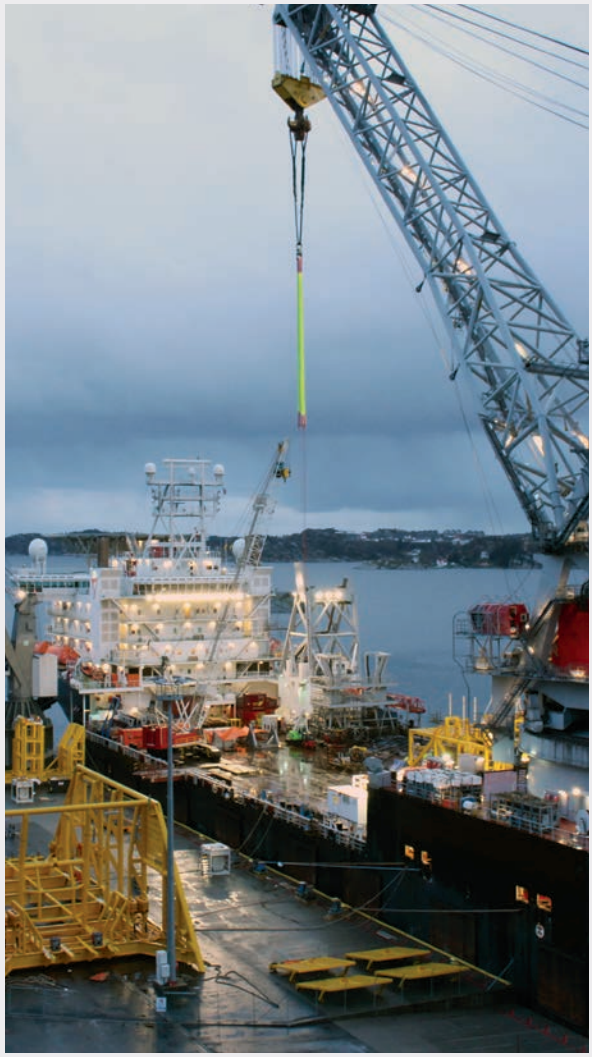
One of the greatest challenges in deepwater oil and gas developments is controlling cost. Digital technology holds the promise of enabling domain experts to detect different ways to reduce cost when designing a subsea system from pore to process. One example could be a reduction in capital expenditure by redesigning the subsea architecture or the topside production system.

OneSubsea Capital-Efficient Solutions extend market-leading subsea boosting technology and are now an integral part of all customer projects. Capital-Efficient Solutions have reduced the average lead times of subsea products by more than 50%, saving up to 60% in project costs. As a portfolio of standardized designs that leverages streamlined engineering and manufacturing processes, OneSubsea delivers integrated subsea production systems that reduce project cycle time and overall cost.

At OneSubsea, early engagement with customers is essential to determine the best way to develop a field. Historically, this early engagement process can last from four to six months. During this time, OneSubsea and customer expert teams study the reservoir, looking closely at its expected flow dynamics, to answer specific questions. The new planning software that Schlumberger is currently developing and testing with customers will shorten the time it takes to obtain viable answers to all the questions that must be answered in the design of subsea development projects.

Our integrated teams of experts employ digital technology to explore multiple scenarios. To reduce the risks associated with complicated subsea developments, the teams need to explore as many scenarios as possible. However, the traditional approach to development entails collecting data from the customer that is used to iterate different concepts on paper for the field's design. When this work takes place in a digital environment, multiple scenarios can be assessed in less time, which ultimately helps to accelerate the time to first oil.

Having all the pertinent data from different domains in one integrated model also facilitates better collaboration between experts. As the integrated team of experts from the customer and OneSubsea moves forward with planning, it will also benefit from the cognitive abilities of this new subsea planning software.



Components of a multiphase compressor for subsea processing applications are loaded onto a vessel in Horsøy, Norway, for delivery to an oil and gas field in the North Sea. OneSubsea Capital-Efficient Solutions deliver integrated subsea production systems that reduce project cycle time and overall cost.

Over time, monitoring services for subsea equipment have expanded to include production monitoring, such as real-time flow assurance consulting to optimize field production. Using software such as the PIPESIM* steady-state multiphase flow simulator and OLGA* dynamic multiphase flow simulator—both of which are available in the cloud-based DELFI cognitive E&P environment—in combination with production chemistry testing and customized advisory services, Schlumberger can provide a complete flow assurance solution for any type of oil and gas operational challenge. Furthermore, subsea monitoring uses all the data intelligence available from an operation to enable future intelligent design and manufacturing for new developments.

Digitally Enable End-to-End Solutions

It is time for the E&P industry to do something it has never done before to achieve a genuine step change in performance. It needs to rise above historical attempts to make incremental improvements and instead completely redesign the workflows and redefine the work itself with a clear focus on efficiency and consistency. This requires deep domain knowledge and operational experience that Schlumberger possesses in understanding how workflows can be improved to create a more efficient pathway to lowering the cost per barrel.

Technology is the fulcrum on which the oilfield services industry turns. The Schlumberger focus on technology integration drives a leading portfolio of pore to pipeline products and services. We speak our customers' language, and we are committed to developing the technology and aligning the business models they need to overcome the challenges they face.

Schlumberger leadership in hardware, software, and domain expertise has enabled our customers to gain access to new reserves, increase reservoir recovery and production, and maximize their returns. Digital technology enablement represents a new dimension that unlocks further value for Schlumberger and its stakeholders.

The adoption of digital technology improves the speed at which field personnel have access to critical information during operations. For example, OneSurface engineers using handheld devices will be informed of live flow events from inside hydrocarbon processing plants, enabling them to take immediate action to maintain system health status.

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