The open data platform imperative for the energy industry

A scalable data foundation based on open standards can help the oil and gas industry compete and thrive in a digital world.

IBM

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Innovation for upstream oil and gas companies (also called exploration and production, or E&P) has centered on cost-efficiency plays, facilitated by technological advancements in sensors, bandwidth, data storage, cloud and edge computing. Shifting upstream exploration toa value creation business is critical to the success of the E&P industry. Reserve replenishment, reserve estimation, geological modeling and quantifying risk are complex multidisciplinary activities across the geoscience and engineering domains and include the challenge of managing assets across a multi-decade lifecycle. Trusted data is at the heart of these activities, and central to exploration success.

> "Lower exploration costs, development costs and reduced cycle times are the top three key drivers in returning exploration to value, yet speed of decision making is the most significant challenge in exploration today."
>
> Wood Mackenzie[3]

Tackling the upstream subsurface data challenge

The four V's of big data—volume, variety, velocity and veracity—are exemplified in the overwhelming nature of upstream subsurface data. Terabytes (TB) and petabytes (PB) of it are available. Additionally, subsurface data is commonly stored in warehouses on outmoded, non-digital media technologies, meaning it can't easily be accessed on today's systems. Beyond paper records, magnetic tape, physical samples, cores and various forms of historical data storage a multitude of legacy software, applications and databases add further complexity to the challenge. Moreover, E&P data exhibits six different quality dimensions (completeness, consistency, validity, accuracy, integrity and timeliness) adding further complexity and increasing the requirement for cross-referencing among a multitude of sources.

Poor data quality is problematic especially since the majority of oil and gas production is generated from mature wells. It is critical that geoscience and engineering teams be able to evaluate mature oil field economics by integrating, visualizing and analyzing data across disciplines. All relevant reservoir data—for example seismic, geophysical, petrophysical, reservoir simulations, well logs, completions and production—must be of high quality to inform investment decisions. Use of seismic data leads to more efficient oil and gas extraction optimizing the number of wells drilled and ultimately boosts the production of hydrocarbons. It is estimated by The Economist that the industry only leverages about 5% of seismic data it has collected in E&P activities.[1]

In addition, over half a geoscientist's time is spent looking for data and assembling it before multidisciplinary analysis can take place.[7] A recent 2019 Geodata Management Survey further revealed that geologists spend nearly 20% of their time weekly on performing data conversions.[2]

A data foundation: The basis for subsurface understanding

Upstream Intelligence's Offshore Digital Services Report made the case for a data foundation: "An enterprise integration framework is the enabling technology suite that allows the seamless transfer of information from collection, to analysis and modelling. The purpose of an integration framework is to enable the transfer of information between various applications, according to a defined workflow and the presentation of information in such a way to facilitate decision making based on a global trusted view of data. In a word, this is about interoperability."[3]

A modern upstream data foundation should incorporate common data models and leverage tools and technology that reduce the need for data transformations, moves and migrations while enabling workflow integration between geoscience and engineering; in addition, it should contribute to ensuring independence between data and interpretation and analysis applications. As data quality is critical, an upstream data platform should provide level-1 quality inspections achievable through cross-referencing. Unlocking data across the E&P lifecycle expands and enriches traditional workflows to deliver intelligent energy decision-making, thereby empowering leaders to enhance enterprise agility and resiliency.

With the right data foundation and data governance in place, data management should be more intuitive and should free up geoscientists' time to do what they were trained for—analyzing and interpreting the geological data to guide exploration and investment decisions.

Workflow efficiency: Industry data standards

Geoscientists encounter and host of exhausting issues in trying to connect and ultimately correlate different types of data to achieve a holistic view of the subsurface. Building an interpretative model becomes an overwhelming task as geoscientists and engineers are faced with too much data, lack of data standards and inability to easily move data between technology and software environments. Management, storage, size and handling of modeled data—including structured, semi-structured and unstructured data—is a major bottleneck in E&P.

Organizations such as Energistics and the Professional Petroleum Data Management (PPDM) Association have been around for decades and represent global consortiums that help facilitate the development, management and adoption of data exchange standards for the upstream oil and gas industry.

