

Digital Transformation Oil & Gas Industry

Develop agile business models with higher margins, improve regulatory compliance, streamline process innovation, capture and retain workforce knowledge, and enable a zero-accident culture focused on operational excellence.

WHITE PAPER

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Executive Summary

This whitepaper discusses:

- Understand the key challenges and opportunities facing oil and gas companies today.
- Learn how digital transformation empowers oil and gas companies to deliver increased value across asset and operations lifecycles.
- Develop your strategy for implementing digital transformation

INTRODUCTION

Given the existing market dynamics, enterprises in the oil and gas industry are facing increased pressure across multiple dimensions of their enterprise. Heightened regulatory compliance requirements, while put in place for good reasons, create new and complex pressures manufacturers have never faced before. At the same time, the industry strives to improve knowledge creation and retention as its workforce undergoes a generational transition exposing potential risk to business continuity.

Upstream producers seek maximized production of oil and gas from onshore and offshore wells safely and economically. Amid increasing demand, environmental pressures, and potential security threats, the primary concern of hydrocarbon pipeline operators in the midstream oil and gas market remains the same: to ensure safe, reliable, and compliant operations, 24/7 - all while managing energy costs and minimizing time and installed costs. While downstream refining and petrochemical producers strive to achieve superior performance through better management of their energy usage and costs, optimization of their process yields, reduction or elimination of safety-related incidents and improved operator performance.

Coupled with these challenges is the uncertainty caused by digital technology's increasing disruption in the oil and gas industry. Pivotal technologies like cloud computing, the industrial Internet of things, digital twins, and augmented and virtual reality are precursors of the next industrial revolution. How can producers in the upstream market, pipeline operators in the midstream market and refineries in the downstream market all ensure they make the right technology investments? Digital Transformation is the key to oil and gas companies driving new and better customer experiences while maximizing

value creation across asset and operations lifecycles to improve profitability, maximize return on capital and improve their overall competitive edge.

The Digital Twin

A digital twin is a digital representation of a physical asset; like a pump, motor, turbine, even an entire industrial process or plant. Digital twins enable full lifecycle management of physical assets, starting with the design of the asset or process itself and continuing throughout its operational life. As the operational life continues, a digital copy is updated in real time. By creating digital twins data generated by the asset or process during its design and operational life is collected, visualized and analyzed to maximize return on capital and increase enterprise profitability.



PROCESS OPTIMIZATION

In today's economic environment, capital budgets and overhead are constantly being cut. Oil and gas producers are faced with rising manufacturing costs, global competition, and soaring energy costs. To meet these challenges, companies are forced to optimize manufacturing operations and make performance improvements to positively affect their bottom line.

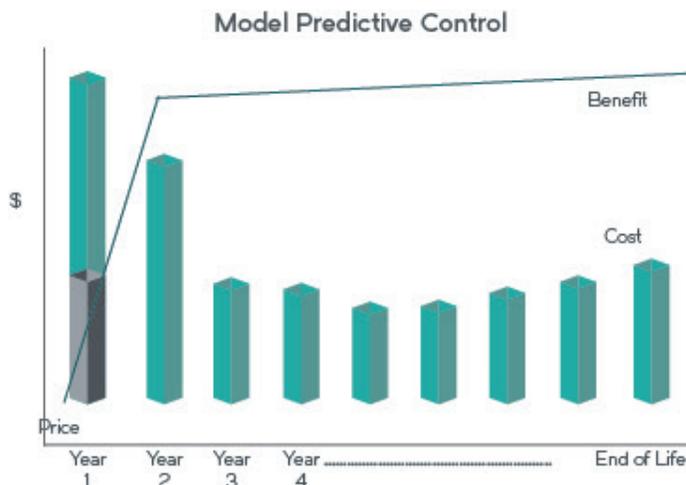
Feedstock prices shift dramatically over very short periods of time. This forces manufacturers to stay on constant alert with economic conditions and forecasts. Energy costs are also increasing, forcing manufacturers to identify new opportunities for optimizing and reducing energy costs across all facets of process design, implementation and production.

Digital Transformation offers new toolsets that enable oil and gas producers to increase their competitive levels in their market and industry. These digital toolsets help to improve yield of valuable product while reducing energy consumption and increasing throughput. Using digital technology, manufacturers can create a complete digital twin of their processes and assets allowing them to evaluate what-if scenarios in batch processing and manufacturing.

Through digital transformation operators can mash up real-time process data with current economic conditions giving operators the ability to make informed decisions at an expedited rate. Information sharing increases while stakeholders increase their ability to visualize results and key performance indicator data across process and overall plant production. Online process optimization and reporting offers a large potential impact on process yield, energy usage and throughput optimization

Increase Profitability

APC Model Predictive Control is comprehensive, advanced process control software that improves process profitability by enhancing quality, increasing throughput, and reducing energy usage. It uses modern, state-of-the-art technology to provide automatic control systems that are capable of releasing process potential. Predictive control helps process operations realize their full potential by moving the process closer to active constraints — resulting in reduced process variability and increased profits.



