Toward a Greener Future: Digital Transformation in the Energy Industry
In this Executive Conversation, thought leaders from TCS and Halliburton Landmark discuss digital transformation in the oil and gas business and describe some of the cutting-edge technologies that are helping the industry solve its most pressing problems.

The oil and gas industry is no stranger to downturns; price wars and supply chain disruptions have occurred throughout its history. The current slump, caused by an extreme imbalance in supply and demand, was already underway before pandemic-related business closures pushed it into overdrive.

But this time, additional forces are exacerbating the downturn. An increase in stakeholder demands to reduce emissions, declines in capital investment, the growth of renewables, an industrywide need to reduce costs, and shortages of the in-house technology skills needed to improve operations have all combined to create extraordinary pressure. To succeed in this challenging, rapidly changing environment, energy companies must make adopting digital technologies an urgent priority. Digital tools can dramatically improve productivity, agility, and cost savings in the near term. Over time, they will revolutionize efficiency through advanced automation and help companies transition to new business models that include green energy.

In this Executive Conversation, Manish Sharma of Tata Consultancy Services explains how digital transformation, automation, and cultural change will work together to solve the industry’s most pressing problems. Nagaraj Srinivasan of Halliburton Landmark continues the conversation by describing specific technologies that are transforming the industry, including cloud-based collaboration, digital twins, and AI-directed equipment.
BRINGING A SPIRIT OF INNOVATION TO THE OIL AND GAS INDUSTRY

Manish Sharma | Business Head of Energy and Resources in the Americas | TCS

As oil prices decline and the world begins a shift to renewable resources, the oil and gas industry is experiencing extreme disruption. At Tata Consultancy Services, we believe that addressing that disruption with technology will lead the industry to its most transformative period ever. Digital technology can breathe new life into energy companies, moving them away from traditional, siloed processes to an agile environment that encourages innovation.

Technology solutions for the industry cover a wide spectrum, allowing companies to revamp operations from bedrock to boardroom. Advanced data modeling and real-time information collected from an internet-of-things-connected infrastructure support better and faster decision-making. Automation can cut costs dramatically while improving safety and efficiency. Combining data from disparate parts of the business generates insights that can lead to new products, partnerships, and business models.

But success with digital transformation requires more than just tools. Leaders must reexamine their cultures and encourage experimentation. One good way to begin that effort is by seeking additional value hidden in the data they already collect.

Integrating Data to Improve Operations — and Insights

Energy companies gather mountains of data across broad ranges of operations, but — as many of those companies’ executives know all too well — much of that data often remains stuck in silos. Today’s technology can integrate this information to provide a better picture of how business units interact, allowing leaders to make decisions that boost the bottom line. Analyzing digital information has the potential to create $1 trillion of additional value for oil and gas companies, according to a report by the World Economic Forum (WEF).

At TCS, helping companies capture value from their data is a cornerstone of our business. For example, we codesigned a software platform with Petroniak Nasional Berhad (Petronas), Malaysia’s national oil and gas company. The platform, known as DOVE (for Drive Optimization Value for Enterprise), collects data about downstream operations — the transformation of crude oil into gasoline, plastics, and other finished retail products — and combines it with financial data about product sales, market conditions, and competitors.

With the insights obtained from these analytics, Petronas can, for the first time, accurately forecast retail demand for its oil. The DOVE platform makes AI-based recommendations that optimize the timing of downstream oil deliveries, allowing managers to quickly adjust retail prices as market conditions shift.

In October 2020, we began collaborating on a similar platform for Equinor, Norway’s largest oil and gas company. To help the company achieve data democratization across its core operations, we’ve begun conducting an analysis of complex data sets from subsurface operations, the results of which the company will use to improve hydrocarbon recovery rates and lower extraction costs.

Improving Asset and Resource Management

Managing and maintaining the vast infrastructure of wells, rigs, pipelines, trucks, tanks, and other assets that make the energy industry function is a gargantuan task that’s complicated by aging wells, platforms, and equipment. Older infrastructure requires more frequent maintenance, but because inspection and servicing are costly, labor intensive, and sometimes hazardous, companies often put off that work.

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Industrial technology company ABB estimates that suboptimal maintenance procedures cost refiners $60 billion per year globally in unscheduled downtime. For example, a single pump breaking down on an offshore rig can lead to $100,000 to $300,000 per day in lost production.

