Market Guide for Oil and Gas Upstream Modeling Suites

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Initiatives: Energy and Utilities Technology Optimization and Modernization

The market for UMSs continues to evolve. Users want enhanced modeling iteration, faster cycle times and high cost-effectiveness. Vendors are expanding functionality and delivery models. This guide provides insights for oil and gas CIOs on market direction and representative providers.

Overview

Key Findings

- Oil and gas companies’ expectations of upstream modeling have grown, from providing discrete models of the reservoir to being the foundation that drives overall production system optimization and improving the quality of reservoir management over its entire life cycle. As a result, upstream modeling suite (UMS) requirements have become more complex with greater integration of geophysical, geological, petrophysical and reservoir simulation workflows.

- Demand is increasing for support of tighter integration with surface network optimization along with machine learning techniques in conjunction with classic engineering-based modeling and traditional workflows.

- Vendors are modernizing their technology architectures, enabling smoother data sharing, faster model iteration, machine learning, higher performance and large-scale cloud usage as well as the ability to handle very large datasets compared to their predecessors.

- COVID-19-related disruption will reinforce these trends and elevate ease of use, flexible licensing and tight integration that produces high-fidelity models with minimal data transfer as key requirements.

Recommendations

As oil and gas CIOs responsible for energy and utilities technology optimization and modernization, you should:

- Modernize your geoscience work management and single-mindedly pursue cost-efficiencies in the supporting upstream modeling portfolio. Begin by clarifying your aspirations for creating proprietary geoscience intellectual property and the depth of capabilities that you expect UMS vendors to provide to enable this.
Market Definition

Gartner defines upstream modeling as the development of a virtual model that describes the physical characteristics and future performance of subsurface hydrocarbon reservoirs, predicting their future performance and economic value. UMSs consist of bundles of complementary software that integrate the data, applications and workflows necessary to build and maintain upstream models.

Market Description

The upstream modeling process involves creative and flexible workflows that can be divided between many different software applications. UMSs improve workflow efficiency over point solutions by reducing the amount of data transfer and sharing output between different functional modules or applications within the suite.

The market divides into five functional domains:

- **Geophysical interpretation and modeling** — Software tools that integrate and analyze seismic and well data, or other geophysical data, to identify and delineate hydrocarbon reservoirs

- **Geological interpretation and modeling** — Software tools that integrate and visualize well data, well logs and wellbore formation data to identify and characterize hydrocarbon reservoirs

- **Formation evaluation (petrophysical interpretation)** — Software tools that integrate and analyze well log and other geological formation-related data to calculate the rock properties required for estimation of hydrocarbon volumes and flow rates

- **Reservoir modeling** — Software tools that integrate data from geological, geophysical and petrophysical workflows to build so-called static models of the reservoir and its properties, and prepare these models for reservoir simulation
Market Direction

The feature-functionality set of geophysical, geological, petrophysical interpretation and reservoir simulation tools is highly mature. Development of enhanced functionality for interpretation tasks has for some time been incremental, with incorporation of the latest scientific advances in geoscience modeling being the main driver. Many upstream modeling applications originated more than 10 years ago. Customers have continually sought enhancements to address specific application weaknesses, incorporate newer computing techniques such as machine learning, and improve performance and model resolution as well as increasing data volumes. Other application enhancements have come as vendors have sought to satisfy customer requirements or compete by providing better data integration, smoother and more repeatable workflow, and easier sharing for collaboration across the whole UMS toolset.

These trends have resulted in some vendors developing platform architectures for their UMS offerings. These are designed to provide greater workflow efficiency and data integration across the whole range of tools. Some vendors also provide development environments allowing users to create their own plug-in applications that integrate with core products in the platform environment.