CLOUD-BASED PROCESS DESIGN

Cloud computing offers several opportunities to reduce costs in process design. By leveraging the almost infinite processing power and storage available through cloud-based architecture, process design can accelerate while also reducing capital investment costs for process modeling and training. Oil and gas producers can spin up cloud based servers and computing resources as needed. This also accelerates the flow of information throughout process design. Through a cloud based architecture for process design information accessibility is increased, availability is enhanced and total cost of ownership (TCO) is significantly reduced.

As process design moves to the cloud the production process can be continually improved through revamp and process improvement. They can also digitally connect process and control strategy design to accelerate startup after plant turnaround and quickly debug control application design. Through a cloud-based architecture offering an open model writing environment, simulation benefits can be extended to areas not well covered today. Like many reactors, polymers and specialties. Process innovation becomes

seamless through collaboration by separating the content from the product allowing the content, such as simulation models, to be managed easily with file history logs in a central repository.

Efficiency is significantly increased using cloud-based architecture as refineries can adapt to changing needs. Computing power can be scaled up or down with varying numbers of virtual machines or instances to facilitate simulation templates for engineering test or training scenarios. Secure user access control allows administrators to add, delete or edit users and privileges as needed. IT overhead is simplified to a pure on-demand cloud-based architecture where machines are accessed via a secure URL, and new versions of process designs are available as soon as they're released. Companies in the upstream, midstream, and downstream markets can also adapt their plants and facilities to changing legislative and market requirements faster through a cloud-based architecture. As process design information is digitally stored in the cloud it becomes easier to mashup this information with other sources of data and drive the enterprise towards a completely digital planning and operations model.

Accelerate Operational Excellence

Simulation Platform supports the entire engineering lifecycle; from representation of actual P&ID, mapping each equipment object to a detailed engineering database; to building/testing the dynamic stimulation early in the process design; to optimizing the process and control design, comparing capital versus operating costs; to the continuous improvement of operations, as the simulation model becomes a plant's Digital Twin.



DIGITAL PLANNING AND OPERATIONS

Integrated petrochemical production networks are highly complex and difficult to visualize for planning and operations. While at the same time, increasing volatility of supply and demand in feedstock enables opportunities for margin improvement. Through digital transformation business units that have historically been disconnected silos can connect in real time to create a unified supply chain model that maximizes profitability by taking advantage of data mashups between real-time economic and market data sources and current plant and production status data.

In a unified supply chain model planning and operations are fused together across the digital value chain. A complete 360-degree view of the digital value chain emerges allowing all aspects of the enterprise to be visualized, analyzed and optimized. Inputs to the enterprise such as feedstock and raw materials are analyzed in real-time against planning, operations, scheduling and distribution. Full plant models are managed simultaneously within a supply and distribution network. Fast optimization, combined with user-configurable visualizations and reporting, allows the impact of uncertainties and data changes to be evaluated and understood in real-time.

Feasible and robust schedules emerge that lead to business decisions that are simpler to understand and explain across the entire enterprise.

Reconciliation and back casting allows businesses to understand how and why deviations from plans occurred, enabling increased planning efficiency while making it easier to generate feasible and robust schedules that shrink the gap between planned and actual operations. The amount and accuracy of production information increases substantially, equipping users with tools and insights to go beyond basic data, OEE and lean manufacturing principles to discover the real metrics that are driving performance, availability and quality throughout all levels of supply chain management, planning and operations.

Metrics generated by newly tapped digital data sources enable users to gain immediate insight into economic decisions across a range of scenarios. Direct integration of operational data and reconciliation environments enables rapid and continual updating of production schedules. Powerful modeling tools and drill down analytics allow users to discover bottlenecks, and understand how to design more efficient operational workflows.

Through digital transformation oil and gas producers can explore opportunities, reduce operational risk and shrink the gap between plan and actual results. Product value streams can be maximized within the petrochemical value chain through a site wide planning model. Optimal feedstocks can be selected based on real-time economic data and for feed flex crackers to maximize margin. And maintenance costs can be reduced through optimized part inventory and the combination of multiple logistics facilities into a single envelope. Digital transformation also offers opportunities to improve workforce training, productivity, safety and regulatory compliance.

Unified Supply Chain Management

BP implements industrial software from AVEVA with advanced modeling to optimize supply chain management from source materials and feedstock to planning, scheduling, operations and distribution. Information is easily shared between users and business functions, improving understanding and collaboration between traders, planners and analysts and delivering a complete visualization of the digital enterprise value chain.



