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Whitepaper

Agentic AI for Oil and Gas Upstream Operations

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Executive Summary

Agentic AI is reshaping upstream oil and gas by embedding intelligence directly into everyday operations. Rather than just generating reports or predictions, agentic AI consists of goal-driven, autonomous agents that act and make decisions across enterprise systems, driving transformative change throughout the value chain. These agents continuously monitor operational data, including drilling, completions, and production. They can autonomously adjust processes, predict equipment failures, prescribe injection rates for fluids and chemicals, simulate fracking parameters, and optimize for improved safety and performance.

By breaking down discipline silos and introducing real-time responsiveness, agentic AI accelerates interventions, reduces downtime, and enhances efficiency while ensuring contextual judgment and auditability at every step. The resulting advancements lead to substantial gains in operational reliability, sustainability, and profitability, positioning early adopters to define new industry standards in competitive and safety-critical environments. This paper reveals how autonomous agents and hybrid intelligence drive out silos, accelerate interventions, and deliver gains in efficiency, sustainability, and profitability.



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Introduction: The Evolving Landscape of Upstream Operations



Oil and gas asset management teams still struggle with siloed departments and disciplines due to the very nature of the processes needed to find and extract hydrocarbons, long and complex analysis, and manual approval loops. For many asset teams and engineers, it's a daily struggle to track down critical information, run simulations in very specialized apps, de-risk uncertainty, or predict subsurface equipment failures, like electro submersible pumps (ESPs) and replacements at scale. Field management and optimization must consider the entire subsurface-surface system, including its challenges and underlying physical and engineering models. Meanwhile, underperforming assets quietly drain value from operations. Too often, important decisions rely more on hard-won experience than on real-time data. As a result, interventions are primarily reactive rather than proactive, and the improvements achieved are usually incremental at best.

Today, upstream operators face immense pressure not just to maintain and increase production, but to get ahead, whether it's optimizing costs, increasing efficiency, reducing nonproductive time, while also achieving sustainability goals. Production environments are tangled with manual handoffs and disconnected data sources, making it nearly impossible to respond rapidly or scale operations smoothly. Add stricter environmental standards, volatile markets, aging infrastructure, and mounting stakeholder expectations, and the urgency for transformation is clear.

Transformation isn't just about moving to digital systems; it's about close collaboration, agility, and intelligent automation. Without bold moves toward integrated and automated solutions, organizations risk falling behind on environmental, cost, and performance goals. Now more than ever, digitization and smart tools like intelligent agents aren't just a competitive edge; they're the new imperative for oil and gas fields striving to stay ahead in a demanding, volatile, and geopolitically changing market.

Workflow Blueprint for Agentic AI in Upstream Operations

Agentic AI refers to interactive, goal-driven autonomous agents that coordinate, learn, and act within complex petro-technical workflows. Automated workflows anchor the transformation of upstream operations. Agents aggregate real-time surface and downhole data, diagnose well performance, tune lift parameters, and autonomously optimize injections across the field lifecycle. Automated surveillance ensures all issues are promptly identified and managed. People and AI agents collaborate where humans guide strategy while agents execute the routine at lightning pace, making 'business as usual' smarter, safer, more efficient, and scalable.

TechM Orion

- Reshaping Upstream operations
- Interactive goal-driven autonomous agents that coordinate, learn and act within complex petro-technical workflows
- An asset supervisor agent orchestrating N agents such as:
 - Production deviation
 - Downhole event detection
 - Surface equipment surveillance
 - Subsurface model updating
 - Recovery method surveillance
- People and AI agents collaborate where humans guide strategy while agents execute the routine at lightning pace, making "business as usual" smarter, safer, more efficient, and scalable.