In addition, oilfields themselves are aging. More than 70% of global oil and gas now comes from mature fields, where production and quality are declining. To operate economically, companies must find more efficient ways of extracting oil from depleted reservoirs.

Digital technology can help solve both problems, while also improving safety.

With the power of high-speed computing, companies can create digital models for extracting harder-to-reach oil. They can use drones and IoT sensors to bring real-time information about infrastructure and equipment conditions directly to managers’ desks.

IoT sensors — wearable, handheld, or head mounted — also protect employees, warning them when unsafe conditions, such as overexposure to hazardous chemicals, arise. Workers also receive streaming data from equipment. Some companies provide employees with IoT-connected glasses displaying instructional videos. Such real-time information makes workers more productive and cuts costs. By 2025, workers with IoT connectivity could be up to 15% more productive than their nonconnected counterparts, the WEF report states.

Harnessing the Automation Revolution
Cloud-based technology, combined with machine learning and AI algorithms, enables increasingly sophisticated levels of automation. At its highest level, an automated system can become autonomous, detecting and solving problems without the need for human intervention. Autonomous systems represent a quantum leap in productivity.

The oil and gas industry has already automated many processes and is increasingly moving toward autonomy. For example, sensors can now measure oil-tank levels across multiple well sites, open relief valves when necessary, and summon truck drivers when it’s time to haul oil away, optimizing their driving routes. In the meantime, automakers are working toward manufacturing automated fleets.

As automation presses forward in the coming decades, the oil field will become a smaller place. Companies will no longer need to expend enormous amounts of capital hiring tens of thousands of employees. Far fewer will be needed, and the machines they control will be smarter and more efficient.

Autonomous systems are also transforming oil companies’ office operations. As just one example, TCS’s cognitive automation product Ignio finds, fixes, and predicts IT breakdowns ranging from overheated servers to software bugs. It can solve problems in minutes that might take an IT team weeks to diagnose and resolve. Autonomous systems can also analyze millions of business transactions at once and uncover instances of fraud that have slipped by auditors.

Transforming the Culture
To succeed in the future, oil and gas companies must change not only the technologies they use, but their cultures as well. The industry’s traditional approach has been to explore more, produce more, and sell more oil. Profit margins in the past were staggering, offering little incentive for change.

But over the past two decades, the industry’s agenda has altered radically. Stakeholders, regulators, and consumers are increasingly pushing for alternative energy and demanding that oil companies reduce carbon emissions, regardless of strained economic conditions and more difficult extractions.

Renewables are set to grow rapidly. The U.S. Energy Information Administration predicts that hydropower, wind, and solar technologies will provide nearly half of the world’s electricity by 2050.

But those who believe that the rise of alternative energy spells doom for oil and gas are misinformed. The same agency also says that world energy consumption will increase by nearly 50% during the same period, driven largely by economic expansion in Asia.
The world’s energy needs are enormous and growing. Industries and consumers will continue to rely on oil and gas for many decades to come, but those resources will exist as part of a mixed-energy system.

To adapt, today’s oil and gas companies must find ways to reduce their environmental footprints while remaining profitable. They must create new business ecosystems by engaging in partnerships with wind and solar energy producers and manufacturers of electric vehicles.

Pursuing these initiatives will require companies to adopt a “digital-first” mindset. Digital analytics will help them explore new revenue sources and evaluate the economic and technological feasibility of working with nontraditional partners. Software applications and cloud connectivity will help them get new lines of business up and running quickly.

These efforts should be at the heart of every energy business rather than on the sidelines. That means leaders must retrain employees to become experts in technology and data analysis instead of hiring outsiders. They must give people incentives for exploring new ideas. And they must make their organizations more attractive to new talent by adopting more agile ways of working. The organizations that succeed in the coming decades will be those that make innovation a priority by wholeheartedly embracing digital technology.

LEADING THE WAY TO THE FUTURE WITH TRANSFORMATIVE ENERGY TECHNOLOGIES

Nagaraj Srinivasan | Senior Vice President | Landmark, Halliburton Digital Solutions, and Consulting | Halliburton

To reap digital technology’s full benefits, energy companies must embrace it as a fundamental change in the way they do business, rather than viewing it as a series of components to be acquired piecemeal to address specific pain points. The good news: In recent years, we’ve been seeing a shift to a more holistic approach as companies realize technology’s positive impacts on efficiency and costs. Events over the past year have only accelerated that transition.