DIGITAL WORKFORCE KNOWLEDGE CAPTURE AND RETENTION

A generational shift is occurring in the oil and gas industry. As a generation of highly experienced refinery and pipeline operators begins to retire it's critical for oil and gas companies to accelerate the onboarding and training of new operators as much as possible to ensure safety and performance.

At the same time training budgets are also being tightened increasing the need to deliver training through a sustainable, efficient and effective model. Digital transformation offers several options to address these challenges.

Virtual Reality (VR) and/or Augmented Reality (AR) are digital toolsets capable of connecting control room operators, maintenance, and field personnel in a single realistic learning environment. Through an immersive 3D environment and high-fidelity dynamic simulation operator training is accelerated across several categories:

- Equipment understanding
- Hazop design evaluation
- Operator training (OTS): Procedure training, Safety scenarios, Crew training
- Maintenance planning and execution
- Real-time enterprise asset management

Augmented and virtual reality training solutions facilitate minimized project risk by preventing delays during plant commissioning and start-up and also maximize return-on-investment in plant personnel training. Mobile technology enables workers to become a data capture point, collecting data from non-instrumented and stranded assets, enhancing operational visibility and acting as a data input point for an Asset Performance Management strategy focused on increasing plant and asset uptime and driving reduced maintenance and operations costs.

Mobile technology also offers the ability to bring teams together in virtual settings no matter where they're physically located. People can perform their duties from wherever they are, accessing, monitoring and managing the refinery, plant or process in real time from their handheld devices. Workers are no longer tied to the physical location but instead carry a virtual version or digital twin of the plant or facility in their pocket at all times. New operators for greenfield sites need to be qualified for start-up and operation quickly to meet specifications.

Through mobile technology new maintenance technicians are trained faster as maintenance procedures and decision support workflows are delivered directly to their mobile devices. Mobility is also a tool that millennials, having been born digital themselves, are already accustomed to. This helps to accelerate their assimilation into the workforce. AR/VR Enhanced Operations based training through IntelTrac Mobile Operator Rounds can accelerate that process while laying the foundation for improved safety and regulatory compliance.

IntelTrac Mobile Operator Rounds

As the industry-leading mobile workforce and decision support system IntelTrac Mobile Operator Rounds includes configurable software and ruggedized mobile hardware solutions that enable workflow, data collection and general task management for plant operations, maintenance management, production tracking and compliance applications. As part of their overall "Visual Factory" initiative Ascend Performance Materials implemented IntelTrac Mobile Operator Rounds along with other software solutions from AVEVA Software and achieved significant results:

- Savings of \$500,000 in utilities and materials costs
- More than \$1 million in savings from reduced maintenance costs
- Avoided potential plant shutdowns equating to a savings of \$2 million



IMPROVED SAFETY AND REGULATORY COMPLIANCE

Environmental, health and safety compliance is a paramount focus in the oil and gas industry. One of the main drivers of this focus is the implementation of a "Zero Accidents" culture. In terms of accident prevention strategies, a Zero Accident culture can be viewed as the idea that all accidents can be prevented through policy and procedure adherence. Many factors contribute to a good safety culture, including skilled employees, continuous safety risk assessment (HAZOP) and good practices and standards, next to primary and secondary process safety.

Environmental regulation and emissions targets have continuously tightened over the past several years. As well as the need to document and audit compliance of new regulations. Examples are the Industrial Emissions Directive by the EU (IED) and implementation into local legislations like TA-Luft in Germany. For example, emissions include flaring activities, which requires the increasingly efficient start up and shut down of plants through tighter process design tolerances and strict, auditable operational adherence to processes and procedures.

Mobilizing the operator workforce helps ensure regulatory compliance as stacks of paper maintenance reports, audit logs and repair procedures become digital versions of themselves.

Information is stored digitally in a central location and backed up to the cloud. Regulatory audit trails are automatically generated. As comprehensive operations efficiency models are deployed, visualizing which equipment, processes, teams or sites are underperforming becomes easier and provides part of the foundation for developing an asset performance management strategy that maximizes return on asset investment for oil and gas producers and pipeline operators.

Capital expense constraints limit investment in new equipment across all markets of the oil and gas industry. While demand increases, requiring greater production from existing machines. A complete digital Asset Performance Management (APM) solution combines enterprise data capture with asset management, advanced workflow, mobility, predictive analytics and risk-based management to drive maximum return on asset investment through reduced downtime, lowered total cost of ownership, decreased maintenance costs and improved overall equipment effectiveness.

