

From Silos to **Insights**

How Gen AI and OSDU Are Redefining Data
Discovery in Upstream Energy

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Introduction

The upstream oil and gas industry is undergoing a significant transformation. This sector covers exploration, drilling, and production—the earliest phases of energy development. While global energy demand continues to rise, upstream companies face mounting pressure. **They must reduce costs, improve efficiency, accelerate decisions, and meet sustainability goals.**

Achieving these goals hinges on one critical factor: data.

Upstream operations generate massive volumes of data, including seismic surveys, well logs, core samples, and geological maps. These datasets are essential for identifying reserves, planning wells, and optimizing production. Yet, they are often fragmented, inconsistent, and difficult to access.

Historically, data gathered in the oil and gas industry is stored in proprietary formats across siloed exploration and production (E&P) systems. Each application may use its own structure, making integration a challenge. This fragmented infrastructure slows down analysis and decision-making and limits collaboration across teams and disciplines.

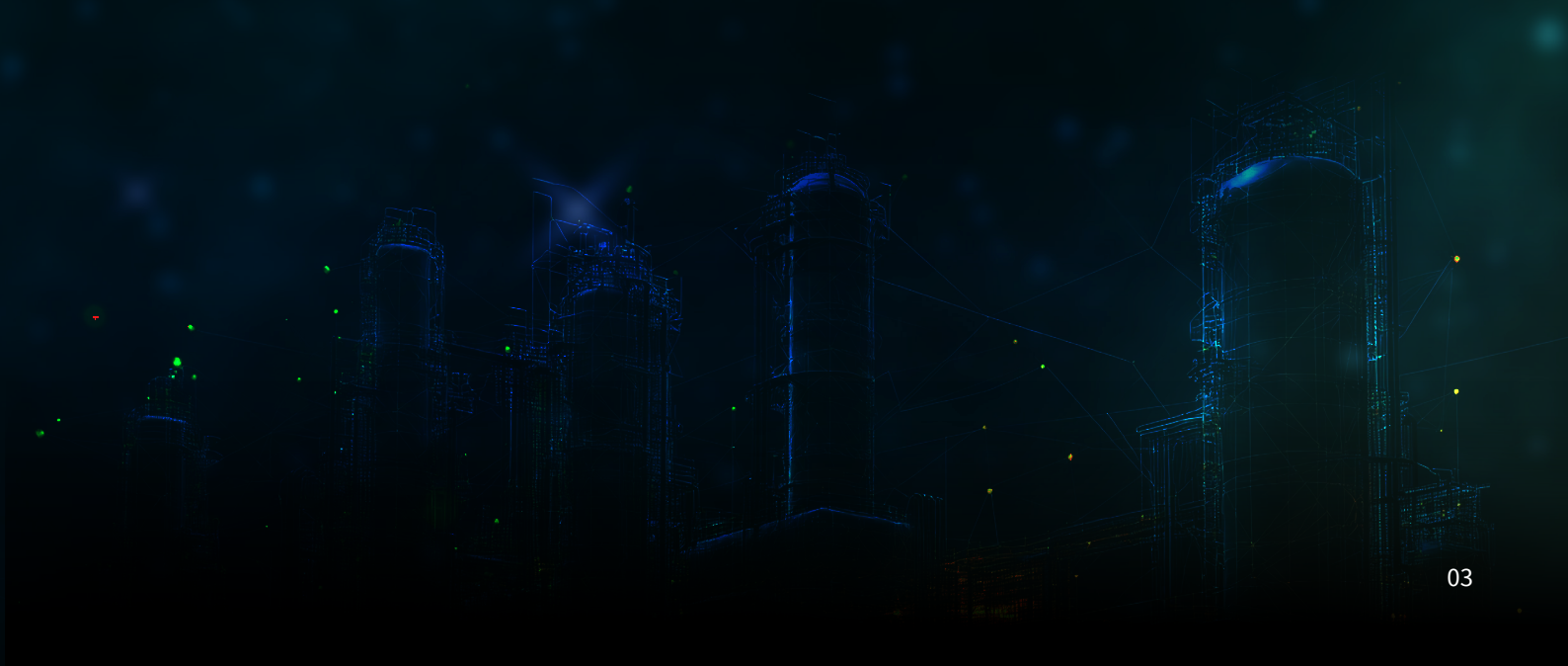
The result? Valuable insights remain locked away. Interpreting data requires high expertise, and even then, the process is slow and error-prone. Traditional storage methods make data sharing across domains complex and inefficient.