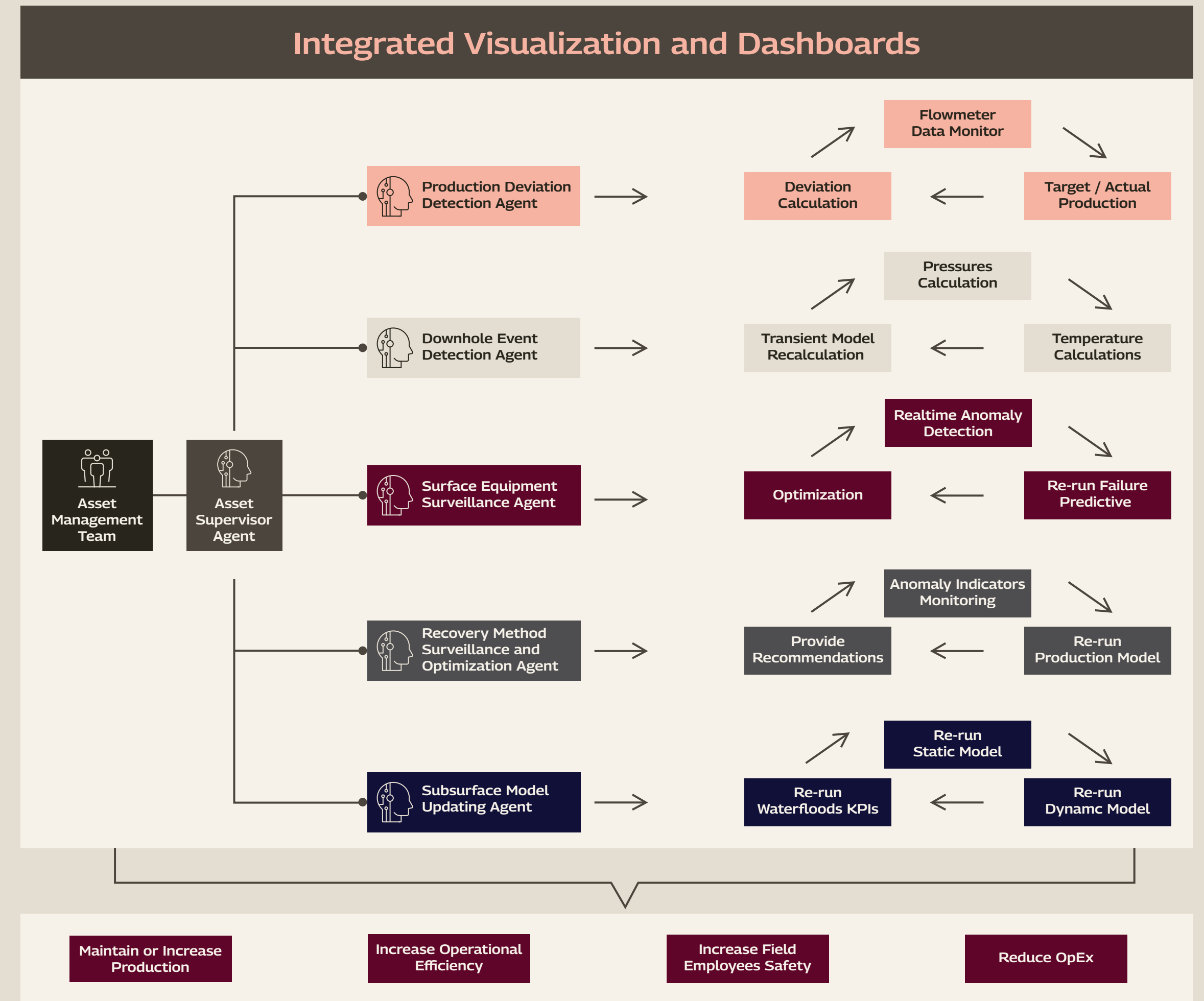


Figure 1: Solutioning Workflow

Smarter Fields, Safer Futures: How Agentic AI Delivers in Oil & Gas

Smart Waterflooding: Reducing Flaring, Maximizing Uptime

Inefficiencies and slow responses to complex reservoir events plague traditional waterflooding operations. Now, agentic AI brings real-time monitoring and adaptive control to the table. AI agents track injection rates, pressure events, and sensor data around the clock, identifying trouble before they escalate. One agent flags pressure drops; another quantifies skin growth; another estimates permeability loss; another evaluates declining reservoir pressure over time. Another set of agents calculates the Waterflood KPIs: voidage Replacement Ratio (VRR), Nominal Pressure (Pn), Volumetric Sweep Efficiency (Evol), and Displacement Efficiency (Ed).

Operators receive data-driven recommendations to adjust injections and control flaring, significantly reducing waste gas and maximizing oil recovery without increases in sand, solids, or water cut. These agents don't just optimize operations; they reduce hours of manual oversight, allowing engineers to focus on strategy while the system handles routine decisions. Real-world deployments have delivered tangible gains in sweeping efficiency and major reductions in operational risk—the result: greater output, less flaring, and a more efficient field.

Intelligent Unconventional Planning: Next-Gen Field Development and Risk Management

Field planning often involves generating reports, managing fragmented data, and making critical, time-bound, high-cost decisions under pressure. With agentic AI, teams gain fully automated surveillance and smarter risk management. These agents synthesize technical and economic insights, run scenario modeling at speed, and alert teams to emerging risks well before they become problems. As a result, investment decisions and drilling strategies are guided by real-time, actionable insights. Pilot programs document faster drilling, completions, and fracking times, more robust risk flagging, and fewer surprises in the field, all leading to improved returns and smoother project execution.



Speed, Safety, and Scale: Workflow Automation in Action

Automation isn't just fast; it brings repeatability and discipline to critical upstream workflows. Agentic solutions standardize responses to known issues, speed up effective interventions, and synchronize teams in real time. The impact is measured in hours saved, errors avoided, and bottlenecks eliminated, unlocking scalable operations that set a new bar for industry performance. This is a critical step in enabling companies to globalize their operations management and optimization through centralized, standardized real-time operations centers.

Continuous Monitoring and Optimizing: Advanced Surveillance and Digital Twins

Digital twins and continuous surveillance deliver a live, holistic view of the field, from subsurface models to control rooms. Agentic AI links these models with live data feeds from sensors and equipment, delivering a holistic, transparent picture of field health, reservoir integrity, and performance. Agents interpret sensor streams, highlight anomaly patterns, notify engineers, and recommend actions. With 3D visualization and interactive dashboards, even the most complex operations become easy to orchestrate, helping leaders make smarter decisions about investments and interventions.

