avathon.

White Paper

The Avathon Autonomy Platform

Optimizing Oil & Gas Operating Performance with AI

Introduction—Energy and industry in transition

The global oil and gas (O&G) industry has, in recent years, embraced artificial intelligence (AI) and digital transformation as key enablers to deliver its vast and complex array of products more efficiently and cost-effectively. Embracing these technologies not only helps to drive operating efficiency and manage costs but is also an invaluable tool in maintaining worker safety and achieving sustainability goals.

Operational optimization and cost reduction are, though, perceived very differently by the various contributors to the end-to-end O&G value chain, making it critical to think in terms of systemwide improvements that can ultimately result in added revenue, cost savings, or ideally both. An integrated approach to operations optimization is thus required—one that evaluates hundreds or even thousands of data points in real-time from interconnected assets, processes, and systems.

For example, a single pump streaming multi-variate sensor data like pressure, temperature, flow rate, and vibration can generate as much as 2.5MB/sec of data, or 216GB/day. Typical onshore and offshore production platforms can have anywhere from 10-35 interconnected assets and processes generating similar quantities of data, making it impossible to perform manual analysis and extract timely, actionable performance insights. AI is thus quickly becoming the next generation analytical technology of choice for industry leaders as they work to address the challenges of optimizing asset performance to reduce production disruptions.

Avathon's Autonomy Platform uses AI technology to ingest, analyze, and learn from normal performance data, whether structured or unstructured. The result is automated real-time understanding of integrated system performance. By modeling normal behavior, then monitoring for anomalies, the system provides alerts well in advance of actual equipment failures, saving maintenance time and dollars, extending equipment life, averting unplanned downtime, and ensuring worker safety. Avathon's Autonomy Platform generates predictive and prescriptive insights that not only identify failures before they occur but also provide crucial insights into the causes of such events so that steps can be taken to mitigate them in the future.

The Numbers Behind O&G Operations

5.2 %
Global O&G industry growth CAGR (2025 – 2029)

10–30 %
Expected demand decline in automotive fuel consumption from vehicle electrification

$654B
Upstream O&G CAPEX projected for 2025

$3M / day
Potential lost production revenue from one day of downtime

$200B / year
Revenue lost annually to production inefficiency

77 %
Typical offshore platform production as a percentage of capacity

Upstream

Unplanned upstream downtime is one of the most significant sources of lost revenue and a major cost driver, both of which significantly harm profitability. A critical asset failure on an offshore production platform can cost a company $3M in a single day. AI-powered predictive maintenance is the best way to keep capital-intensive assets up, running, and producing. Machine learning applications ingest sensor data from critical systems and equipment, applying analytical algorithms, and uncovering patterns that point to assets trending toward failure. This technology then flags impending asset failures days or even weeks in advance, giving operators the insights they need to plan accordingly.

McKinsey & Company analysis has found that offshore platforms typically only realize an average of 77% of their full production potential, leading to annual industry losses from operating inefficiencies of as much as $200B. This is due in large part to the sheer quantity of variables and data involved in O&G production. Proactively detecting inefficiencies requires analyzing and understanding these immense volumes of data, a challenge far beyond what human analysts—and their legacy systems—can manage. As an example of applied AI, machine learning can monitor and evaluate multiple control variables in drilling operations, identify the parameters driving performance, and use this knowledge to build recommendations for operators, indicating which variables they should adjust to optimize production. With continued learning and feedback from operators, the system can be operated with autonomous decision making, speeding continuous optimization.

Midstream

The midstream segment of the industry, responsible for the safe and efficient transportation, storage, and initial processing of O&G raw materials, is the critical intermediary between production and refining. The infrastructure associated with these important processing responsibilities is, though, typically several decades old, requiring continuous inspection and repair to minimize losses and ensure reliable, profitable operations. Events like leaks, ruptures, corrosion, and even cybersecurity breaches can lead to losses that not only affect profitability but also compromise environmental compliance and worker safety.

