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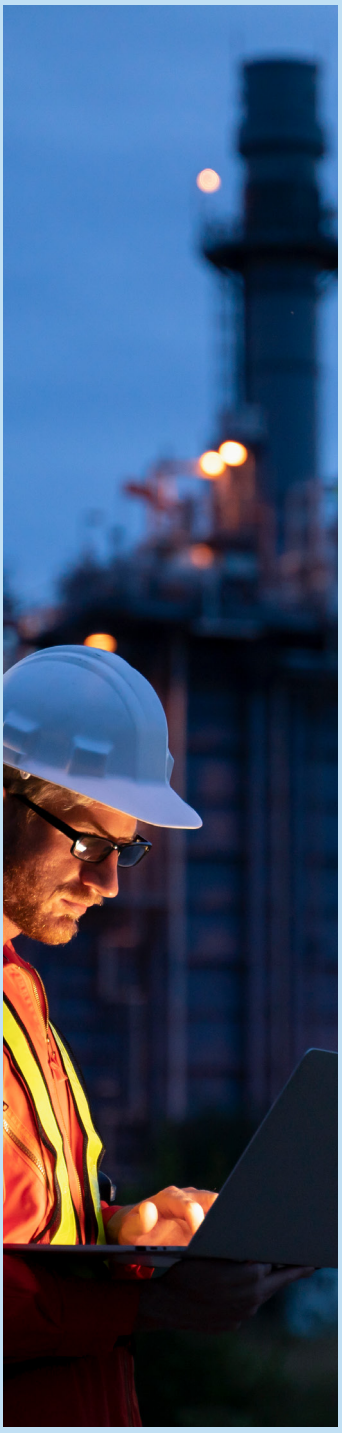

AI IN OIL & GAS: TURNING EXPECTATIONS TO REALITY

Abstract

AI is transforming several sectors. Sectors such as Travel, Banking, Healthcare are leveraging AI applications that include virtual assistants, customer care and patient diagnosis. These applications are transforming effectiveness, efficiency and experience across value chains. Enterprises are increasingly adopting AI with a surge in adoption in 2024. The Oil & Gas Industry is following suit. While Oil & Gas C-suites anticipates substantial technological progress and new business value from AI in their discussions, the actual outcomes often differ from these expectations. Therefore, it is essential for C-suite dialogues to result in business plans that clearly demonstrate AI's real value and detail the tactical steps needed to capitalize on the technology.

