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Overcoming the odds: Accelerating digital transformation in the oil and gas industry

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Executive summary:

The oil and gas sector faces many challenges. Market uncertainty and pricing volatility, increased environmental regulations and sustainability initiatives, and workforce and pandemic-related disruptions represent significant challenges for the industry. By transforming the way their teams work through the adoption of digital tools, oil and gas companies can leverage all available industrial data and turn that information into innovative insights. These insights will enable companies to 1) speed time from concept to full-capacity production, 2) empower the workforce, 3) optimize the value chain to create more agile operations, 4) enable reliable, efficient, and safe operations, and 5) meet sustainability and decarbonization objectives.
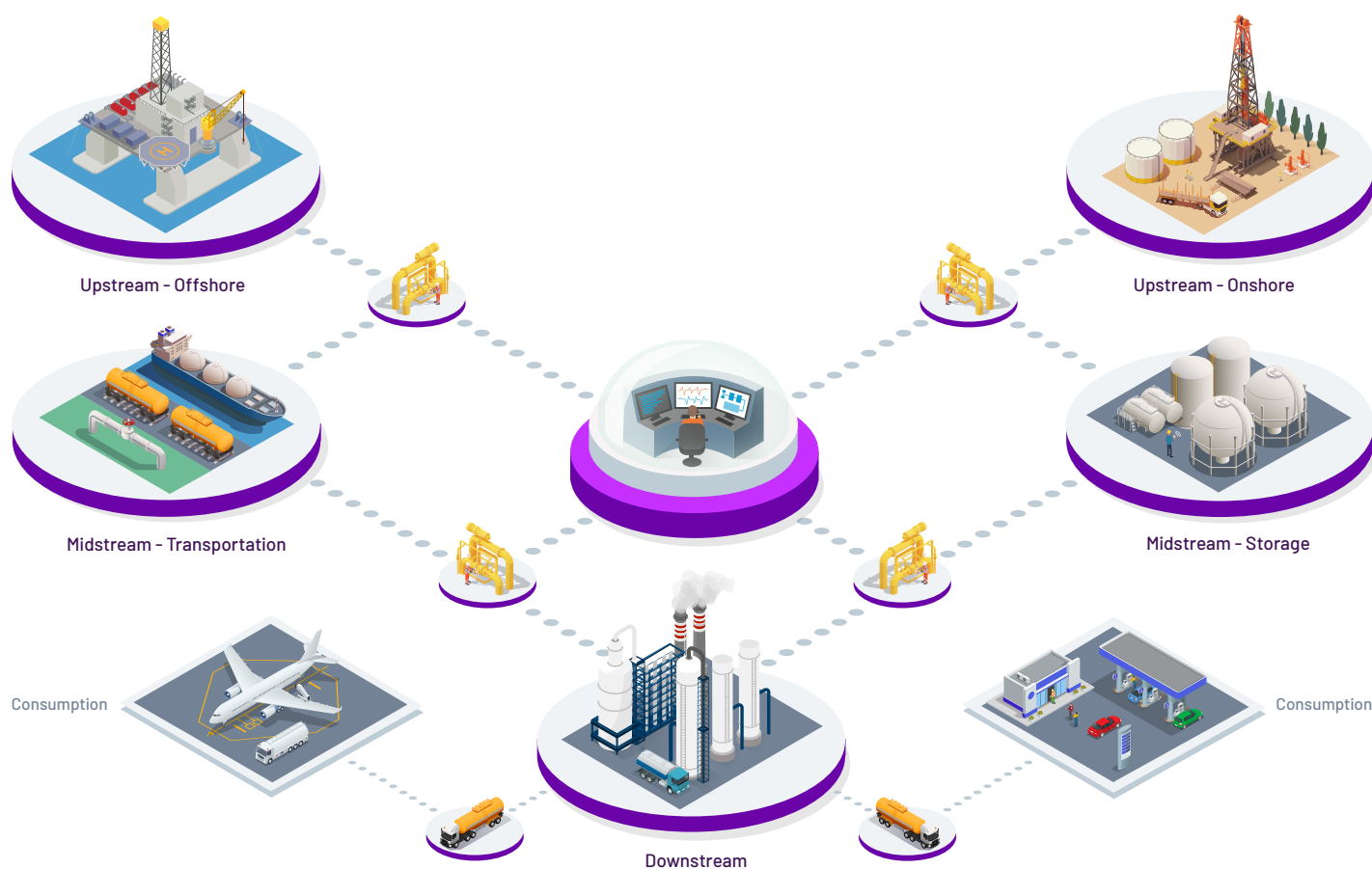
To accelerate this transformation, oil and gas companies can undertake digital initiatives powered by the latest advances in cloud, artificial intelligence (AI), big data, digital twin, and industrial Internet of Things (IIoT) and edge technologies. Built on open, agnostic industrial software design principles, oil and gas companies can use these digital initiatives today to overcome key challenges while improving sustainability and the profitability of their businesses.

