ENERGY

Operationalizing AI in Midstream Oil and Gas: Use Cases, Benefits and Barriers

The Midstream Oil and Gas Landscape Is Complex

The Midstream sector is facing a convergence of pressures that is forcing operators to rethink their operating models. Aging infrastructure requires escalating maintenance spend while market volatility, from fluctuating commodity prices to shifting geopolitical landscapes, demands greater agility. At the same time, the sector must navigate a generational transition in its workforce, where seasoned operators are retiring and digital-native talent is scarce.

The operationalization of artificial intelligence (AI) within the Midstream sector can provide a path forward to address many of the barriers stifling value capture in the sector today. However, without a proper plan and structure in place, the use of AI can be ineffective and cost organizations millions.

Challenges Span the Midstream Value Chain and Are Not Easily Solved With AI

Much of the Midstream sector's physical assets were built decades ago, with limited digital records. This lack of record makes it difficult to collect the high-quality data needed to fuel AI models, particularly those used for predictive maintenance or digital twin simulations.

The unpredictability of commodity flows and geopolitical disruptions means that AI tools must be dynamic and regularly retrained, which can strain internal capabilities. This strain is exacerbated by talent shortages. As older workers retire, companies are struggling to attract younger employees with the technical skills required to manage and interpret technology systems.

Operational inefficiencies, stemming from disconnected IT and OT systems, hinder efforts to build unified platforms that can harness AI at scale. Many Midstream operators still rely heavily on manual workflows and legacy systems, making integration costly and cumbersome. Overcoming these barriers requires strategic investment, strong executive sponsorship and a willingness to reimagine traditional ways of working.

As evidenced by these challenges, implementing AI is complex. However, early adopters like ADNOC and BP have shown AI deployments can yield meaningful returns if they are well-governed and aligned with broader business strategy. For example, ADNOC reportedly generated $500 million in added value by deploying over 30 AI tools across its value chain. As a result, ADNOC realized optimized pipeline throughput and terminal operations, improving efficiency in transporting and storing hydrocarbons while avoiding 1 million tons of CO_2 emissions through AI-driven energy optimization across facilities. Additionally, BP partnered with Palantir Technologies to enhance AI-driven decision-making across physical infrastructure, resulting in improved analysis of asset health and optimized product flow across Midstream networks.

Certain regulatory forces are even reinforcing digital adoption. The Federal Energy Regulatory Commission (FERC) has introduced standards aimed at enhancing real-time data visibility across pipeline operations, and the SEC's proposed climate disclosures mandate rigorous emissions tracking. These external pressures, combined with internal cost-efficiency mandates, are pushing Midstream operators to consider AI not as a novelty, but as a necessity. As such, private equity investors and digital transformation leaders are increasingly viewing AI adoption as a differentiator in value creation.

AI Has the Foundation to Be a Transformative Force in the Midstream Sector

As companies grapple with aging infrastructure, market volatility, shifting talent demographics and operational inefficiencies, AI offers new avenues for value creation and resilience. Operators, however, often fail to realize the value of AI initiatives due to an underinvestment in the underlying foundational structure needed to deliver scalable products and capabilities. As a result, proper diligence is not performed, and operators often only capture the tip of the iceberg when defining their focus and solutions that best fit their business.

These unclear business cases make AI implementations a long and costly initiative that stifle the ability to maximize value capture as a result of the technologies' use. Alvarez & Marsal (A&M) has identified seven specific use cases to help organizations start the right discussions around the potential AI solutions that they can leverage to navigate common barriers and extract tangible business value.