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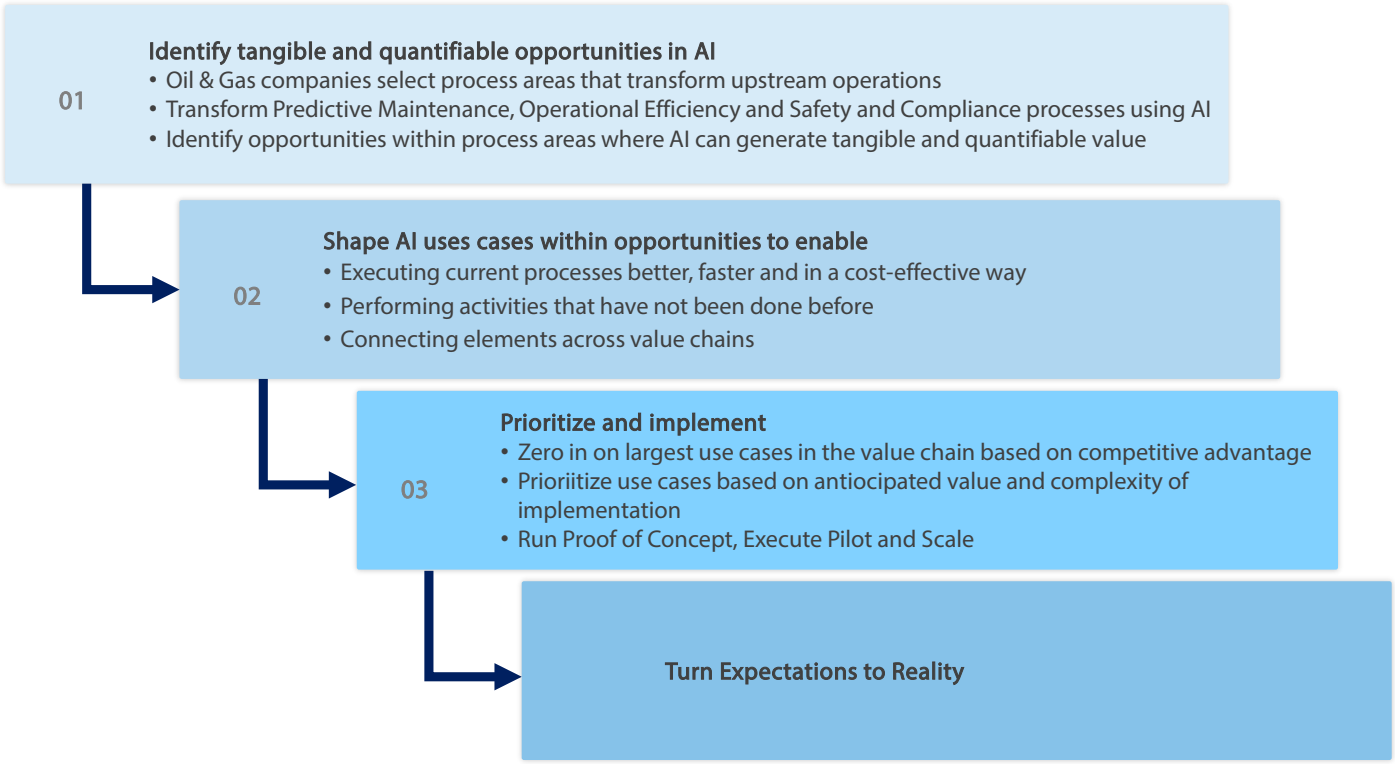
AI in Oil & Gas: Turn Expectations to Reality



The following POV shares how AI has evolved over time, its application in Upstream operations, what AI can do for Upstream today and where lies the greatest opportunity for AI along the value chain. It reviews AI use cases through the lens of Floating Production Storage and Offloading (FPSO) systems to demonstrate the breadth of transformation capabilities that AI offers in Upstream Oil & Gas.

AI has a long history in Upstream Oil & Gas:

Starting from the 1970s with Basic Data Analytics to progressing to Artificial General Intelligence in 2025, AI is becoming all pervasive with advances in computing power, network connectivity and storage devices. The table below traces the history and evolving of AI and key applications in Upstream Oil & Gas.

