

Technology's impact on today's oil and gas value chain

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Technologies in the industrial world have taken a great leap forward. With the advent of the Fourth Industrial Revolution, a new era in the manufacturing of industrial goods has dawned: an era of autonomous and personalised mass production can deliver products with nearly a 100 percent quality and availability rates. Integrated systems are beginning to utilise the full potential of their various components. And data is becoming one of the most important resources as operators finally start to turn it into practical value.

The oil and gas sector has experienced its own transition: The shale boom in the US has permanently shifted the market equilibrium. During the downturn, many were forecasting that a 'lower-for-longer' price horizon would squeeze North American independents out of existence. Yet the industry transformed itself, adopting new technologies and approaches to produce profitably at a lower price per barrel.

Today, shale operators are not only staving off market pressures, but they are thriving with technological upgrades which are challenging the market to keep pace. Prices near or above USD \$60/bbl for WTI are unlocking the potential for strong US crude oil production gains. The scale of growth in shale production is now at levels last reached in 2012-2014. This is increasing pressure across the entire market to lower OPEX and CAPEX expenditures and maximise production and recovery. To secure their competitiveness in this shifting resource landscape, operators must innovate and put themselves at the forefront of the industry.

Digitalisation unlocks system value

Intensified leverage of technology, more effective use of data, and new holistic approaches to project development are increasingly important success factors in this market environment. These levers have the potential to reduce capital and operating expenses, shorten project development cycles, and minimise interfacing risks across the entire oil and gas industry.

O&G fundamentals intact – changed business environment requires adaption and new approaches.

Given its demanding environment and high risk, the extraction of oil and gas resources in the offshore sector is an especially promising field for deploying lessons learned from digitalisation and technology integration. The industry downturn in recent years has made the sector rethink how it manages the entire asset lifecycle.

In what ultimately will be a full-scale digital transformation,

operators are turning to a digital lifecycle methodology that begins in the conceptual and design phase of a project with a comprehensive digital roadmap. This approach applies advanced capabilities, ranging from enhanced design, testing, manufacturing, and lifecycle maintenance through virtualisation (the creation of digital twins), to remote monitoring and pre-emptive maintenance of mission-critical equipment and enabling cybersecurity capabilities.

The digital twin is a software model that not only mirrors the status and working condition of the asset in near real-time but also the operational behavior of its real-world counterpart. This virtual twin enables operators to design and test their assets in a risk-free environment and serves as an invaluable tool for lifecycle decision-making support and asset optimisation.

One area where we have put this approach into practice is offshore. Using our digital lifecycle solution for offshore production facilities approach, we have shortened overall project cycle times for mid-sized offshore platforms by three to nine months, while reducing CAPEX by up to US\$15 million. We estimate OPEX reductions at more than US\$100 million over a ten-year period.

Integration over the full lifecycle

The midstream sector is also profiting from fully integrated, pre-tested, ready-to-install pumping and compressor solutions. Operators face the need to increase capacities, maximise efficiency, and drive down costs. Shale production in North America is projected to grow steadily over the mid-term, Russia is driving pipeline expansion in the European and Asian markets, and China – in its efforts to shift from coal to natural gas for power supplies – is also encouraging infrastructure investment.

In their search for more effective levers to simplify and streamline the process of bringing new transmission capacity online, operators envisage an integrated approach to the engineering, supply and lifecycle optimisation of their assets. This is putting the spotlight on technology suppliers (OEMs) like Siemens, since we can provide detailed functional know-how for optimal solutions. Once the new assets are in place, operators also have to maximise their utilisation and reduce total cost of ownership over lifecycles that last decades. This is now possible as the industry embraces the use of machine learning, data analytics, lifecycle services and cybersecurity strategies to optimise performance.

One example of how Siemens can help customers turn data into practical value in the midstream market is our SmartPumping application we're developing to help crude oil



pipeline operators achieve dramatic energy savings. By deploying sophisticated software technologies – including artificial intelligence and machine learning – operators can improve and optimise pumping operations regarding load management, power consumption and scheduling. Moreover, by utilising turbine and motor vibration data, they can use condition monitoring and preemptive maintenance to extend the life of mission-critical equipment.

Integrating the advantages of every element

Taking an even broader view, the new approaches to integration and digitalisation are not only impacting the conventional oil and gas sector, but also its integration into the entire energy sector. Given the long-term goal of decarbonisation of the energy sector and the new energy mix taking shape, we are seeing a general shift from the classic energy chain toward a more decentralised model, flexibly integrating large and small players in the grid. Digital technology offers an increasing degree of intelligence to all kinds of energy suppliers, consumers, and especially in the grid. It is opening up new opportunities to couple the many different elements of the energy landscape – even across sectors – and optimally exploit the advantages of each.

Hydrogen technology, along with biofuels, is emerging as a sustainable alternative to oil and gas that will even ensure most efficient use of generation capacity and infrastructures. By converting fluctuating power from renewable sources into hydrogen (or hydrocarbons), surplus energy can be flexibly monetised, stored in existing gas infrastructures and re-electrified in gas turbines, making those a sustainable investment even in a decarbonised world.

Furthermore, hydrogen may subsequently be synthesised to hydrocarbon fuels, such as methanol, offering refineries a new business field besides fossil fuel production. These synthetic fuels are a means to utilise renewable power in other sectors, thereby vastly decarbonising energy in all sectors of consumption.

Still, alternative fuels will have to compete against other energy options. Battery storage is among today's most promising game changers, being significantly driven by the growing e-mobility sector. The industrial and building sectors also offer significant opportunities to shift energy allocations



New technologies are powering the fourth industrial revolution

by better integrating their high demand and storage capacities, for example, for heat, cold or chemical products. One thing is certain: The energy landscape will continue to shift and rearrange itself in the coming years and provide opportunities for both old and new players.

Make way for disruptive concepts!

What matters in this transition is not only technological strength, but also strong and strategic partnerships. The industry must be open to the many emerging possibilities to find and implement the most effective and future-oriented solutions. And this applies to the business and academic players as well as to the political community to create the necessary business framework. The pressure to achieve sustainability will continue growing as nations strive to reach the Paris climate target of 2°C. So it's all the more important to invest in solutions that benefit the system over the long run.

As a technology provider that stands for innovation and excellence, we achieve the best solutions when we have the opportunity to collaborate with our customers from a very early phase to identify and solve challenges that may differ from those encountered in traditional customer-supplier relationships. Dialogue and collaboration continue to be essential for jointly mastering the challenges and opportunities presented by today's – and future – energy systems. ●