Today’s UMSs are characterized by easier data sharing between applications, greater API-based access, high performance and the ability to handle very large datasets compared to their predecessors. Most recently, a pivot toward large-scale cloud usage has taken place from some vendors and users now have a choice of entirely cloud-based offerings as well as traditionally delivered offerings. Major trends impacting UMS market development are:

- **UMS Platforms in the Cloud** — Many oil and gas companies have shifted to prioritizing cloud platforms for technical and business applications, including upstream modelling software. UMS vendors have responded by enabling their software suites on private and, more recently, public cloud platforms. However, much legacy UMS software was designed purely for on-premises deployment and was not optimized to run in cloud environments. UMS vendors have enhanced or reengineered recent versions to be optimized for cloud deployment. Some vendors now offer entirely new suites rearchitected as platforms that capitalize on cloud native capabilities for modular development, analytics and high-performance computing. These offerings may be available alongside the latest versions of legacy architected UMS, cloud-enabled or otherwise. Cloud-native end-to-end UMSs are new in the market. Their promise of efficiency, scalability and ability to leverage public cloud platform capabilities gives them the potential to make significant advances on previous generations.

- **Growing Incorporation of Artificial Intelligence (AI)/Machine Learning** — Upstream modeling has traditionally had long cycle times, being highly iterative and relying heavily on the expert judgment of geoscientists and reservoir engineers. Oil and gas companies requirements to
reduce modeling cycle times has been a main driver of UMS development, and upstream modeling tools have long included features to automate workflow tasks such as seismic horizon picking. However, machine learning approaches offer ways to automate labor-intensive interpretation tasks much more quickly at acceptable levels of accuracy. UMS vendors are incorporating machine learning alongside traditional physics and equation-based techniques in order to automate interpretation tasks and reduce uncertainties. Examples include automated fault and horizon picking, feature identification in seismic data, geological formation lithology prediction and well planning. AI is also being applied across adjacent workflow domains, in seismic processing and production operations. UMSs will continue to develop extended AI capabilities, promising greater levels of workflow automation and augmentation of traditional geoscience techniques with novel capabilities.

- **Real-Time and End-to-End Modeling** — Reservoir models need to be updated as data from new wells, new seismic surveys and production operations is acquired. In early upstream modeling workflows, this was laborious, requiring manual reworking at each step. Lack of integration and siloed data management meant drilling and operations data often took time to feed back into geophysical and static geological models, if it made it at all. As vendors have improved integration across their UMSs, they have recognized the feasibility of shortening update cycle times by including modeling scenarios and uncertainties in their workflows. In addition, upstream modeling relies on iterative, forward modeling techniques at key points in the workflow. This involves minimizing the discrepancy between calculated models and observed data to derive values for reservoir properties that generate predictions matching observation (e.g., actual production profiles). Notable examples are seismic inversion and reservoir history matching. Functionality to accelerate forward modeling workflows by linking model output and input parameters and handling of input uncertainties is now included in some UMSs. Customer requirements for higher accuracy together with compressed cycle times along with the shift to cloud and platform architectures and increasing computing power will continue to drive progress toward UMSs built around shared and dynamic earth models. These will have rapid updates and progressively easier interchange between forward and reverse modeling in the workflow.

- **Openness** — Early upstream modeling tools had proprietary data and systems architectures (the earliest interpretation workstations were first sold on vendor manufactured proprietary hardware). Today, major UMS vendors now open source large parts of their UMS data architectures or source code, and publish APIs for developer access. Third-party tools, such as TIBCO’s OpenSpirit, are also available and specifically designed for data sharing between applications and UMSs from different vendors. In March 2019, the Open Group launched the Open Subsurface Data Universe (OSDU) Forum with the aim of developing an industry standard data platform for upstream data (see Note 2). The major vendors are participants in OSDU, contributing data and code to the initiative and announcing future compatibility of their UMS with the standard. If successful, the OSDU will mark a major shift in the UMS market, with
differentiation focused around application capabilities rather than integration or platform capabilities.