Our Perspective on AI Initiatives

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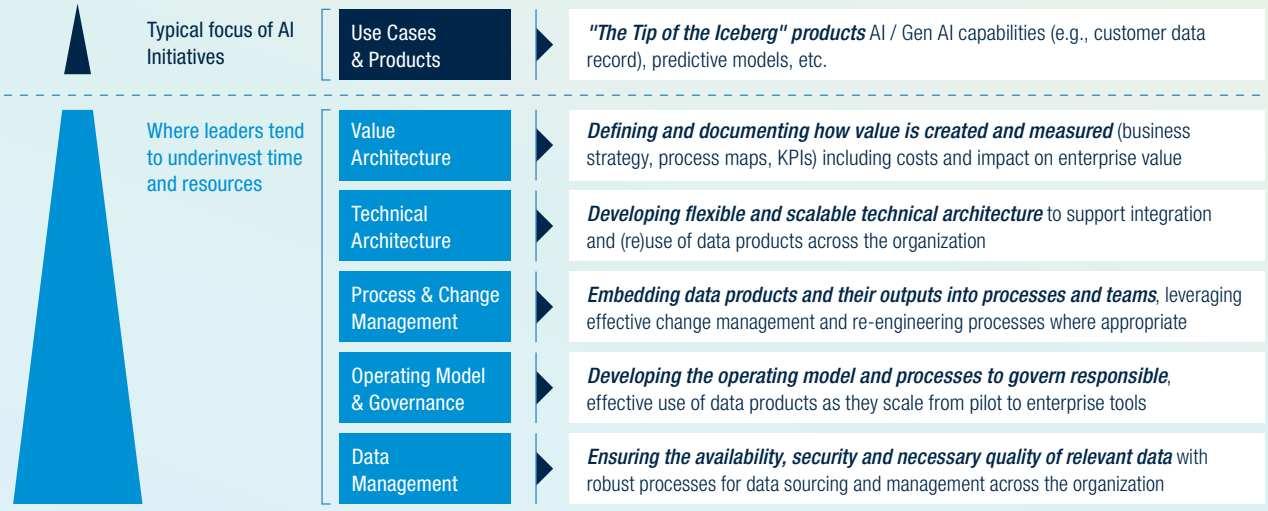

High-Impact AI Use Cases Across Midstream Value Streams

AI technologies are applied across a range of Midstream value streams, each offering distinct opportunities to reduce cost, enhance reliability and improve transparency. A&M summarizes the value streams that can be positively impacted by the use of AI into five key areas:

Trade capture to invoice enables the commercialization of Midstream assets by translating commercial strategies into executed deals and realized revenue. It includes strategy development, deal entry and execution, deal analysis, invoicing, and cash application to ensure accurate transaction capture, financial integrity and timely cash flow.

AI Use Case: AI-driven BOL validation and settlement automates the capture, verification and financial actualization of hydrocarbon deliveries at terminals, truck racks and pipeline interconnects. By leveraging artificial intelligence, particularly machine learning, optical character recognition (OCR) and natural language processing (NLP), the process transforms traditionally manual, error-prone workflows.

AI Use Case: Preventative maintenance and asset management orchestration acts as an autonomous coordinator for preventative maintenance by analyzing sensor data, inspection reports and operational trends to prioritize and initiate maintenance activities. It can generate and sequence work orders, recommend procurement actions for parts and services, and balance maintenance workloads across resources. This orchestration minimizes downtime, extends asset life and optimizes spend by shifting maintenance from reactive to predictive, anchoring procurement and planning in real-time asset health.

Procure to pay manages the end-to-end lifecycle of goods and services acquisition to support safe and efficient Midstream operations. It includes planning, requisitioning, procurement, inventory management, payment, and administrative close to ensure supply reliability, cost control and financial accuracy.

AI Use Case: Intelligent procurement automation enables Midstream operators to optimize sourcing, accelerate approvals and reduce maverick spend by leveraging AI to analyze vendor data, predict delays and streamline purchase-to-payment workflows.

AI Use Case: Automated drone infrastructure inspection leverages computer vision to autonomously assess the condition of midstream infrastructure such as pipelines, tanks and pump stations. High-resolution imagery is analyzed in real time to detect corrosion, leaks or structural anomalies, reducing reliance on manual inspections and improving safety. Insights from inspections inform maintenance planning, work orders and procurement of materials and services, enabling proactive asset care and minimizing unplanned outages or emergency spending.

Record to report enables accurate financial reporting and informed decision-making by transforming transactional data into consolidated financial insights. It encompasses transaction control, accruals, amortization, allocations, period close and consolidation, reporting, cash management, audit and assurance activities, and forward-looking analyses, forecasting and budgeting.

AI Use Case: Back office transaction (BOT) reconciliation automates the labor-intensive process of validating and matching billing data with operational and contractual records. This tool transforms the time-consuming and traditionally manual process using spreadsheets and siloed systems. BOT reconciliation is enabled by transforming the ability to ingest data from multiple sources (SCADA, RightAngle, ticketing systems, BOLs), applying business rules and flagging exceptions for human review.

Transport to invoice manages the end-to-end commercial and physical flow of hydrocarbons from nomination through to revenue recognition. It includes nominations, apportionment, physical movements, actualization and settlement, invoicing, and cash application to ensure accurate billing and timely cash flow.

AI Use Case: Throughput optimization optimizes throughput across pipelines, terminals and storage facilities, ensuring that hydrocarbons are moved efficiently even as demand patterns shift. By integrating real-time data from SCADA systems, flow meters, tank gauges and scheduling platforms, operators can identify capacity constraints, optimize routing and dynamically adjust schedules to accommodate changing supply and demand conditions.