One example from Energistics is the RESQML data exchange format; work began in 2009 and reached full maturity in their 2017 release. The RESQML format was governed under the Special Interest Group (SIG) consisting of collaboration across producers, service companies, software and technology companies as well as academic and governmental institutions. "For producers and oil and gas service companies who perform integrated reservoir studies, data exchange standards ultimately accelerate the ease and efficiency in building workflows across multiple software platforms and boost cost-effectiveness, while reducing the workload of data management support staff in overseeing the data exchange process. This increased flexibility and efficiency frees up more time and resources to enrich the reservoir model."[4]

"The adoption by the industry of data exchange standards alleviates the burden of developing and maintaining customized links between numerous platforms and point solutions. This enables greater focus on higher investments in new technologies and increased application efficiencies that are of higher value to the industry workflows."[4]

The RESQML efforts through Energistics as well as other industry initiatives have greatly benefited industry standards as well as best practices for data management. However, problems with highly fragmented vendor landscapes, interdisciplinary problems and data quality persist today.

Additional data burdens from partnerships, joint ventures and acquisitions

The nature of upstream activity is continuously focused on portfolio balancing, including divestitures from non-core assets and managing risk and capital allocation through joint ventures (JVs). Mergers and acquisitions also play a critical role in balancing upstream portfolios, and growth strategies around barrel of oil equivalents (BOEs) can be purely acquisition-focused. Philip Jong, Data Foundation Design at Royal Dutch Global Shell, stated that it "took two years for Shell to fully integrate the subsurface data from one of its acquisitions," acknowledging openly that this was an industry challenge and "takes way too long."[5]

Because E&P activities cross borders and asset portfolios are global, data sovereignty and in-country compliance present another unique operational challenge. "Data sovereignty is the concept that information that has been converted through digital transformation and stored in a binary form is subject to the laws of the country in which it is located."8 Simply storing data in the cloud doesn't necessarily enable access to all data dispersed across geographic borders. In-country cloud requirements (private clouds) and server storage are all necessities in global operations and help the upstream industry meet data compliance regulations.

Quantifying the value of subsurface data

E&P data is highly complex and linked to the subsurface. It exemplifies big data, and comprises digital data puzzle pieces that must be critically managed as a business priority. The end goal of creating trusted data for the entire upstream organization requires a massively scalable universal landing place for data of any type, format or schema. Only with that landing place established can organizations fully exploit petrotechnical tools and today's advanced technologies to transform data into dollars through faster decision-making and shorter exploration cycles.

Transforming data into dollars through faster decision-making and shorter exploration cycles requires a massively scalable universal landing place—a data foundation—for data of any type, format or schema.

An in-depth industry study was commissioned on the value of data management in E&P. Common Data Access Limited (CDA)—a not-for-profit subsidiary of Oil and Gas UK, and leading representative body for the UK offshore reported several significant findings.

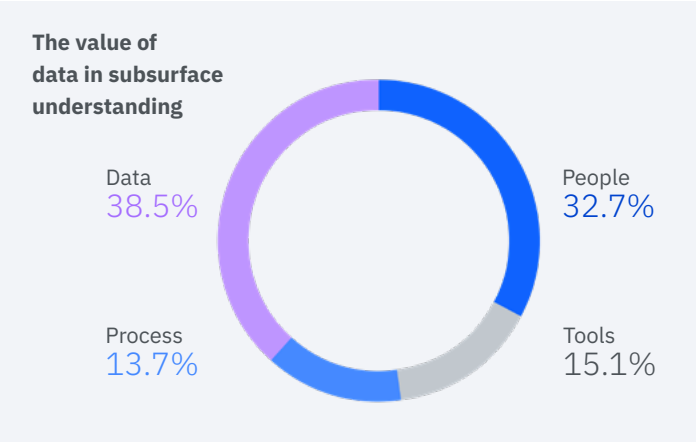
Firstly, the study concluded the value that data delivers can be estimated by exploring four elements:

- The total value delivered each year by projects
- The company's balance between exploration, production and development
- The contribution that knowledge of the subsurface delivers to these activities
- The extent to which interpretation of the subsurface is dependent on the data

The CDA study found that the proper understanding of the subsurface contributes directly to: (i) increased production (ii) asset development and (iii) increase in reserves and is linked to four items:

- People
- Tools
- Data
- Process

The study further concluded that the greatest value of data was found within the subsurface interpretation process, where the value of data directly contributed to 38.5%, and teams (people), where it contributed 32.7%. Its value contribution for tools and process was significantly less.



Within the CDA study, all senior oil and gas executives in charge of exploiting subsurface resources agreed that at least 50% of subsurface understanding impacts reserves replacements. Additionally, the executives said 70% of the value their teams generated came directly from their group's understanding of the subsurface.