Digital tools enable new ways to work

The oil and gas industry is the backbone on which modern society runs. While oil and gas are staples for everyday life, the industry faces numerous unprecedented challenges. Market uncertainty and pricing volatility have plagued the industry, making it difficult for companies to plan and execute accordingly. The COVID-19 pandemic and geopolitical events have fractured already fragile supply chains. In the push to eliminate carbon emissions and increase sustainability, governments, industry organizations, and companies continue to adopt ever-stricter environmental regulations. Companies must stay ahead of mandates and public and industry pressures to meet new ESG targets. Workforce disruptions and the shift to a new generation of workers invite the real possibility of a shortage of skilled labor, forcing companies to find new ways to transfer institutional knowledge and train new workers.

Given the market volatility and uncertainty, oil and gas companies are hesitant to invest in capital upgrades or digital infrastructure to increase efficiencies. Margins are thin and the stakes are high, making every decision critical to future success.

Forward-thinking digital solutions represent the best tools oil and gas companies have to overcome these challenges and improve profitability and sustainability along the way. By digitalizing work, oil and gas companies can drastically improve collaboration and efficiency, prioritize capital spending, and build more agile operations that can withstand market shifts. Because digital work allows workers to complete tasks from anywhere across different sites and locations, fewer operators can accomplish more, which improves overall efficiency and helps companies build resilience against workforce disruptions.

Upstream – Offshore

Upstream – Onshore

Midstream – Transportation

Midstream – Storage

Consumption

Consumption

Downstream

Not only do digital tools enhance enterprise-wide collaboration, but they can also seamlessly unify operations and supply chains, breaking down silos while opening new pathways for information flow. By centralizing operational insights and visualizations, operators can collaborate on the same information at the same time to identify weak spots in the business and work together to improve efficiency and profitability. Digitalization likewise improves sustainability initiatives and regulatory compliance. Software applications optimize operations, streamline environmental reporting, and maximize energy usage.

Sharing data also improves the transfer of institutional knowledge and empowers the workforce. Even when workers are away or retire, new workers can access their knowledge because the information is stored in a central digital repository. Analytics can be applied to digital data, allowing newer employees to find all the relevant information about an asset. Analytics can alert them about abnormal conditions that, they might have previously needed to rely on more experienced workers to recognize.

Digital data augments human insight in new ways. Predictive and prescriptive analytics capabilities can only be applied when digital data is automatically captured. AI and machine learning (ML) can aid operators in analyzing vast amounts of data to make informed decisions.