Ethics and Governance: Ensuring Responsible AI in the Oilfield

As agentic AI takes on critical decision-making roles, governance, ethics, and compliance become central concerns. Oil and gas firms must develop clear frameworks for ethical AI deployment, regulatory adherence, and stakeholder transparency. Features such as human-in-the-loop oversight, explainable recommendations, and secure audit trails are crucial. These practices ensure that powerful automation serves business goals while strictly maintaining safety, accountability, and public trust. Industry standards are evolving rapidly to address these needs, aligning the promise of agentic AI with the responsibilities required in high-risk environments.

The adoption of agentic AI brings the oil and gas sector closer to a future where operational excellence, sustainability, and safety are not just aspirations but realities. The industry is moving toward a world of fully autonomous oilfields, where collaboration between intelligent agents and human experts is seamless, efficiency is maximized, and every field is safer, smarter, and more sustainable.

Run Oil and Gas Sites Remotely with Orion AI Platform



Consider how oil and gas companies are changing the way they work. Most of them want to control, automate, and monitor every part of their operation from one central hub. That's precisely the future Tech Mahindra's Orion enables, and it's making remote and autonomous operations not just possible, but real.

With Orion's modular platform, teams can quickly roll out AI agents that handle the heavy lifting: monitoring pressures, temperatures, and equipment; analyzing sensor feeds; and identifying underperforming wells from the control room. It doesn't matter whether you're working with legacy systems or the latest cloud technologies; Orion integrates them all so nothing is left in the dark.

What really stands out is flexibility. No one needs to be a programmer to use Orion, a low-code/no-code interface, because the users pick what they need, and autonomous agents do the rest. They learn, adapt, and handle everything from optimizing production to keeping systems and equipment safe and compliant. If something needs human attention, validation steps are built in, so asset management or real-time operations center engineers remain in control.

For many clients, building a centralized digital 'Realtime Operations Center' means more than convenience. It improves safety, leads to structural cost reductions, especially for global majors and super majors, and minimizes the time to respond to issues. Whether your team is taking first steps with basic monitoring or aiming for full automation, Orion supports your journey. It's future-proof: as you grow in maturity, the platform grows with you.

What's more, Orion is designed to deliver responsible and scalable AI. Enterprise-grade governance is built right in, so you avoid costly mistakes and build trust as you automate more. Companies around the world are using Orion to transform their operations from single pilot fields to massive multi-site deployments, giving decision-makers the tools they need to keep every asset running smarter and safer.

In short, Orion brings remote and autonomous operations to life, making real-time control, automation, and insight achievable for every oil and gas company striving for the next level.

Fueling Success with Agentic AI

The agentic AI revolution is already reshaping what oil and gas companies do every single day. If you're quick to embrace this technology, you'll see changes that go way beyond more efficient operations. Fields become smarter, decisions get faster, and safety is at the center. Imagine a system that notices problems before you do, provides recommendations, and frees your teams to focus on what really matters instead of fighting fires.

What makes this shift so powerful? It's all about real people working with real, intelligent technology. The best part: you don't have to overhaul your entire operation overnight. Most companies begin with a single field, building confidence and experience step by step. As you see the benefits, it makes sense to scale these solutions across the business to connect teams, automate complex workflows, and stay ahead of unexpected disruptions.

When autonomous agents handle routine tasks and keep a watchful eye on production, you get more time to address bigger goals and meet higher standards for safety and the environment. This is more than just an upgrade; it's about creating a culture where people and advanced AI learn from each other and drive the company forward. Companies that start now will lead tomorrow, and the entire industry will be watching.



About the Author



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As Group Practice Head – Oil & Gas at Tech Mahindra, Cano specializes in digital transformation, production optimization, and intelligent industry solutions. She brings more than 25 years of experience in the Oil and Gas industry and deep expertise in asset management, analytics, operational efficiency, field development planning, and subsurface evaluation; she is passionate about driving innovation in the Oil & Gas sector. With a strong background in leading global strategies and implementing advanced technologies across the energy value chain, Lidia is also committed to mentoring and empowering women in the energy industry. She is an active member of the Society of Petroleum Engineers (SPE), right now the Chair of the Continuing Education Committee of the Gulf Coast Section.

About Tech Mahindra

Tech Mahindra (NSE: TECHM) offers technology consulting and digital solutions to global enterprises across industries, enabling transformative scale at unparalleled speed. With 152,000+ professionals across 90+ countries helping 1100+ clients, Tech Mahindra provides a full spectrum of services including consult-ing, information technology, enterprise applications, business process services, engineering services, network services, customer experience & design, AI & analytics, and cloud & infrastructure services. It is the first Indian company in the world to have been awarded the Sustainable Markets Initiative's Terra Carta Seal, which recognises global companies that are actively leading the charge to create a climate and nature-positive future. Tech Mahindra is part of the Mahindra Group, founded in 1945, one of the largest and most admired multinational federation of companies. For more information on how TechM can partner with you to meet your Scale at Speed™ imperatives, please visit <https://www.techmahindra.com/>.



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