	Stage of AI Evolution	Key Technologies and Methods	Applications & Uses (General)	Applications & Uses (Oil & Gas Upstream)
1970	Basic Data Analytics	• Rule-based systems • Statistical analysis	• Early business intelligence (BI) systems • Report generation • Financial and actuarial modeling	• Reservoir characterization using basic statistical methods • Well log analysis • Simple economic assessments for exploration
1980	Early AI & Expert Systems	• Symbolic AI • Expert systems	• Diagnostic systems (e.g., medical diagnosis) • Military simulations • Simple decision-making systems	• Drilling advisory systems for optimizing well placement • Early seismic interpretation systems • Rule-based exploration tools
1990	Advanced Data Analytics	• Data mining • SQL and relational databases	• Market analysis • Fraud detection in finance • Customer segmentation	• Improved reservoir modeling using historical data • Production data analysis • Risk analysis in exploration projects
2000	Machine Learning	• Decision trees • Naive Bayes • SVM	• Spam filtering • Recommendation systems (e.g., Amazon, Netflix) • Predictive maintenance	• Predictive maintenance for drilling equipment • Optimization of production rates based on historical well performance • Data-driven reservoir management
2010	Deep Learning	• Neural networks • CNNs • GPUs for AI	• Image recognition (e.g., in Facebook, Google Photos) • Speech recognition (e.g., Siri, Google Assistant)	• Seismic data interpretation using deep learning for fault and fracture detection • Predicting reservoir properties from well logs and seismic data • Enhanced drilling automation
2015	Reinforcement Learning	• Deep Q Networks • Large-scale training (GPUs, TPUs)	• Autonomous vehicles (e.g., Tesla) • Game-playing AI (e.g., AlphaGo) • Virtual assistants (Alexa)	• Real-time production optimization using AI models • Intelligent drilling (e.g., path optimization for horizontal wells) • Autonomous drilling rigs • Reinforcement learning for drilling optimization
2020	Generative AI	• Transformers • GPT (Generative Pre-trained Transformer)	• Text and code generation (e.g., ChatGPT) • Image generation (e.g., DALL-E) • Personalized chatbots	• Automated generation of geological and reservoir reports from raw data • AI-driven insights from historical exploration data • Natural language interfaces for accessing technical data (e.g., voice-based exploration reporting)
2025	Artificial General Intelligence	• Multimodal AI • Self-learning algorithms	• Early research in AI capable of general tasks (broadly intelligent) • Ongoing advancements in robotics, complex decision-making	• AI-driven decision-making for integrated field development • Cross-disciplinary insights (geology, geophysics, engineering) for autonomous field planning • AI-guided autonomous operations for new exploration plays

What AI can do for Upstream today:

Transformation opportunities using AI in Upstream can be broadly classified into three areas:

Predictive Maintenance:

Utilizing AI to monitor equipment health and predict failures before they occur, thereby reducing downtime and maintenance costs.

Operational Efficiency:

Implementing AI-driven analytics to optimize production processes, manage energy consumption, and enhance overall operational efficiency.

Safety and Compliance:

Using AI to ensure safety protocols are followed and to monitor compliance with environmental regulations.

An optimum way to get tactical and applying AI is through use cases. There are several uses cases for AI in each of the three areas. A sample of use cases are noted in the table below:

Predictive Maintenance

Activities	Current Process	AI Use Cases
Fluid Monitoring	• Flow meters	• Virtual Assistants
Tank Cleaning	• Manual reading	• Integration with rig sensors
Weather predictions	• Rig sensors	• Customized report generation
Pipeline Live Conditions	• Visual inspection	• Drone inspection
Power Generation	• Connect from base	• Predictions from GPS reports
	• GPS tracking	• Notifications based on object tracking through pipelines
	• Visual inspection	• Customized report
	• FPSO sensors	• Integration with legacy systems

Operational Efficiency

Activities	Current Process	AI Use Cases
Crew Changes activities	• Email tracking	• Automatic notifications
Crude Oil flow rate monitoring	• Legacy systems	• Optimized learning from legacy systems
Scheduled shut down activities	• Flow Meters	• Computer vision
Vessel tracking	• Scheduled per vendor certification	• Object detection and automatic scheduling
Vessel positioning	• GPS	• GPS tracking with estimated time for arrival notification
	• Vessel Systems	• FPSO system integrated with cloud to track location

Safety & Compliance

Activities

- H2S level monitoring
- Safety Drill manual counting
- Flare gas measurements
- Waste disposal predictions
- Assurance activities

Current Process

- Sensors
- Manual counting
- Gas measurement meter
- Manual lot counting and loading
- Physical assurance

AI Use Cases

- Remote sensing of H2S through producing wells
- Object detection and computer vision
- Automated monitoring integrated with legacy systems
- Automated tracking of waste and vessel allotment
- Physical and Digital assurance combined in one frame

We have categorized the three areas of Predictive Maintenance, Operational Efficiency and Safety and Compliance into four categories that facilitate an easier understanding to adopt AI in large enterprises. The four general categories of AI use cases in Upstream Oil & Gas are:

Real-time, Continuous Advisory and Insight

Fault Detection	Production Monitoring	Virtual Assistants	Work Recommendations
Compliance Monitoring	Recovery Procedures	Risk Assessments	Onsite Training

Complex Modeling and Optimization

Process Modeling and BPO	Asset Performance and Utilization	Root Cause Analysis	Simulation and Scenario Testing
Routing Optimization	Inventory Optimization	Remediation Planning	Resource Allocation

Predictive Analytics and Forecasting

Production Forecasting	Reserves Forecasting	Inventory and Capacity Forecasting	Financial Forecasting
Fault or Failure Prediction	Weather Prediction	Design Recommendations	Resource Requirements

Content Generation and Integration

Regulatory and Financial Reporting	Service and Maintenance Reports	Historical Records Processing	Work Order and Purchase Order Creation
Data Cleansing and Integration	Data Standardization and Governance	SOP and Training Content Creation	Code Generation for Automation

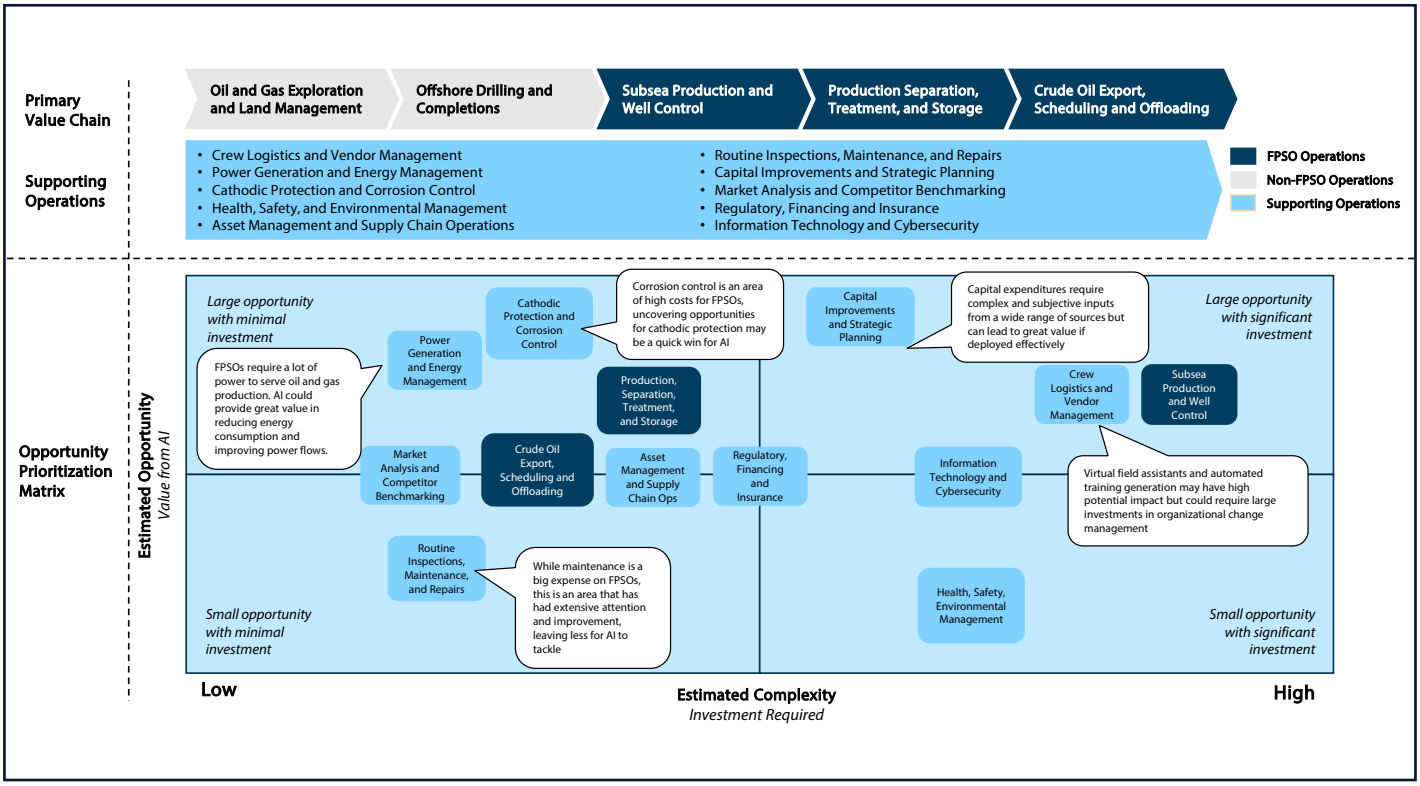
Greatest opportunity for AI along the value chain:

Opportunities are realized through implementing use cases. We use the example of an FPSO to identify AI use cases that can unlock value. Several operations categories from FPSOs can also be applied to other areas within Upstream as depicted below.

FPSO Operation Categories	Real-time, Continuous Advisory and Insight			Complex Modeling & Optimization			Predictive Analytics and Forecasting			Content Generation & Integration		
Subsea Production and Well Control	Fault Detection	Production Monitoring	Recovery Procedure	Asset Perf. & Utilization	Root Cause Analysis	Simulation & Scenario Testing	Production Forecasting	Fault or Failure Prediction	Reserves Forecasting	Service & Maintenance Reports	Historical Records Processing	Data Cleansing & Integration
Production Separation, Treatment, and Storage	Fault Detection	Production Monitoring		Asset Perf. & Utilization	Root Cause Analysis	Process Modeling and BPO	Production Forecasting	Inventory & Capacity Forecasting	Design Recom.	Service & Maintenance Reports	Historical Records Processing	Data Cleansing & Integration
Crew Logistics and Vendor Management	Virtual Assistant	Onsite Training	Work Recommends	Routing Optimize	Resource Allocation	Remediation Planning	Resource Req.	Weather Prediction		Work Order & PO Creation	SOP & Training Creation	Code Gen. for Autom.
Power Generation and Energy Management	Fault Detection	Production Monitoring	Recovery Procedure	Asset Perf. & Utilization	Root Cause Analysis	Simulation & Scenario Testing	Inventory & Capacity Forecasting	Fault or Failure Prediction	Weather Prediction	Service & Maintenance Reports	Historical Records Processing	
Cathodic Protection and Corrosion Control	Fault Detection	Risk Assessment		Asset Perf. & Utilization	Root Cause Analysis	Simulation & Scenario Testing	Fault or Failure Prediction	Design Recom.		Service and Maintenance Reports	Historical Records Processing	
Health, Safety, and Environmental Management	Compliance Monitoring	Risk Assessment	Recovery Procedure	Root Cause Analysis	Remediation Planning	Simulation & Scenario Testing	Fault or Failure Prediction	Weather Prediction	Design Recom.	Regulatory & Financial Reporting	SOP & Training Creation	Data Standard. & Governance
Asset Management and Supply Chain Operations	Compliance Monitoring	Risk Assessment		Inventory Optimize	Resource Allocation	Routing Optimize	Inventory & Capacity Forecasting	Financial Forecasting		Work Order & PO Creation	Data Standard. & Governance	Data Cleansing & Integration
Routine Inspections, Maintenance, and Repairs	Virtual Assistants	Onsite Training	Work Recommends	Resource Allocation	Root Cause Analysis	Routing Optimize	Resource Req.	Financial Forecasting	Fault or Failure Prediction	Work Order & PO Creation	SOP & Training Creation	Service and Maintenance Reports
Crude Oil Export, Scheduling, and Offloading	Compliance Monitoring	Work Recommends		Asset Perf. & Utilization	Resource Allocation	Routing Optimize	Financial Forecasting	Inventory & Capacity Forecasting	Weather Prediction	Code Gen. for Autom.	Data Cleansing & Integration	
Capital Improvements and Strategic Planning	Work Recommends	Risk Assessment		Asset Perf. & Utilization	Resource Allocation	Remediation Planning	Financial Forecasting	Reserves Forecasting	Inventory & Capacity Forecasting	Data Standard. & Governance	Data Cleansing & Integration	Historical Records Processing
Market Analysis and Competitor Benchmarking	Production Monitoring	Work Recommends	Risk Assessment	Asset Perf. & Utilization	Simulation & Scenario Testing		Financial Forecasting	Reserves Forecasting	Design Recom.	Code Gen. for Autom.	Data Standard. & Governance	
Regulatory, Financing and Insurance	Compliance Monitoring	Risk Assessment		Simulation & Scenario Testing	Process Modeling & BPO		Financial Forecasting	Fault or Failure Prediction		Regulatory & Financial Reporting	Code Gen. for Autom.	Data Standard. & Governance