The CDA-commissioned study concluded that data contributes between a quarter and third of the total value generated each year by all the activities of an E&P company. So in an asset team that is generating USD 100 million of value per year, for example by arresting the production decline of a field, a value of USD 25 to 33 million a year is derived from the petrotechnical data it holds.

In an asset team that is generating $100M of value per year, for example by arresting the production decline of a field, a value of $25M–$33M a year is derived from the petrotechnical data it holds.[6]

Data as a truly differentiating asset

To a resource-focused industry, it has required an evolving perspective to consider something as abstract as data as a truly differentiating corporate asset, and treat it as a strategic priority. The collaboration between IT teams and the subject matter experts (users) such as geologists, geophysicists, petrophysicists and engineers who drive the business technology (operational technology), is key to solving the challenge.

A small number of leading energy players are aggressively investing to get their data foundation ready for subsurface innovation. ExxonMobil is unlocking the potential of advanced technologies by building a comprehensive data foundation. "Shell, BP & XOM have also embraced the opportunity of digital and have built in-house capabilities primarily to focus on existing production to identify inefficiencies".[7] For most energy producers, the strategy for collecting, streaming, storing, transporting, cleansing and securing data is evolving but has not yet reached the maturity required.

The emerging data ecosystem

The emerging conditions are creating a ripe ecosystem of technology companies, cloud providers, oilfield service companies and producers—all of whom contribute value. This provides new opportunities within upstream innovation which will propel the industry forward in capitalizing on its data stores to unleash business transformation across its diverse operational landscape.

Overall reluctance to sharing data within the oil and gas industry has been a longstanding challenge. This has resulted in the development of complex proprietary solutions and capabilities which has limited the overall effectiveness and speed of transformation within the industry. Barclays reports "in some cases, data sharing even became an issue intra-company, where historically the difficulty of sharing data often negated the incentives for cooperation."[11]

Barclays further reports that "over the last 12 months a host of industry collaborations have emerged causing the oil and gas digital landscape to be categorized into three major components: (i) Cloud storage (Big Tech), (ii) Ecosystems and Platforms—dominated by the big three oil and gas service providers and (ii) Applications—Digital Innovators and service providers."[7]

Why now?

The Barclays report nicely summarizes the unique digital convergence, collaboration and market dynamics within the energy industry that is leading to the unprecedented digital opportunity today.

A step change in enabling technologies

- Cloud computing
- Sensors and measurement
- Edge computing software architecture
- Programming capabilities
- O&G C-suite level acceptance

An industry ripe for disruption

- Lower prices putting spotlight on industry efficiences
- Producers under pressure to deliver FCF, capital discipline
- ESG increasingly important to investors
- Service companies eager to develop new markets

Evolution of software business models

- **SaaS:** faster innovation, better performance, more flexibility, recurring revenue streams vs. on-premises
- **Open data:** acceptance of the cloud, data is no longer siloed, benefits of collaboration
- **Open architecture programming:** increased reliance on 3rd parties in software architecture, “future proof” systems

Summary from North America Oilfield Services and Equipment. Frac to the Future; Oil’s Digital Rebirth. Barclays, London, England, January 2020.

The Open Group OSDU Forum: Innovating subsurface data

The industry has been at work since 2018 on an initiative called the Open Group OSDU™ Forum—this aims to renew focus on collaboration, innovation and enabling ecosystems while placing data at the center as a critical E&P asset.

The Forum represents a wide-ranging consortium across 130 leading oil and gas service companies, systems integrators, cloud providers and academia, and over 30 of the world’s leading energy producers including Shell, BP, ExxonMobil, Equinor and Chevron, who form the core producer management committee.

The OSDU Forum has been collaborating on solving the decades- long problem of accessing multi-source and multi-level complex E&P data that is locked in non-standard repositories and within software-vendor-proprietary data models and homegrown implementations.

The OSDU Forum has collaborated on a data foundation encompassing the full spectrum of E&P data from exploration, development and wells, with future plans for production and facilities. However, the vision goes beyond an integrated upstream data foundation to include the supporting supply chain for existing energy sources (e.g. gas) as well as new energy and future energy sources such as wind, solar, hydrogen, hydro, geothermal, and more.

All subsurface data is placed in a scalable data foundation and made accessible from a single set of application programming interfaces (APIs). APIs are defined as a set of functions and procedures allowing the creation of applications that access the features or data of an operating system, application or other service. The standard API layer is a key component of the OSDU data foundation architecture that unlocks data from vendor-specific and proprietary applications. This ubiquitous API layer is what enables interoperability between software, essentially unlocking data and interpretation models from specific software and enabling them to be leveraged into other software and applications along the workflow process.