The challenges imposed by the COVID-19 pandemic and subsequent market downturn after March 2020 meant customers once again are reviewing their upstream modeling portfolios and upstream modeling processes to ensure maximum cost and workflow efficiencies (see “Navigating 2020 Disruption in Oil and Gas: A CIO Guide”). These imperatives elevate reduced end-to-end cycle time and cost-effectiveness as key drivers. Buyers are likely to prioritize simplicity, ease of use, advantaged and flexible licensing, and tight integration that produces high-fidelity models with minimal data transfer.

Market Analysis

The fundamental purpose of upstream modeling is to build virtual models that characterize hydrocarbon reservoirs enabling companies to decide how to maximize economic return and minimize risk in exploiting their oil and gas reserves. Upstream modeling applications (aka geological and geophysical [G&G] or petrotechnical software) enable geoscientists to derive subsurface structures along with rock and pore fluid physical properties from seismic, wellbore and other data in workflows known as interpretation.

Reservoir models are built with these assembled properties to then simulate fluid flow under various field development scenarios. Reservoir and production engineers use the results to design optimum production facilities and processes which maximize the return on the investment made in field development and operation. During field production, reservoir models are updated with data from field operations and used in maintaining and optimizing production as reservoir conditions change and facilities are extended or upgraded.

Typically, UMSs come in the form of core products, with add-on modules to cover discrete workflows. Historically, the type of licensing significantly differed between vendors, with asset-, regional- or global-based licensing models and terms that were perpetual, multiyear or annuity. Additionally, there may be leasing options — and in very rare cases, certain vendors will provide an unlimited licensing model to customers — along with per-seat and concurrent user access types. More recently, customers have preferred enterprise access deals or subscription models for licensing, which have increased in frequency.

Architecting full UMS environments for high-quality reservoir modeling and workflow efficiency is complex. Competing business requirements must be balanced. These include the completeness of UMS-provided capabilities, ease of integration with non-UMS data/solutions, support for developing/applying geoscience intellectual property outside the UMS and optimizing the productivity of a global workforce that interacts from multiple locations. Buyers have a broad range of UMS solutions and can decide how much functionality they want from a single UMS vendor. The fully featured platforms from the larger vendors are priced as premium products. Firms seeking cost optimization may choose less expensive solutions from the smaller vendors. This
approach trades off efficiencies of integration and breadth of functionality against lower total cost of ownership while seeking not to lose (or even gain) significant feature-based quality. These complexities and replacement costs mean many firms still have not standardized the UMS portfolio and have multiple solutions with functionality overlap. Some may also still run legacy applications that do not take advantage of modern architectures.

Gartner identifies three main drivers in the evolution of upstream modeling tools leading to the development of UMSs:

- **Best-of-breed functionality** — As they first appeared in the marketplace, upstream modeling tools were narrowly focused solutions engineered to best incorporate current earth science. Vendors competed to deliver the best and most efficient computing techniques and algorithms that applied current science to create the most accurate possible understanding of the subsurface within the scope of the tools. Reflecting advances in earth science interpretation and simulation techniques — as well as computing science — continues to be an important consideration for end-user buyers. Superior proprietary incorporation of advanced scientific and computing techniques is one factor of differentiation between vendors.

- **Workflow efficiency preference** — Much best-of-breed upstream modeling software was developed by a small number of oil and gas industry specialist vendors using architectures that lacked integration and standardization between the software. The number and scope of applications grew to cover more of the overall interpretation process, creating significant inefficiencies in managing data, conducting workflow, integrating talent and deploying technical resources, and in comparing modeling approaches between assets and reservoirs. Buyers began to emphasize greater integration, standardization and ease of use to address these issues, especially as upstream tools at one time suffered in comparison with business software that was much cheaper on a unit basis. True UMSs have emerged as vendors develop greater integration and built in standardized or user-created workflows into their tools. Data integration and workflow efficiency have matured as essential requirements across the market. Vendors now split roughly into two groups:
  - Those who provide a wide range of (sometimes duplicated) core products or application modules with high levels of integration and workflow support, though every module may not be best-of-breed
  - Those whose applications cover a narrower process footprint but maintain high degrees of best-of-breed differentiation. These solutions typically now also include some level of data and workflow integration between vendor applications and, importantly, the market-leading UMS from other vendors