Prioritizing use cases by identifying the largest opportunities along the value chain enables us being one step closer to reality. Opportunities may be unique to every enterprise based on what drives its competitive advantage. Furthermore, enterprises can also look at opportunities that create value across different value chains such as Upstream, Downstream, Midstream, Chemicals and Petrochemicals. Such opportunities will assure broad-based support for running Proof of Concepts, executing Pilots and Scaling AI use cases. Each enterprise needs to assess the anticipated value from AI and complexity of implementation.

The C-suite can use the below assessment to support informed decision making on investments in AI. Infosys' Enterprise IT Consulting Services, Infosys Consulting offers C-suite support with this assessment paired with a recommended structured approach for scaling. Enterprises can thereby increase the probability of success of turning expectations from AI into reality and generate business value for their organization.



In Conclusion:

AI can transform Upstream Oil & Gas operations and unlock value by:

- executing current processes better, faster and in a cost-effective way
- executing activities that have not been done before
- connecting elements across value chains

AI promises to transform Predictive Maintenance, Operational Efficiency and Safety and Compliance in Upstream Oil & Gas operations. Several AI use cases impact these three areas and span across four categories: Real Time Continuous Advisory and Insight, Complex Modeling and Optimization, Predictive Analytics and Forecasting, Content Creation and Integration. Upstream organizations should evaluate the value these uses cases can generate versus the complexity of implementing the use cases in their unique environment. Identifying tangible and quantifiable opportunities to use AI, shaping AI uses cases, and prioritizing and implementing use cases with the highest value vis-à-vis the complexity, offers a path to turning expectations from AI in Upstream Oil & Gas into reality.

Infosys' Enterprise IT Consulting Services, Infosys Consulting are focused on creating business value through technology innovation for Oil & Gas companies worldwide. The combined expertise guides clients on their AI journey in all stages of their maturity and through these partnerships, enables enterprises in turning their AI aspirations into reality.

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Rima combines her Oil & Gas industry and consulting experience to serve multinational clients through business & digital transformation engagements. Her experience spans across Upstream, Corporate, and Downstream Oil & Gas sectors in the US and Canada regions. She is passionate about helping her clients make great strides in real-time data analysis, AI & advanced analytics, value generation from AI use cases, and managing the entire digital product lifecycle for client transformation efforts.

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Sachin works on Digital Strategy and Transformation in Oil & Gas. He has experience in Downstream, Midstream and Upstream Oil & Gas in the US, India and South-East Asia. Sachin works with several large Oil & Gas companies to frame their digital strategy encompassing customer and employee experiences, operations, and new business models. Sachin helps quantify value across the Value Chain beginning with industry opportunities, ending with decisions and tools using AI/ML, Analytics, Insights, Visualization and Narratives.

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