The Open Group OSDU Forum data foundation is a set of APIs enabling a cloud-based system of record for the full spectrum of current subsurface data types. This includes wells and logs, seismic files, well delivery, wellbore DDMS and seismic DDMS with production, sensor and facilities data planned for 2021. Furthermore, alternative energy data sources are in the roadmap, such as wind, solar, hydrogen, geothermal and more.

The OSDU Data Foundation: A step towards solving longstanding industry data challenges



Data is locked in applications

Proprietary file formats lock data to applications and vendor environments



Data is stored in disciplinary silos

Inability to understand data lineage, significantly reducing accuracy and authenticity of information



Metadata is not stored with data

Is critical for traceability, searchability and validity and has significant impact on exploration costs and ultimately productivity



Limited search capabilities

Renders data lost to building interdisciplinary workflows; prevents real time access to data and business-driven decisions



Data is not ready for AI and advanced technology workflows

Stalls the pace of digital transformation across the industry

The OSDU Forum is a cloud-native platform, another critical component of the design decision. The oil and gas industry have been a relatively slower adopter of cloud technology. In the industry cloud and hybrid cloud report, IDC states that "the top business drivers for cloud adoption in the oil and gas industry are, business agility, IT modernization and replatforming as well as hardware/ software end of life."[8]

Advanced technologies are essentially unleashed by cloud. A hybrid cloud computing environment uses a mix of on-premises, private cloud and public cloud. "By enabling workloads to move seamlessly between different cloud and storage systems, as computing needs and costs change, hybrid cloud provides greater flexibility and more subsurface data deployment options."[8]

The OSDU data foundation incorporates industry data standards and best practices that will play a critical role in unleashing data across E&P workflows:

- WITSML
- RESQML™
- SEGY
- IOGP P6/11
- UKOOA P7/2000 & WITSML P7/17
- LAS 2.0/3.0, LIS, DLIS
- Energistics global consortium
- Open ZGY
- Continued support for legacy applications, Microsoft Windows and Linux® desktop

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Metadata: A system of record of every transaction made on subsurface data

Metadata is a critical component of any data management and governance strategy and is embedded into the OSDU data foundation.

The importance of metadata is revealed when we consider that data can be:[9]

- Aggregated from all kinds of sources
- Aggregated at different points in time
- Aggregated by different people
- Moved between multiple storage systems
- Accessed by multiple applications and users
- Transformed and modified at different instances
- Managed until it is no longer required
- Transformed and modified at different instances
- Managed until it is no longer required

Metadata management is defined as “the end-to-end process and governance framework for creating, controlling, enhancing, attributing, defining and managing a metadata schema, model or other structured aggregation system, either independently or within a repository and the associated supporting processes (often to enable the management of content).”[9]

The E&P industry has long suffered from poor data and metadata management practices. Building metadata capabilities and powerful search functionality into the OSDU data foundation will help accelerate meaningful and trusted data workflows.

Schlumberger contributed the data ecosystem developed for its DELFI cognitive E&P environment to the OSDU Forum as open source code.

The OSDU Data Foundation enables geoscientists and engineers (users) to:

- **Find meaningful data** that is curated, integrated and accessible across workflows, ultimately reducing the need for data transformations and migrations that are costly and do not add business value to subsurface interpretation or understanding.
- **Understand data lineage and relationships** including registering and understanding decision history on data sets—leading to trusted data decision-making and greater confidence in geoscience interpretation and understanding.
- **Access a seamless enterprise data foundation enabling cross-disciplinary workflows** (geoscience, engineering, planning and fiscal) with a single view of all subsurface data regardless of user or location.
- **Get greater choice and flexibility across leading technology and interpretation software** without worrying about proprietary data models attached to the software.
- **Increase data portability** across business and technical borders.
- **Accelerate data exchange** between JV partnerships.
- **Shorten time cycles for purchasing, selling and integrating data** through M&A integration

Emerson’s leading GeoLog suite is available now, and their reservoir-domain software will become available on the OSDU foundation.

From an overall business-value perspective, the OSDU data foundation is the upstream industry big bet for driving value creation and innovation within the E&P landscape. As digital moves beyond discrete applications within the oil and gas industry, the OSDU data foundation provides a clear and trusted path forward. Capitalizing on the industry consortium investment helps reduce exploration risks by reducing cycle time, improving field efficiencies and achieving a fully realized framework for both current energy sources as well as new and future energy sources.