Moving to Cloud-Based Communications

The COVID-19 pandemic brought headwinds to an industry that was already struggling. As partners and customers shut their doors to combat the spread of the virus, the supply chain was disrupted and oil demand decreased. Geopolitical tensions and trade restrictions compounded the problem.

But the COVID coin also had a flip side. With offices closed and travel greatly restricted, energy companies began to move business processes to the cloud at a much more rapid rate. For example, at Halliburton, the number of customers using our digital technology solutions in 2020 was five times greater than it was in 2019.

Operators collaborated and communicated through cloud-based audio and video applications, including those running on Halliburton’s DecisionSpace 365 platform, an integrated experience of exploration and production (E&P) cloud applications. DecisionSpace 365 runs on iEnergy, the Landmark hybrid cloud designed to deploy, integrate, and manage customers’ E&P applications.

During the pandemic, cloud-based collaborative tools allowed people across the energy business — from geoscientists and drilling engineers to production managers and reservoir operators — to exchange information and view graphic representations of assets together as though they were in the same room. Organizations using such tools have told
Better Together: Benefiting From ‘Digital Twins’

For the oil and gas business, enhanced collaboration is just the beginning of the digital revolution. Companies are increasingly using a key technology, known as “digital twins,” to remotely plan and manage operations.

Digital twins — virtual representations of geologic structures, equipment, plants, and business processes — are created through advanced data-modeling techniques. The companies we work with are using applications in DecisionSpace 365 to create digital twins across the energy value chain.

Among the most complex use cases is the development of plans for new wells, a multipart process fraught with uncertainties, especially for offshore projects. Traditionally, planning for an offshore well begins when geologists believe a deposit of hydrocarbons may be sitting in a reservoir five miles or so beneath the ocean floor. The size and dimensions of that potential pool are unknown, and devising a drilling path to reach it is complicated. Companies have spent tens of millions of dollars to drill paths to a promising location, only to find that the deposit is not where it was thought to be.

A digital twin for a planned well crunches enormous amounts of data about subsurface geology, including advanced reservoir mapping, revealing faults, water conditions, and other variations that affect drilling trajectory. The twin pinpoints a location with the best probability of containing a reservoir and determines the best path for reaching it. It then ingests financial data about operational costs and projected returns, helping companies determine the financial feasibility before they spend the capital. All of these processes substantially lower the risks involved in drilling a new well.

Digital twins can also be used to create detailed simulations of the construction sequence for undersea or in-ground wells. Well construction is a massive, long-term endeavor that requires coordinating the operations of many companies in the proper order to avoid expensive delays. Twenty years ago, it took oil companies five to 10 years to bring an oil discovery to first production. With digital twins, they can do the job in three to seven years, saving billions of dollars.

As well construction proceeds, digital twins incorporate new data about the environment below from fiber optics and acoustic sensing instruments, enabling companies to modify plans as they move from one phase of construction to the next.

Companies also use digital twins to optimize production. In the past, if production quantity or quality declined, identifying the source of the problem required lengthy and often dangerous physical inspections. Today, sensors attached to interior valves and controls feed managers continuous information about the well’s productivity and condition. Companies can change equipment settings remotely to optimize production. Data can now help diagnose well problems and pipeline leaks faster than humans, saving time and money by getting equipment back up and running sooner.

Digital twins can be used in industrial operations as well. At Halliburton, we have created models of our well-equipment manufacturing facilities. By remotely analyzing factory operations and making tweaks to machines and procedures, we have improved throughput, velocity, and product quality.

Another important benefit of digital twins is their ability to speed innovation. When oil companies try out a new process or piece of equipment, it typically takes them a long time to obtain feedback from the field. With digital twins, they can experiment digitally and determine effectiveness before implementing physical equipment and paying workers to operate it.”
workers to operate it. Companies using digital twins thus make better and faster decisions about which innovations to adopt and can deploy them sooner, gaining a significant competitive advantage.