Despite market disruptions and volatility, oil and gas companies are finding success by adopting new ways of working collaboratively in digital environments. These new ways of working, based on common data platforms and global visibility, help companies become more profitable and advance the circular economy. To succeed in the future of the industry, oil and gas operations must:

1. Speed time from concept to full-capacity production
2. Empower the workforce
3. Optimize the value chain to create more agile operations
4. Enable reliable, efficient, and safe operations
5. Meet sustainability and decarbonization objectives

Speed time from concept to full-capacity production

Managing capital expenditures is more important than ever in an uncertain, volatile market. Faced with aging infrastructure and market demands to meet sustainability and net-zero goals, upgrading and replacing facilities and equipment is essential. While these types of capital projects are critical to enabling future business outcomes, oil and gas companies must find ways to lower overall CAPEX and ensure projects are completed to scope. As CAPEX and OPEX needs change, oil and gas companies must find the balance between managing costs, allocating resources, and reaching sustainability goals to deliver on-time and on-budget capital projects.

Cloud-enabled data gives engineers flexibility in where and how they access information and insights. This accessibility gives teams the visibility they need to quickly run scenarios to optimize project designs, budgets, and scheduling. Using one single source of truth for engineering and operational data, teams can collaborate every step of the way, ensuring faster, more efficient projects that are executed with lower cost and risk.

Digital twin technology enables teams to validate start-up procedures while ensuring an efficient, reliable handover that leaves room for future improvement. Thanks to new digital tools, oil and gas teams can reduce CAPEX and OPEX and quickly deliver products according to market demand, increasing profitability, reducing carbon emissions, and improving sustainability.

Promon is an engineering firm that works with several oil and gas projects across Brazil. Promon analyzes its customer data to simulate process upsets and must also deliver instrumentation data to its partners in a consistent, clear manner. However, customers and partners use different databases, which slowed the company's ability to run simulations. Promon needed a way to accelerate its simulation time and adhere to varying requirements and interface with numerous technologies.

The company embarked on a project to integrate its engineering databases and simulation platforms to enable digital twins.

This integration allowed teams to easily analyze data from separate databases and simulate plant processes and process utilities in a single platform. Not only did this improve the engineer's experience and promote greater collaboration among teams, it considerably reduced engineering hours.

Overall, the project reduced engineering hours by 15% and enabled Promon to implement projects 60% faster.

"To synchronize all the data that moves across different areas - five, six areas – is hard work. So, working with the tools like the ones that AVEVA offers helps us to reduce a lot the number of people working on the project, helps us to keep data more integrated, allowing us to do the work with better quality and higher productivity."

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Alex Sandoval
Systems Coordinator, Promon

Empower the workforce

An aging workforce, high industry turnover, and difficulty retaining or attracting new teams are just a few of the hurdles facing oil and gas workforces. Low digitalization levels prevent knowledge capture as subject matter experts retire. This high level of workforce disruption and subsequent knowledge gaps is impacting operations. Attracting a new generation of workers while retaining critical information about assets, processes, and performance, requires a shift to digital solutions.

To empower and upskill their existing workforce as well as attract and retain new team members, oil and gas companies must digitize. By arming workers with real-time, contextualized data and remote training tools such as augmented reality (AR), virtual reality (VR), or extended reality (XR), companies can increase operational understanding and response time while creating more connected, productive, and collaborative teams.

When data and digital tools are available onsite or via mobile devices, teams can monitor operations remotely, leverage self-service analytics, and identify ways to improve.

From there, they can standardize best practices and capture knowledge from subject matter experts, ensuring that process and asset information is available even if the workforce changes. Digitizing not only increases visibility and ownership for current teams, it also enables oil and gas companies to attract and retain talent for years to come.

Shell: Mitigating risk with VR training

Shell operators work in dynamic, high-risk environments. Inexperienced operators can make poor decisions, which makes training incredibly important. However, it was difficult for Shell to perform training in real environments without exposing operators to unnecessary risk. In response, it deployed a training system that used VR-based scenarios to equip operators to make the most informed decisions every time. Now, operator risk is significantly reduced by training environments and Shell can do deeper and more extensive training that gets operators up to speed and gives management confidence that their teams are operating safely.