Building AI into day-to-day midstream processes helps ensure the efficient movement of product, allowing upstream companies to get raw materials to refiners and downstream companies to receive necessary feedstocks, thereby optimizing the entire value chain. Logistics and routing models provide a comprehensive view of operating interdependencies by mapping pipelines, pumps, valves, and other infrastructure elements. Mapping shipping and logistics interdependencies using tools like computational knowledge graphs and leveraging machine reinforcement learning optimizes fleet effectiveness and reduces emissions. Pipeline and tank integrity monitoring detects leaks, corrosion, and flow anomalies by analyzing performance data from sensors, visual inspection, and acoustic monitoring, enabling automatic shutoffs or other corrective actions to minimize equipment damage, product losses, and safety/environmental risk.

Downstream

As the segment of the O&G value chain responsible for producing and distributing final saleable hydrocarbon products safely and economically, downstream operations demand efficiency and effectiveness across vast scales. A large modern refinery can cover several thousand acres of land and include a vast range of individual assets that include pumps, compressors, pipelines, tanks, and a host of other interconnected equipment. The failure of even a single piece of equipment in these complex processes can lead to the shutdown of an entire feedstock line, causing millions in production losses, repair expenses, increased capital outlays, environmental exposure, and compromised worker safety.

AI-enabled predictive identification and diagnosis of pending failures and prescriptive recommendations mitigate these failures, saving cost and ensuring continuing product output. Process mapping using computational knowledge graph technology and AI optimization integrates feedstocks, chemistry, and equipment to maximize refinery throughput, ensure product quality, and minimize emissions. Prescriptive maintenance of refining assets like pumps, turbines, and compressors predicts anomalies and avoids disruptions, prescribes failure mitigating solutions, and autonomously acts to avoid costly downtime.

Supply chain optimization enhances forecasting of refining and distribution equipment demand, automates procurement, and balances product inventory across far-flung networks of warehouses, refineries, and storage facilities. And optimization of retail operations ensures fuel distribution and sales happen efficiently and profitably using automated monitoring to ensure product availability, customer service, and health/safety compliance.

Key benefits of Avathon Autonomy for Oil and Gas

The Avathon Autonomy Platform leverages the many capabilities of AI to dramatically lower operating and capital costs while improving exploration, production, refining, and distribution efficiency for O&G operators. Avathon Autonomy is the only energy management platform that optimizes day-to-day operations using agentic-AI management of assets and supply chain processes. Features of the platform include:

Shortened data-to-action lead time: No data science experience needed. With Avathon's intuitive dashboard and reporting capabilities, users can be trained and working in less than one day.

No black-box results: Avathon's AI technology explains when, and most importantly why, an anomaly will occur. Behaviors that cause anomalies are analyzed and trended over time to show progression, highlighting issues as they develop, and histogram distributions show where current values are relative to historical performance and related sensor or process data.

Zero alert fatigue with smart alerts and auto-calibration: Alert thresholds are tuned with real-time human subject matter expert (SME) feedback to automatically categorize and benchmark alerts, reducing false positives.

ROI in days, not months: With normal behavior modeling (NBM), system training occurs in just a few days. Our patented technology learns 'normal' behavior and transitory states from historical healthy operational data, rapidly and accurately identifying performance anomalies and flagging unknown unknowns.

Asset-aging ready, with human-in-the-loop automatic re-training: Driven by user knowledge and alert scoring, the Autonomy Platform learns the system's 'new normal' and operating states as assets age and maintenance practices change.

Visual image analysis: The Autonomy Platform includes multi-modal situation analysis capabilities that use a company's existing camera network to ensure personal protective equipment (PPE) compliance, enhance operating safety, and identify environmental and process risks before they become incidents.