- **Platform-enabled capabilities** — In addition to providing incremental enhancements to improve data integration and workflow efficiency, some UMS vendors have transitioned their suites to more modular platform-type architectures. These include:
UMS platform architectures are designed to provide both tighter integration and greater flexibility in tailoring functionality to reservoir or asset-specific needs while retaining the benefits of standardization and tighter data and model integration.

Entirely cloud-based and highly integrated UMS platforms are a recent development in the market that hold the promise to deliver cost-efficiency and productivity benefits without the need for in-house rationalization of applications and data architectures. Until recently, UMS vendors took their own approaches to their underlying data and solutions architectures. While data transferring and sharing has been made easier, buyers still face the choice of commitment to the UMS from a major vendor or assembling a portfolio of tools from several providers. This remains true of the cloud platforms from most vendors, however, Schlumberger’s DELFI environment is positioned as an open, secure and scalable cloud-based platform with APIs and interoperability with third-party systems. Halliburton’s DecisionSpace 365 is positioned as an open architecture facilitating connectivity to third-party applications and plug-ins.

In this context, the OSDU is a significant development in the market. If momentum for adoption grows across the industry, operating companies will increasingly require vendors to offer compatible applications. Notably, integration, interoperability and openness will cease to be important differentiating factors among solutions and existing platform offerings may be seen as competitive to the OSDU standard. Best-of-breed considerations may again become the primary ground of competition between solutions. Operating companies are also likely to be able to develop more highly tailored and modular portfolios combining their own intellectual property with that from a range of solutions providers. Vendors may have to adopt new solutions architectures and approaches to generating value based around ecosystem participation and co-creation with their operating company clients. Notably, Schlumberger has contributed to the OSDU by open sourcing what they describe as their data ecosystem on the platform.

**Representative Vendors**

**Market Introduction**

In Table 1, we have selected UMS vendors that represent the breadth of offerings in this market (see Note 1 for inclusion criteria).

**Table 1: Representative Vendors in Oil and Gas Upstream Modeling Suites**
<table>
<thead>
<tr>
<th>Vendor</th>
<th>Geophysical interpretation</th>
<th>Geological interpretation</th>
<th>Petrophysical interpretation</th>
<th>Reservoir Modeling</th>
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<tr>
<td>Baker Hughes</td>
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<td>Beicip-Franlab</td>
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<td>Divestco Geoscience</td>
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<td>DownUnder GeoSolutions (DUG)</td>
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<td>Emerson (E&amp;P Software)</td>
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<td>Halliburton Landmark</td>
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<td>Rock Flow Dynamics (RFD)</td>
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<td>SeisWare</td>
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Vendor Profiles

Baker Hughes

Baker Hughes is a publicly listed international industrial services provider and a major oilfield services company. Originally Baker Hughes Incorporated, the company was formed by merger of Baker International and Hughes Tool Company in 1987. It became Baker Hughes following divestment by General Electric (GE) in 2019. GE retains a minority stake.

In upstream modeling, Baker Hughes offers JewelSuite, a subsurface modeling package for geological modeling, geomechanics and reservoir simulation model building. JewelSuite has geological modeling workflows with structural, stratigraphic, fluid and rock property modeling, gridding and model upscaling. The package facilitates reservoir simulation with pre- and post-simulator processing and hydraulic fracture flow modeling. JewelSuite incorporates gridding technology designed to provide accurate modeling in complex geological environments.

The JewelSuite Subsurface Modeling application is built on the JewelEarth environment — a development toolkit that allows users to create new plug-in applications and workflows, and integrate third-party applications.

Baker-Hughes is a member of the OSDU Forum.