**Using Digital Technology to Boost Equipment Capabilities**

Oil field equipment is becoming increasingly digitized, helping companies cut costs and improve efficiencies in the field. For example, a couple of years ago, Halliburton developed iCruise Intelligent Rotary Steerable System, an automated drilling technology that uses advanced sensors and AI algorithms to increase speed, accuracy, and reliability.

Accurate drilling is especially valuable for lateral wells, which traverse rough, uneven terrain as they branch out from a vertical drilling platform. As many as six horizontal wells can be drilled from a single vertical platform, and more companies are using laterals to save on costs as oil prices decline. Because oil flows more freely through them than it does in deeper operations, one lateral well can replace as many as 30 vertical ones.

Embedded algorithms in iCruise help operators position their lateral wells more accurately and measure the intensity of downhole vibrations, providing early warnings about maintenance issues to prevent costly breakdowns.

Companies also use digital technology to improve mechanical controls on hydraulic fracturing equipment. With the Halliburton SmartFleet Intelligent Fracturing System, equipment operators receive detailed geographical measurements and real-time 3D visualizations of a well’s subsurface. As the information flows in, they use remote controls to improve fracture placements and fix equipment problems as they arise.

**Multiplying Digital Benefits**

Companies gain the most advantages from digital technology when they use it for both office processes and field operations. By delivering joint solutions with TCS for the past 15 years, Halliburton has helped companies improve their entire business through deeper integrations.

For example, TCS worked with an oil company to reengineer its back-office processes while we developed software to help them gain information about subsurface operations and improve petrochemical engineering processes. Then TCS and Halliburton together created a software architecture to connect the complex interdependencies between these systems. As a result, the customer improved efficiency and lowered costs for both its field operations and its business processes.

**Easing the Transition to a Greener Future**

We are also using technology to help energy companies transition to a green future in three ways.

First, we are gathering data to help companies quantify their digital footprints. Second, we are applying “sustainability labels” to the equipment and solutions we provide to our clients, making information about emissions as transparent and clear as possible to both customers and regulators — similar to the way the food industry provides nutrition labels on its products. Finally, in 2020, we also launched Halliburton Labs — a collaborative environment where entrepreneurs, academics, investors, and industrial labs come together to advance cleaner, more affordable energy. Halliburton Labs will accelerate the growth of innovative early-stage companies by providing them with access to Halliburton’s lab facilities, technical expertise, and business networks.

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Planning for a cleaner energy future is like planning a new well: The path is complex and filled with unanticipated risks and expenses. In both cases, digital technology plays a key role by quantifying operational and financial challenges and revealing the most effective way to proceed.

**Nagaraj Srinivasan** is senior vice president of Landmark, Halliburton Digital Solutions and Consulting at Halliburton. He has extensive experience leading teams in developing and delivering enterprise-class software solutions. He joined Halliburton in 2011, focusing on product strategy and delivery of Landmark software. Previously, he spent 18 years at Oracle, where he was vice president for supply chain products. He also served as Oracle’s senior director of advanced planning for applications and director of business development for supply chain. He holds several patents in technology and supply chain management and serves on the advisory board for the Master of Science in Analytics program at Texas A&M University. He received master’s degrees in business management from the University of California, Los Angeles, and in engineering from the University of California, Berkeley, and earned a bachelor’s degree in technology from the Indian Institute of Technology, Madras.

**ABOUT TCS**

Tata Consultancy Services is an IT services, consulting, and business solutions organization that has been partnering with many of the world’s largest businesses in their transformation journeys for more than 50 years. TCS offers a consulting-led, cognitive-powered, integrated portfolio of business, technology, and engineering services and solutions. This is provided through its unique Location Independent Agile delivery model, recognized as a benchmark of excellence in software development. A part of the Tata group, India’s largest multinational business organization, TCS has more than 469,000 of the world’s best-trained consultants in 46 countries. For more information, visit www.tcs.com.

**ABOUT HALLIBURTON**

Founded in 1919, Halliburton is one of the world’s largest providers of products and services to the energy industry. With more than 40,000 employees, representing 130 nationalities in more than 70 countries, the company helps its customers maximize value throughout the life cycle of the reservoir — from locating hydrocarbons and managing geological data to drilling and formation evaluation, well construction and completion, and optimizing production throughout the life of the asset. Visit the company’s website at www.halliburton.com.