Use cases

Avathon Autonomy for O&G tackles a wide range of potential equipment failure types, autonomously driving excellent asset performance and minimizing operating costs, both recurring and capital, including:

✓ **Large-scale compression equipment**	✓ **Compression systems for gas takeaway**
✓ **Flaring/emissions compliance**	✓ **Gas dehydration units, separators, and heat exchangers**
✓ **Pumps for offshore operations (variable frequency drive, salt water, single/multiphase)**	✓ **Pipeline blockage and leak detection**
✓ **Pumps for refining operations (single/multiphase)**	✓ **Rotating equipment (compressors, pumps, turbines, turbo**
✓ **Process equipment, heat exchangers**	✓ **Pumps, valves, and actuators**
✓ **Centrifugal and reciprocating compressors**	✓ **Gas turbine generators**
✓ **Tank and pipeline integrity**	

Case studies

Performance Gains at Industrial Scale

A supermajor implemented Avathon Autonomy on critical offshore systems to model asset degradation and process instability. Deployment required one month per platform, reducing predictive triage time by 80% and delivering a 4% production gain — a $30M annual increase per platform.

$30M
annual production increase per platform

80%
reduction in triage time

4%
production improvement

Visual Intelligence for Safer Operations

A large Asian midstream firm deployed Avathon's visual intelligence solution to improve safety and PPE compliance. Real-time AI detection of unsafe behavior allowed supervisors to intervene immediately, averting one fire and improving SOP adherence by 80% across field operations.

80%
improvement in SOP adherence

1
fire averted

Autonomous Planning for Global Operations

A multinational O&G producer used Avathon's Autonomy Platform to optimize logistics planning and reduce manual operations. Leveraging Avathon's knowledge graph technology improved fleet agility, saving $1M per week and reducing FTE from 75 to 6 through automation and reliability gains.

$1M/week
savings from reduced spot charters

75 to 6
FTE reduction

4%
Automation/reliability improvements

Predictive Maintenance Extends Asset Life

A large refining firm implemented Avathon Autonomy to predict compressor events caused by vibration and power surges. The system achieved 86% event detection, extending lead time from 15 to 100 minutes and reducing unplanned downtime across the refinery.

86%
event detection rate

15 to 100 mins
Lead time improvement

↓
Reduced unplanned downtime

Conclusion—The future of oil and gas operations is autonomy

Enabling predictive/prescriptive workflows, real-time data integration, automated model-building, powerful planning and visualization toolkits, generative AI workflows, and more, Avathon's Autonomy for Oil and Gas Operations is a highly scalable solution that helps O&G companies learn from diverse structured and unstructured data types to deliver explainable actionable insights, reduce costs, and optimize processes.

The Autonomy platform is a complete asset management and prescriptive analytics suite that seamlessly integrates with existing workflows while leveraging SME knowledge and expertise. The solution applies our patented NBM technology to deliver, from day one of deployment, AI models that are easily tuned to find the optimal balance between high accuracy, low false positive rates, and long prediction windows.

Our unique end-to-end approach and deep experience in the O&G industry enable us to provide faster data-to-insight results backed by evidence, with meaningful and accurate explanations that can be understood by staff with no data science knowledge. Our team members have deep experience in O&G systems and processes—from E&P to the refinery. This extensive knowledge allows us to design intuitive and fluid user experiences into the Autonomy Platform that drastically reduce your staff's learning curve. And when the Autonomy Platform identifies an issue, the Avathon services team stands ready to assist in root-cause analysis, helping you to develop and implement corrective actions that save time and money.

As E&P companies scale production, refiners manage supply and workforce shortages, and midstream operators manage aging fleets and assets, autonomy for operations is becoming essential. Avathon Autonomy embeds decision-making directly into operations, accelerating production and refining throughput, improving product quality, repairing transport networks, and strengthening asset readiness. By linking asset health, supply chain signals, and workforce capacity and skills with the power of AI, O&G organizations can detect issues earlier, prescribe precise solutions, and sustain production at scale. The next era of O&G operations will belong to those who adapt intelligently—with autonomy.

About Avathon

Avathon delivers industrial autonomy powered by AI, enabling organizations to connect data, processes, decisions, and actions across operations. Its Autonomy Platform brings decision intelligence and execution to the world's most critical industries, empowering safer, more resilient, and more efficient operations.