To move forward, the industry must shift from an application-centric to a data-centric approach. This means centralizing data, ensuring consistency, and enabling seamless integration. It also requires strong data governance and quality controls.

Digital transformation is no longer optional—it is essential. Cloud platforms, open data standards, and AI-driven tools can unlock the full value of upstream data. They enable real-time access, improve collaboration, and support faster, more accurate decisions.

Data centralization, integration, quality, and governance are now the top priorities for upstream organizations. By addressing these, companies can unlock new capabilities and drive long-term value.

The future of upstream oil and gas will be defined by how well it manages and mobilizes its data.





Eliminating silos to unlock potential and deliver value

Upstream data challenges demand smarter, scalable solutions. Rising challenges in managing upstream data volumes have led to new, data-driven solutions. The adoption of AI, machine learning, and cloud-native platforms has become essential. To address these challenges, the industry is increasingly turning to open standards and cloud-native platforms that enable better data integration and accessibility. That's where the Open Subsurface Data Universe (OSDU) steps in.

OSDU is a flexible, technology-agnostic, cloud-native, and open-source data platform built specifically for the upstream oil and gas industry. It breaks down data silos by decoupling data from applications. This enables seamless access, sharing, and collaboration across teams and domains. Solutions like Microsoft Azure Data Manager for Energy (ADME), built on OSDU, bring this vision to life. They offer secure, scalable, and unified access to subsurface data. With OSDU, companies can automate workflows, improve data quality, and accelerate insights. Combined with generative AI, it transforms how data is discovered, interpreted, and used. The result? Faster decisions, better collaboration, and real business value. OSDU's ability to automate workflows, optimize data quality, and improve global data accessibility translates into substantial cost reductions and operational efficiencies, making it the game changer in the industry.

Life of a subsurface data analyst

A subsurface data analyst interprets geological datasets to identify and estimate commercially viable oil and gas reserves for exploration and development. The role is crucial for reducing uncertainty in geological models, reserve estimations and enhancing hydrocarbon recovery. The major challenges include:

- **Data integration complexity:** Combining seismic, well logs, core samples, and production data requires significant time and expertise. The subsurface datasets undergo multiple reprocessing during their lifetimes, required strict version and lineage controls.
- **Data quality issues:** Inconsistent or incomplete data must be pre-processed and validated before analysis.
- **Software and tool limitations:** Data integration between various specialized Petro-technical software applications can slow workflows and cause compatibility issues.
- **Collaborative bottlenecks:** Collaboration with geologists, geophysicists, and reservoir engineers can face misalignment.
- **Time-consuming model updates:** Updating reservoir models manually with new data delays scenario analysis and decision-making.
- **Pressure for real-time insights:** Delivering faster insights for real-time monitoring demands quick results, often under tight deadlines.

Despite these challenges, their work is vital for maximizing hydrocarbon recovery, reservoir performance and guiding field development programs.