IBM Open Data for Industries is a cloud-native open source-based data platform enabling a secure, seamless enterprise-ready experience that unlocks data across any cloud, on-premises or edge deployments based on the OSDU-compliant data foundation.

IBM Open Data for Industries: The right business choice to power the OSDU data foundation

Data platforms must combine business and technology drivers to be successful, and the choice of platform really matters. In order to realize the most value from the OSDU data foundation, IBM and Red Hat, a global leader in open source technologies, have teamed up to create IBM® Open Data for Industries. This is a new market offering built on Red Hat® OpenShift® foundations and fully integrated with IBM Cloud Pak® for Data, to deliver a seamless data and AI platform that modernizes how businesses collect, organize and analyze data to infuse AI- enabled business and operational decision-making.

IBM Open Data for Industries is an enterprise-grade open source-based platform, backed by security and world-class service levels trusted by Red Hat and IBM. It delivers the only end-to-end enterprise grade platform on the OSDU data foundation that supports infrastructure-agnostic, cloud-agnostic and vendor-neutral solutions to reduce complexity in building a single exploration, drilling and production workflow.

The power of open source technology in the oil and gas industry:

Connectivity between legacy databases and new operational sources is enabled by an open source-based architecture. This is critical to enable the oil and gas industry to overcome challenges with legacy software and architecture in a digital world. Energy companies who create a data-driven approach and embrace open source technologies will accelerate on the path to operational scale.

IBM Open Data for Industries differentiators:



Cloud independence

Deploy optimal IaaS anywhere, leverage multi-vendor models and avoid vendor lock-in for optimized business value.



In-country cloud and on-premises behind the firewall

Protect data sovereignty. Bnng your application to where your data resides.



Edge deployment

Deploy closer to where your data is, powering applications to capitalize on your organization's data gravity.



Fully managed Saas on IBM Cloud

Leverage flexible consumption models—PaaS, SaaS, multicloud or fully managed on IBM Cloud® infrastructure.



Open source to unlock data

Deliver a seamless enterprise-wide development and operational experience anywhere with Red Hat OpenShift.



Security built in

Achieve full-stack, full-lifecycle container security and enterprise-grade service levels.

Cloud independence: Full control over your cloud journey
The subsurface industry has a deeply fragmented software vendor landscape. The OSDU data foundation will help alleviate interoperability issues; however, industry software collaborations with cloud providers have resulted in vendor lock-in and reduced flexibility.

That's because even after subsurface data is unlocked from its applications and proprietary data stores through the OSDU data foundation, specific cloud vendor implementations can re-lock it, ultimately reducing choice and vendor flexibility within the entire infrastructure. This has consequences for both the OSDU data foundation and ultimately the subsurface data itself.

Therefore, a hybrid cloud strategy is the optimal path for the oil and gas industry. This enables flexibility and control across infrastructure ensuring both efficiency and cost effectiveness. Additionally, it better prepares the energy industry to leverage future and rapidly evolving new energy sources.

In-country cloud and on-premises options for maximized security and compliance
The oil and gas industry has been slower in cloud adoption then other industries. The reason for this is "the size and complexity within subsurface data, regulation and compliance challenges, IT governance issues and security and risk acceptance."[8]

IBM Open Data for Industries delivers a seamless enterprise data experience across the unique and diverse oil and gas operational landscape driven by joint ventures and mergers & acquisitions. From super majors to IOCs, NOCs and large independents, we help power OSDU subsurface data—anywhere—to meet data sovereignty and evolving regulatory landscapes.

To meet data sovereignty and security compliance, in-country cloud and cybersecurity is essential in rapidly expanding regulatory landscapes. IBM Open Data for Industries provides the greatest flexibility to meet the unique and diverse operational requirements of the upstream industry including on-premises hardware and behind-the-firewall security.

IBM is the world's trusted leader in security; 10 of the world's largest banks and 80% of global transactions daily are secured by IBM.

Red Hat OpenShift: Delivering with speed and agility
OpenShift is the leading enterprise-ready Kubernetes container platform to seamlessly and securely manage across any cloud, on-premises hardware or edge deployments. Kubernetes is an open source container orchestration platform that automates many of the manual processes involved in deploying, managing, and scaling containerized applications.