Hire to retire supports the full employee lifecycle, aligning talent management with business objectives across the Midstream oil and gas workforce. It spans recruiting, hiring, development, payroll, benefits and pension administration, performance management, and retirement to ensure a capable, engaged and well-supported workforce.

AI Use Case: Remote knowledge management for field technicians enables intelligent knowledge delivery for field technicians by transforming technical documents, procedures and subject matter expertise into conversational, accessible formats. Technicians can access guided support via mobile or voice-enabled tools while on site, reducing downtime and improving first-time fix rates. This capability supports onboarding, cross-training, and ongoing workforce development, ensuring continuity of institutional knowledge and enhancing the productivity of both permanent and contract staff across the employee lifecycle.

These use cases vary in terms of implementation complexity and return on investment (ROI) timelines, but all offer compelling returns when deployed thoughtfully and with adequate organizational readiness.

Case Study: Predictive Maintenance Enabled a 25% Reduction in Unplanned Downtime

Shell, one of the world's largest energy companies, operates a complex portfolio of Midstream infrastructure where equipment reliability is critical to maintaining safe and efficient operations. Historically, much of the maintenance activity across its pipelines, terminals and processing facilities relied on scheduled inspections or reactive repairs, which often resulted in unplanned equipment failures, production disruptions and elevated maintenance costs. These breakdowns not only impacted throughput and operational efficiency but also introduced safety and environmental risks, particularly at high-volume assets.

To address this, Shell launched a predictive maintenance initiative leveraging AI and machine learning technologies. The company partnered with data analytics providers to implement models that continuously analyze sensor data from pumps, compressors and rotating equipment to detect early signs of mechanical degradation.

As a result, Shell achieved up to a 25 percent reduction in unplanned downtime and lowered maintenance costs by 10–15 percent, while improving asset availability by as much as 10 percent. The platform demonstrated a clear return on investment within 12 to 18 months and has since been scaled globally across hundreds of critical assets, supporting Shell's broader goals of operational excellence, cost efficiency and enhanced safety performance.

Alvarez & Marsal Is Best Positioned to Support Organizations Throughout Their AI Journey

For Midstream operators, the path to AI maturity is not a sprint but a journey that requires deliberate planning and execution. Success starts with a robust business case that clearly outlines expected benefits, implementation costs and risk factors. Organizations must be prepared for a cultural shift, with strong change management and cross-functional collaboration to ensure that AI is embraced, not resisted, by operational teams.

Pilot programs should be designed for quick wins, demonstrating value early to build momentum and secure ongoing investment. Data governance is equally important; high-quality, accessible data is the lifeblood of AI. Private equity investors evaluating Midstream assets should also look for indicators of digital readiness, as operators with a scalable AI strategy are likely to outperform peers in both margin and resiliency.

Our Approach to AI Implementations

A&M leverages a phased approach to design and deliver AI solutions to Midstream operators.

01 Design a Business Case

Align AI with business outcomes

- Connect operational needs and objectives to clear, AI-driven improvements
- Identify high-impact use cases and their capabilities while addressing critical pain points
- Quantify value with metrics by defining KPIs to measure success
- Build a compelling narrative and align with strategic corporate goals

02 Organizational Readiness

Review AI readiness

- Evaluate data infrastructure (e.g., IoT, sensor reading, maintenance logs, SCADA systems outputs) and other tools for data quality and maturity
- Audit technology stack to determine if existing infrastructure can support AI workloads
- Assess cultural readiness for stakeholder buy-in and addressing workforce concerns

03 Impact Analysis

Assess value, impact, & success

- Baseline current operations by quantifying existing metrics (e.g., downtime costs, maintenance spend, emission levels)
- Calculate use case impacts at all levels of the organization
- Model long-term scalability through a phased rollout roadmap

04 Deployment

Pilot, scale, and govern

- Execute phased roadmap
- Leverage a strategic plan for deploying emerging technologies that drive business outcomes

Monitor and Optimize: KPI & Impact tracking based on business case

Artificial Intelligence is rapidly transitioning from a conceptual advantage to a core operational requirement in the Midstream oil and gas sector. Amid mounting pressures, from aging infrastructure and regulatory demands to talent shortages and margin compression, AI provides a critical lever to unlock efficiencies, enhance decision-making and future-proof operations. The success stories of early adopters underscore a key takeaway: AI delivers real business value when deployed with clear intent, robust data governance and strong executive alignment.

Midstream operators that commit to foundational readiness, invest in high impact use cases, and foster a culture of digital adoption will be best positioned to lead. With disciplined execution and the right advisory partner, AI can become a strategic enabler of operational excellence and long-term resilience in an increasingly dynamic energy landscape.

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