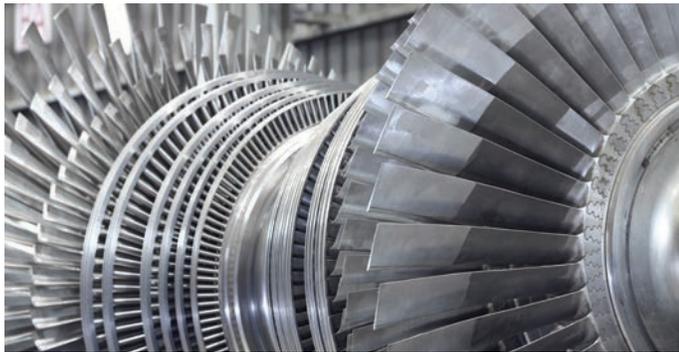
A complete APM solution allows operators and maintenance engineers in upstream production, midstream transportation and downstream processing to automatically generate work orders to relieve maintenance issues as soon as they're discovered. While advanced data capture and analytic capabilities provide detailed insight into the health of production assets. The integration of these capabilities with advanced workflow facilitates continuous process improvement while ensuring assets are not overly maintained and MRO inventory costs reduced.

A study of common failure patterns by ARC Advisory Group found that a full 82 percent of failure types are random. Only 18 percent are predictable and preventable with traditional maintenance methods. Machine learning helps identify inefficiencies and abnormalities in equipment operation long before regular inspection. Engineers can reference operational models and

digital twins for recent abnormalities in design versus operational performance. As data is collected at an operational level and fed into other digital toolsets it imperative that oil and gas enterprises make the right digital technology investments.

Catch Asset Failures Before They Occur

In a large regulated and non-regulated utility with over 60+ plants in 6 states, including coal, simple cycle combustion turbines, combined cycle and integrated gasification combined cycle plants, AVEVA helps monitor and optimize the maintenance of critical power generation assets with PRiSM Predictive Asset Analytics software. A single early warning of a crack in a turbine rotor saved the utility over \$7.5 Million.



OIL AND GAS TECHNOLOGY INVESTMENT PILLARS

Choosing the right technology investment requires analysis of four key technology pillars to ensure successful digital transformation and optimum ROI.

Comprehensive Value Chain

Modern digital platforms must deliver returns across the comprehensive value chain of the enterprise. Technology Investments must enable the digital integration of engineering, planning and operations, control, visualization, information and asset performance solutions to create a 360° view, from the shop floor to the top floor.

Open and System Agnostic

Interoperability and cross platform support accelerate a path towards continual process improvement. Rapidly sharing big data and insights across multiple platforms including cloud, mobile, augmented and virtual reality requires open, system agnostic technology solutions that augment rather than rip and replace existing asset investments. An open, system agnostic approach to digital transformation drives long-term value and lower total cost of ownership (TCO).

Digital Ecosystems

Technology investments should be backed by a multidisciplinary ecosystem of technology partners. Ecosystems should include capabilities of design, development, delivery, maintenance and support of industry specific solutions on a global scale. Ecosystem partners may include software developers, technical distributors, system integrators, OEM providers and technology partners, all focused on extending value and driving innovation across industries.

Flexible and Agile Implementation

Adapting to unforeseen events becomes automatic through flexible technology implementation options. True digital transformation platforms provide the ability to choose between deployment options including on premise, cloud or hybrid rollouts. Agility in procurement options allows enterprises to obtain the required tools through several options.



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including perpetual licensing or subscription based services Solutions for implementing technology on an as needed, staged approach help the enterprise reduce upfront costs and decrease time to value of new technology investments while accelerating a path toward increased profitability.

START SMALL. START NOW. WITH AVEVA SOFTWARE

Digital transformation is part of an ongoing journey towards continuous process improvement involving the collaboration of people, processes and assets through digital technology. It doesn't happen all at once but instead gains speed and velocity over time as people, processes and assets are digitally fused together to eventually bridge the operations technology and information technology gap. Start small in your strategy and adoption. But start now to maintain or improve your competitive market and industry position.

AVEVA is a proven industry leader stacked with digital transformation technology including:

- Engineering
- Planning and Operations
- Asset Performance
- Control and Information

Make your Digital Transformation journey flexible, effective, measurable and profitable.

About the Author

Matt Newton is Senior Technical Marketing Manager for AVEVA's Asset Performance Management portfolio. With over 15 years of experience planning, developing, and implementing diverse batch and process automation applications, he has extensive experience designing and implementing industrial Internet of things and machine-to-machine applications from the network edge to the enterprise cloud. A former systems and applications engineer, he is responsible for global marketing activities supporting AVEVA's asset performance management product portfolio.

About AVEVA

AVEVA is a global leader in engineering and industrial software driving digital transformation across the entire asset and operational lifecycle of capital-intensive industries.

The company's engineering, planning and operations, asset performance, and monitoring and control solutions deliver proven results to over 16,000 customers across the globe. Its customers are supported by the largest industrial software ecosystem, including 4,200 partners and 5,700 certified developers. AVEVA is headquartered in Cambridge, UK, with over 4,400 employees at 80 locations in over 40 countries.

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