Petroleum Development Oman had information stored in different formats, systems, and locations across the organization – and it was holding back operational performance. Not only were as-built drawings difficult to keep up to date after modification work was completed, it was difficult and time-consuming for teams to access the information needed to make informed operational decisions. The company needed to give its teams a rapid way to access information and establish relationships between disparate pieces of information.

Petroleum Development Oman deployed a solution that enabled detailed asset information visualization, ensuring all data and project documents coming online could be managed efficiently from the beginning. The team also created a tag index-building tool to establish relationships between various types of information. Now, engineers can search for a tag and find all related information, regardless of format. The project was a huge success, saving an estimated 5% of workers' time, or 10,000 days, spent searching for information.

Optimizing the value chain to create more agile operations

Oil and gas companies must also find new measures of agility and optimize their value chains if they are to succeed in the future. Companies face uncertain markets and pricing volatility, supply and demand shocks, supply chain complexity, industry consolidation, and digital disruption – but these challenges are not insurmountable. With more accurate operational data and a model-driven execution process, companies can optimize every part of the value chain, balance supply and demand, and uncover new opportunities that lead to greater profitability.

Agile operations start with good quality data and integrations – and that requires a convergence of engineering, operations, and information technology. By creating one single source of truth for real-time operational data and contextualizing that information alongside engineering, performance, and financial data, teams can use AI-powered tools to run real-time comparisons and simulations to find new efficiencies. Using master data management strategies from planning to execution, teams can optimize processes, energy usage, regulatory compliance, yield, throughput, and waste reduction while adjusting scheduling to capitalize on market opportunities.

BP's downstream business processes 1.7 million bbls per day in eight refineries around the world. Unfortunately, the company's outdated technology wasn't intuitive and made it difficult to share best practices across locations. Teams were also unable to quickly make decisions to reflect market changes, leading to lost opportunities and benefits. As part of its Digital Innovation Program, BP opted to review its global downstream supply chain management process to enable more agile operations.

BP deployed an enterprise data management platform to maximize margin capture, efficiency, and sustainability. The solution also enabled the company to use cloud technology, which allows teams to quickly run complex analyses and analytics using accurate, real-time data. By simplifying and standardizing its downstream supply chain management, BP has fostered better collaboration and planning, which has increased overall agility.