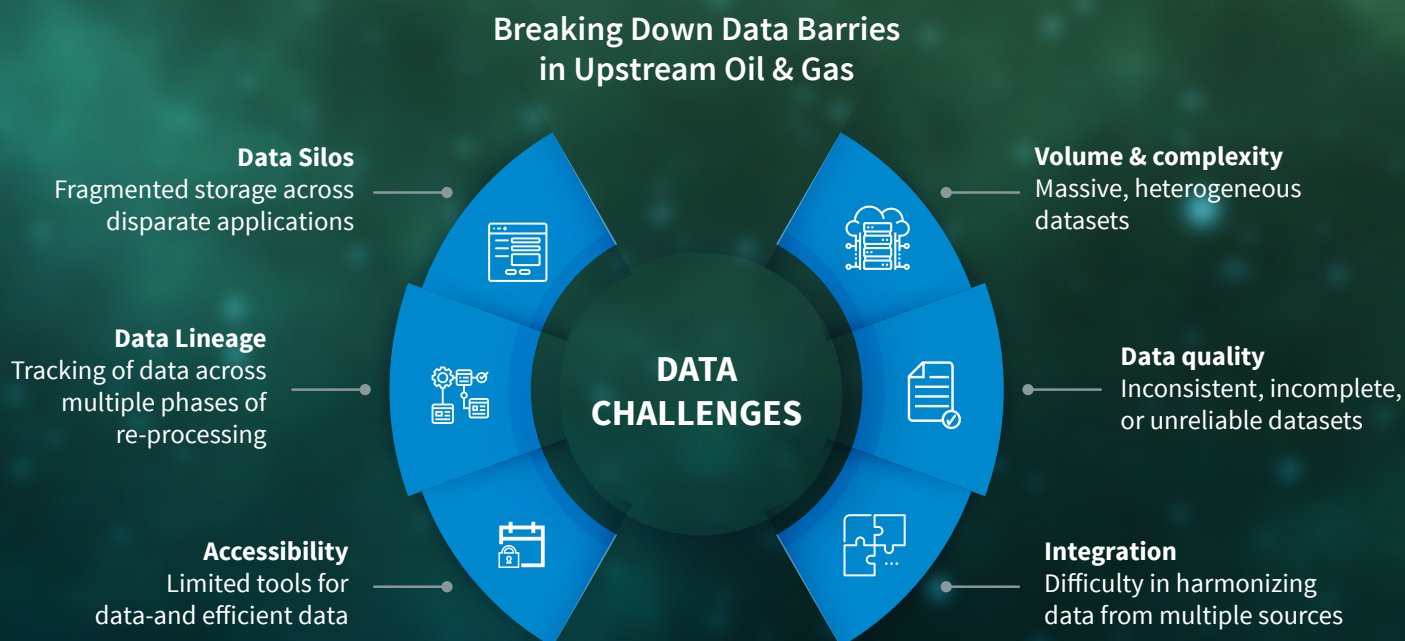


Figure 1: Data barriers in upstream oil and gas industry

Smart data, smarter decisions: LTIMindtree's OSDU-Powered Virtual Data Analyst

The OSDU Data platform is specifically curated for the oil and gas industry. Leading oil and gas companies worldwide are increasingly adopting it to store their subsurface datasets.

LTIMindtree's innovative solution leverages the power of Microsoft Azure Data Manager for Energy (ADME), OSDU APIs, and generative AI to deliver a Virtual Data Analyst that simplifies data discovery and empowers faster, more informed decisions.

The workflow begins with collecting data from various sources like enterprise systems, files, external inputs, and integrated platforms into a centralized Data Lake. This data then flows through a pipeline, where LTIMindtree's solution accelerator GeoProQuiK handles quality control and data ingestion. The cleaned data is integrated into the OSDU platform via APIs and stored in a Vector Store optimized for Microsoft Search and AI Document Intelligence. Azure Search enables efficient querying of this data. Finally, the system integrates with OpenAI through an Azure AI Bot or Assistant, supporting advanced data analytics and platform operations.



Below diagrams show a sample conversation where users can ask questions related to their domain and get the relevant information:

Figure 1: Ask VDA about petroleum prospectivity in certain area

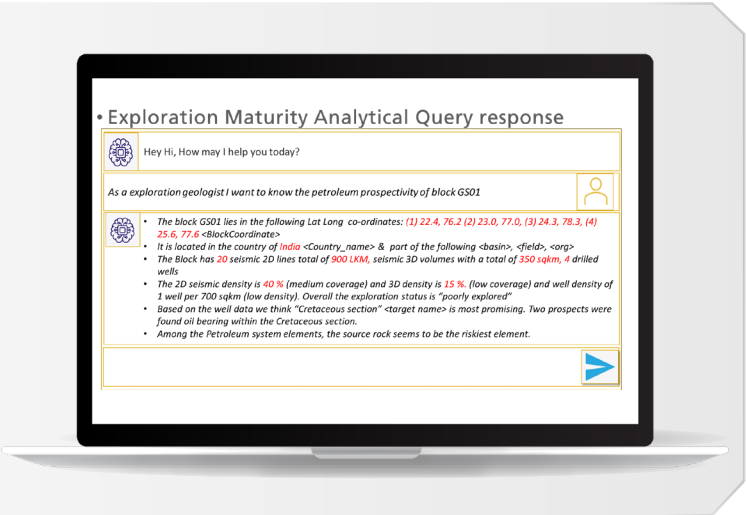


Figure 2: Ask VDA to provide details about certain well

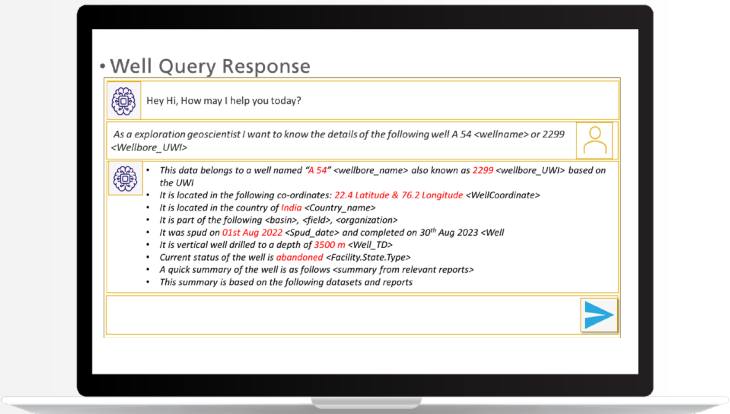
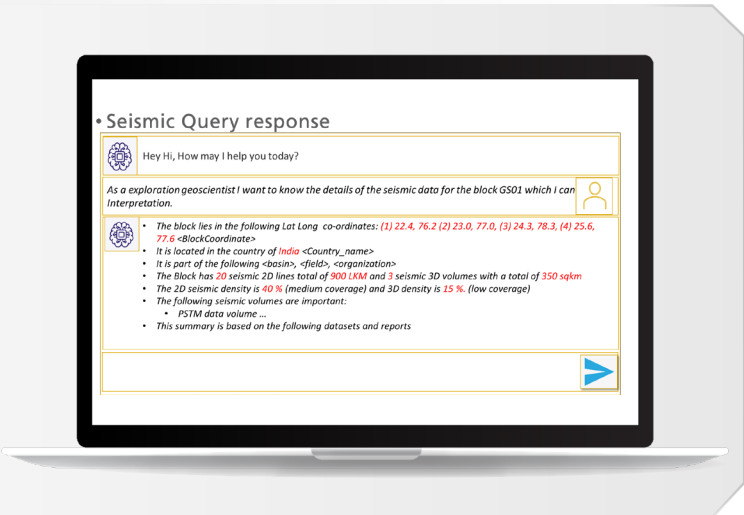


Figure 2: Ask VDA to provide details about seismic data



Figures above: VDA Sample Chatbot Interface

Data interpreters can leverage this solution to search, discover, and retrieve the most appropriate and relevant subsurface dataset stored on the OSDU data platform using simple natural language queries. The availability of the right dataset at the right time in an industry-standard format will significantly lower the interpretation cycle time.