Red Hat OpenShift is the foundation of IBM Open Data for Industries
It empowers IT developers, users (geoscientists and engineers) and data scientists to work effectively across subsurface data to deploy software and technologies that help them model and visualize quickly and at scale. This is key in cross-disciplinary workflows such as exploration and appraisal and well delivery where various teams are working with the same data. With IBM Open Data for Industries all applications can be accessed from anywhere and have flexible and agile deployment options to accelerate collaboration across teams.

Business value highlights with Red Hat OpenShift

3x ROI	78 average hours saved per application	$2.2 million 3-year productivity lift value for a 100 person development team[10]

IBM Cloud Pak for Data: Drive enterprise data and AI strategy in rapidly evolving technology landscapes
IBM Cloud Pak for Data is fully integrated with IBM Open Data for Industries. This fuels the oil and gas industry's efforts to exploit OSDU subsurface data, including other data sources, modernize legacy infrastructure through hybrid cloud, and infuse AI into workflows securely. IBM Cloud Pak for Data has helped industry users all over the globe expand The AI Ladder™ approach: from being able to simply collect, organize and analyze data to becoming a singular AI platform capable of handling the entire advanced analytics and AI journey.

IBM Cloud Pak for Data: The richest open source ecosystem
IBM Cloud Pak for Data delivers a single transformative platform. It is a modular operating system of interoperable services connecting all data with:

- **Simplicity**
- Faster **adaptability**
- **Reduced** reliance on **specialization**

Unlike the traditional mix of many isolated tools, using a single open source-based AI platform enables:

- A single, **unified experience**
- Integrated **automation of manual tasks**
- Enforced **governance and security**

IBM Cloud Pak for Data enables accelerated data-driven insights for operational decision making and leverages the benefits of a hybrid-cloud data and AI solution that runs anywhere and connects all OSDU subsurface data sources. IBM continuously invests in IBM Cloud Pak for Data to ensure it remains the AI platform of choice for industry. IBM Cloud Pak for Data scored as the top ranked current offering and top ranked strategy in the Forrester Wave Enterprise Insight Report.[11]

Data scientists are more productive with IBM Cloud Pak for Data and can deploy models to market faster. Additionally, because IBM Cloud Pak for Data is an integrated platform, companies avoided costs associated with legacy analytics tools or otherwise building a comparable solution internally.[11]

IBM Cloud Pak for Data consistently delivers enhancements and features for data scientists, data engineers, data stewards, developers and industry users. The IBM data and AI vision is to democratize data science and automate the end-to-end process for building, deploying, and maintaining AI at scale with trust and transparency infused throughout. IBM's commitment to hybrid cloud and open source is demonstrated in IBM Cloud Pak for Data.

Schlumberger, IBM and Red Hat: Addressing energy industry deployment preferences

Schlumberger, IBM and Red Hat recently announced a major hybrid cloud collaboration that expands access to the DELFI cognitive E&P environment to address the energy industry's deployment preferences. The joint initiative will provide global access to Schlumberger's leading exploration and production cloud-based environment and cognitive applications by leveraging IBM hybrid cloud technology, built on Red Hat OpenShift.

Using the container platform will enable the deployment of applications in the DELFI environment across any infrastructure, from traditional data centers to multiple clouds, including private and public. This new way of hosting will offer the possibility to use multiple cloud providers and will address critical issues for customers, facilitating in-country deployments in compliance with local regulations and data residency requirements.[12]

Ultimate choice and flexibility to drive today's digital energy

IBM is committed to the Open Group OSDU Forum and helping to drive subsurface transformation across the industry. The supporting ecosystem that is propelling the OSDU data foundation forward will drive industry innovation at a faster rate and scale. Choosing the right platform to drive OSDU-compliant data, other enterprise data sources, as well as new energy data sources across the diverse operational landscape of oil and gas operations is critical in making data intelligence pervasive.

IBM Open Data for Industries is built on Red Hat OpenShift and fully integrated with IBM Cloud Pak for Data. It provides the scale, security, flexibility and choice in a single platform to unlock energy data from proprietary models, proprietary platforms and cloud technology infrastructure.

Many energy companies have already begun to embrace their data and power advanced technologies. Incorporating the OSDU data foundation now will accelerate their efforts and drive scalable subsurface insights for recovery and growth today, while preparing the foundation for future energy sources.

For more information on the benefits of IBM Cloud Pak for Data, read the product brief.

Interested in learning more about IBM Open Data for Industries? Schedule a consultation with an IBM Data and AI expert.

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