Overall, BP has significantly improved margins, made better, faster decisions, increased planning and analysis accuracy, and decreased the time it takes to analyze information from hours to minutes. In addition, BP has continued to build on its solid data management foundation. The company uses its unified supply chain technology and operations data to model carbon emissions and identify ways to reduce its carbon footprint.
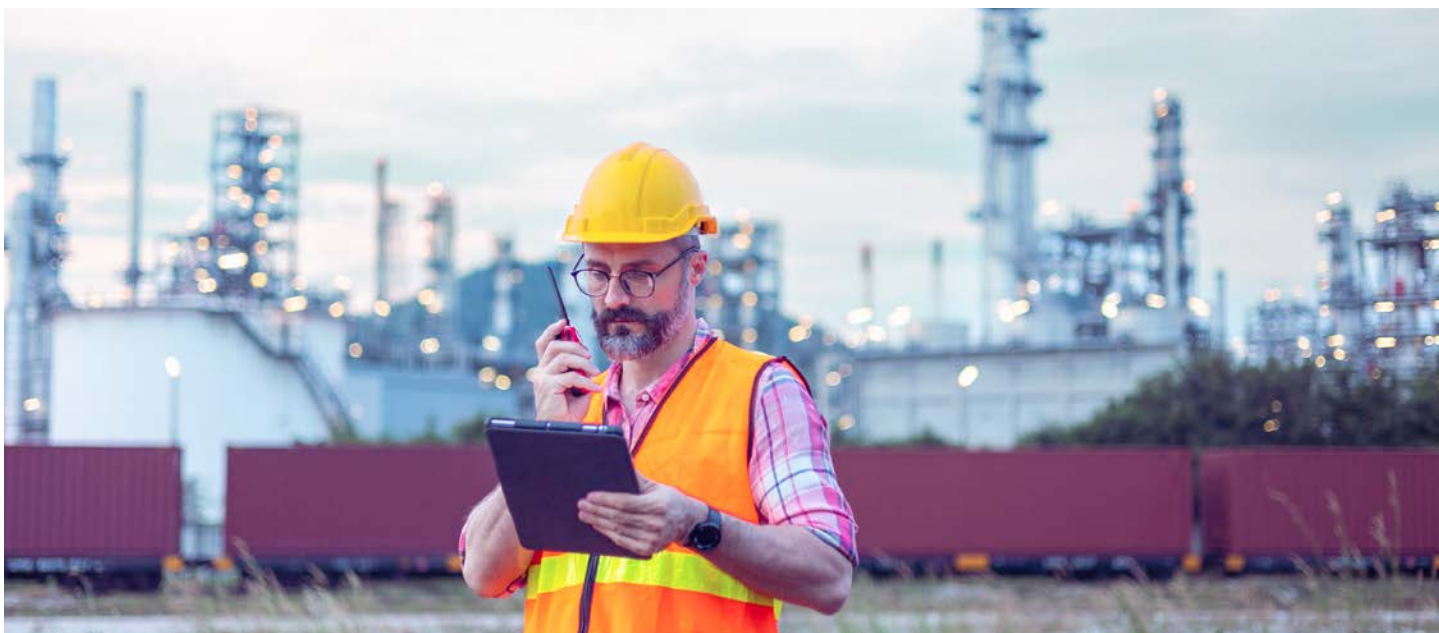
Enable reliable, safe, and efficient operations

As their assets age, oil and gas companies are faced with difficult decisions. Assets must often be replaced or retooled, but margins are already tight. However, increasing regulations and degrading assets make it necessary to spend money on capital upgrades. Failing to perform these upgrades leads to unreliable assets and facilities, which ultimately increases OPEX costs, inefficient operations, and unsafe conditions. Oil and gas companies cannot afford unplanned downtime or catastrophic failures, and they must prioritize which upgrades or repairs to perform at the right time to ensure continuous operations while maximizing operational efficiency and safety.

Cloud and SaaS-enabled data combined with new AI and ML tools allow teams to detect anomalies at the earliest possible point. Teams can use real-time insights to identify hazards, leaks, flow, energy usage, and more. Using predictive insights, they can prioritize capital projects and schedule maintenance at just the right time – ensuring reliable and efficient operations while preventing catastrophic failures. Not only does real-time visibility and operational intelligence help companies avoid unplanned downtime and associated costs, but it also ensures equipment is down for the shortest time possible while ensuring it is operating safely.

Operational data can be integrated with advanced analytics, business integration platforms, or even maintenance systems to automatically calculate KPIs or even trigger automated work orders.

In 2015, DCP Midstream embarked on a new operational excellence program to build a sustainable business model through efficiency, reliability, and risk management.

The company installed a single data infrastructure to gain visibility into operations across its vast network of plants, pipelines, stations, and compressor units. Using smart asset templates to enable analytics, alerts, and notifications, DCP Midstream created a real-time, hierarchical, and contextualized view of its operational data. The company linked operational and simulated data to financial information, assigning monetary values to any changes operators made.

With visualizations showing actual performance compared to set goals and alerts that indicate when an asset is operating more than 10% below optimal, operators can now make informed decisions and work toward a common goal. Overall, DCP Midstream's digitalization efforts paid off. In 2017, the company saved $25 million thanks to improved plant operations.

Meet sustainability and decarbonization objectives

Sustainability and decarbonization are key drivers for the oil and gas industry. As companies look to reach net-zero targets by 2050, they must increase compliance with energy transition mandates and open up new value chains for carbon and hydrogen. Reaching these goals and complying with new market demands requires oil and gas companies to reshape business models, increase investment in ESG programs, and bolster decarbonization initiatives. To succeed, oil and gas companies need to modernize facilities and increase visibility across the value chain.