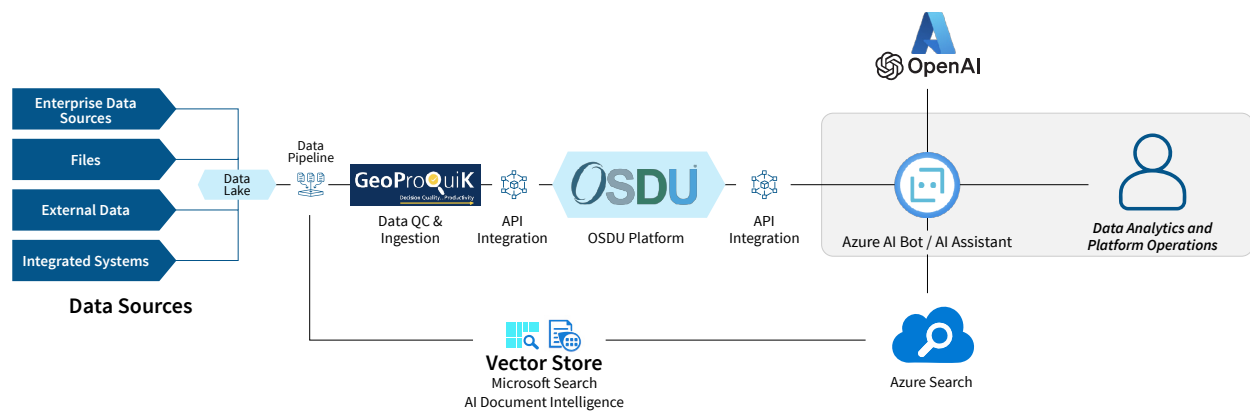


Figure 3: Functional Architecture

Components of Virtual Data Analyst

- **Natural language processing (NLP):** Allows simple, natural language queries.
- **Generative AI:** Uses Microsoft Copilot and Azure OpenAI Services for predictive analytics.
- **Data integration:** Utilizes OSDU APIs for seamless data retrieval from various sources and interfacing with various applications.
- **User-friendly interface:** Designed for easy access and interpretation by business users and geoscientists.

Barriers and path to success

While the benefits of gen AI-driven data integration and analytics are clear, organizations often encounter notable barriers to adoption. Common roadblocks include concerns around data security and governance, especially when integrating sensitive subsurface datasets across legacy systems. The complexity of migrating from entrenched, siloed infrastructure to an open, unified platform can also slow transformation, as can resistance to change among users accustomed to traditional workflows. Additionally, skill gaps in AI, advanced analytics, and OSDU standards, integration present practical challenges, requiring investment in upskilling and change management.

Despite these obstacles, several organizations have achieved remarkable success by embracing GenAI and OSDU-based solutions. Early adopters report accelerated project timelines, improved collaboration between business and technical teams, and measurable gains in operational efficiency. For instance, companies leveraging a Virtual Data Analyst have realized significant reductions in manual data preparation, freeing up geoscientists to focus on higher-value interpretation and discovery.



Case in Point: Accelerating subsurface data discovery with gen AI and OSDU

The OSDU Forum's open subsurface architecture integrates diverse datasets—well logs, seismic, and rock and fluid—into a unified model. LTIMindtree's gen AI-based Virtual Data Analyst (VDA), built for the OSDU™ Data Platform, empowers business users to search and interpret data using natural language. Leveraging prompt engineering and LLMs, VDA can deliver up to 20–30% time savings in data discovery and can enable up to USD 2 to USD 3 million annual cost savings. It enhances insight generation, shortens interpretation cycles, and supports new discoveries. The solution is scalable to nonconventional energy domains pending OSDU approval.

Fueling the future with intelligence

The upstream oil and gas industry is at a turning point—where data is no longer just a byproduct, but a strategic asset. LTIMindtree's OSDU ADME Virtual Data Analyst solution redefines how subsurface data is accessed, interpreted, and applied. By combining open standards, cloud-native architecture, and generative AI, it empowers geoscientists and business users alike to make faster, smarter decisions. The result is not just operational efficiency, but a cultural shift toward data-driven exploration.

As the industry evolves, embracing intelligent platforms like this will be key to unlocking new reserves, reducing costs, and meeting sustainability goals. The journey ahead demands agility, collaboration, and innovation—and with the right tools, the future of upstream energy is not just digital, but intelligent.

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With over 20 years in IT and more than a decade in the oil and gas sector, Shankar has led implementations of subsurface data management and drilling solutions for major energy companies. He specializes in the OSDU Data Platform and has developed AI/ML and gen AI-based solutions tailored for upstream workflows.



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Sidhartha has extensive hands-on work experience in various upstream exploration activities, including subsurface data interpretation, management, well planning, and drilling. Currently, he is working on automating well planning, OSDU data Platform services, and gen AI-based solutions for the oil and gas upstream industry.

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