Cloud and remote operations give oil and gas companies the operational intelligence they need to optimize the value chain, reduce emissions, and reach energy targets. Digital twins enable teams to simulate and design new green processes and products.

Aker Carbon Capture is working to mitigate carbon dioxide emissions for industrial operations. The company uses cloud-based technologies to engage its teams located across projects and time zones. By creating a project-focused culture that encourages collaboration, the company has reduced the overall cost of services to accelerate the uptick of carbon capture globally, reduce its engineering hours, and increased transparency. Thanks to its digital initiatives and cloud-based tools, the company has reduced the cost of medium-sized offerings by 90% compared to just nine years ago.

Six digital initiatives that will transform the way your teams work

According to LNS Research's recent "Industrial Transformation in 2021: Getting Real" research spotlight, half of industrial enterprises report they have embarked on a digital transformation journey, and these programs are yielding very real benefits. LNS found that leaders in digital transformation are 72% more likely to have increased revenues by more than

10% and 57% more likely to have reduced the Cost of Goods Sold (COGS) by more than 10%.

Many oil and gas companies wonder where to start their digital transformation journey and which steps can be quickly taken to catch up with competitors that were early adopters of digital technologies.

Six distinct, cross-functional digital initiatives can define a successful roadmap for the transformation of work and help oil and gas companies address their business imperatives.

1. Build your industrial information infrastructure. Establish a solid foundation for all of your digital transformation initiatives by integrating and contextualizing all sources of engineering and operations data, centralizing information to foster a data-driven decision culture.

2. Enable full visibility and awareness. Go beyond situational awareness by creating a multi-experience single-pane-of-glass and mobile-enabled visualization system that can break down work silos and speed informed decision-making by providing universal visibility tailored to a user's specific role.

3. Optimize your production and value chain. Make the highest-quality product at the lowest cost using AI-powered tools to enhance your operations execution, process optimization, production management, feedstock management, and supply-chain planning and scheduling capabilities.

4. Increase asset health and performance. Improve reliability and identify areas for proactive maintenance. Tap into the power of AI for risk-based guidance to improve your asset strategy, asset analytics, and maintenance execution.

5. Accelerate process design, innovation, and learning. Bring agility to the entire process and plant lifecycle of design, engineering, simulation, training, and operations, enabling a digital twin for faster innovation.

6. Streamline engineering and capital project execution. Break down barriers between process, mechanical, and other engineering disciplines to enable seamless cloud-based collaboration across teams and unify your approach to all aspects of the engineering life cycle.

Conclusion

The World Economic Forum estimates that digital transformation initiatives have the power to unlock approximately $1.6 trillion in value for the oil and gas industry. However, according to Accenture, despite increased spend on digital transformation, approximately 20% of companies struggle to realize significant value. To ensure that investment is successful, they must lay the digital groundwork that transforms the way their teams work and sparks the industrial ingenuity of their staff. Through digital initiatives powered by the latest technology enablers, oil and gas companies can build industrial information infrastructure and upgrade engineering and operations applications to accelerate value creation. They can then visualize and share industrial data within their teams and value chain partners. By undertaking these initiatives, oil and gas companies can streamline engineering cycles, optimize value chains, achieve operational excellence, and empower their workforces to drive the circular economy and ensure profitable, sustainable operations.

About the author

Rishabh Singhal works as the Industry Marketing Manager for the Oil, Gas and Energy segment at AVEVA. A technologist at heart, he is passionate about the ongoing digitalization of the energy industry and has worked with operators, EPCs, OEMs, and consultancies to drive operational efficiencies across the value chain. He also has a deep understanding of energy market dynamics and is passionate about the economics of the energy transition.

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