Beicip-Franlab

Beicip-Franlab is an independent consulting services and software solutions provider focusing in the oil and gas industry. The company was founded in 1960 and is based in Rueil-Malmaison, France. Beicip-Franlab operates as a subsidiary of IFP Energies Nouvelles, a research and training organization in the fields of energy, transport and the environment.

The company offers the Openflow Suite UMS, a workflow-oriented software platform composed in three workflow areas:

- Petroleum systems assessment and basin analysis — including DionisosFlow stratigraphic modeling, KronosFlow basin reconstruction (evolution through time) in complex geological
settings and TemisFlow basin modeling

- Reservoir characterization and modeling — including EasyTrace well log processing and analysis, InterWell seismic inversion and geological reservoir characterization, and FracaFlow fractured reservoir characterization and modeling

- Reservoir simulation, history matching and uncertainty analysis — including TightFlow specifically for unconventional reservoirs, PumaFlow reservoir simulation and CougarFlow history matching and uncertainty analysis

Openflow 2019 is supported on Microsoft Windows 7, Windows 10 and Linux Red Hat 6. TemisFlow and PumaFlow are also compatible with Linux Red Hat 7.

In 2018, IFP Energies Nouvelles announced a partnership with Beicip-Franlab and KAPPA to develop and commercialize Puma, a reservoir simulation solution featuring PumaFlow simulator executed from an interface integrated into KAPPA-Workstation. KAPPA is a petroleum engineering software solutions provider.

CGG

CGG is a publicly listed oil and gas industry geosciences technology and services provider. Under the GeoSoftware umbrella, CGG offers a portfolio of upstream modeling tools, grouped into named solution sets. These include:

- HampsonRussell — Geophysical interpretation and modeling tools
- Jason Workbench — Seismic velocity modeling, inversion and reservoir characterization
- InsightEarth — Seismic volume processing and advanced interpretation
- EarthModel FT — Reservoir geological static modeling and reservoir simulation preparation
- PowerLog — Petrophysics, rock physics, facies analysis and statistical mineralogy
- VelPro — Poststack velocity modeling

CGG also offers MCPU-Deterministic to enable parallel processing for Jason InverTracePlus and RockTrace seismic inversion applications on up to 64 single machine or networked processors.

CGG is a member of the OSDU Forum.

Divestco Geoscience

Divestco Geoscience is a privately held geoscience services company providing geomatics, processing, imaging and seismic data services, and software solutions. Divestco Geoscience formed in 2019 after the assets of Divestco Inc. were acquired by Alberta Ltd (subsequently
renamed Divestco Geoscience). Divestco Geoscience is headquartered in Calgary, Canada and continues to offer the products and services formerly provided by Divestco Inc.

Divestco Geoscience offers an upstream modeling suite through its Software and Data division. The software suite includes:

- GeoCarta for analysis of Canadian land, well, production, reserves, and other exploration and production data
- Glass for seismic interpretation
- GeoWiz for coordinate conversion
- CrossLog and SynthSuite for well log correlation and stratigraphic modeling

The company also offers a library of Canadian exploration datasets to include digital and raster well log data, digital strip logs, well tickets and well documents.

**DownUnder GeoSolutions**

DUG is a privately held geoscience software and services company. The company was founded in 2003 and is based in Perth, Australia.

DUG offers two product sets in the upstream modeling domain:

- **Insight** for seismic interpretation. The product provides 2D/3D/prestack visualization and interpretation capabilities. Additional functionality is provided in a series of add-on modules. These include: Explorationist, Image Gather Processing, Gather Attributes, Pore Pressure Prediction, Rock and Lithofluids

- Also provided as modules are Data Manager seismic volume compression and interpretation project synchronization, Kingdom Reader for data import from IHS Markit Kingdom software, Petrel Link for data interchange with Schlumberger Petrel projects, and OpenWorks Link for data interchange with Halliburton Landmark’s OpenWorks data repository.

- **Insight** is supported on Windows, Linux and Mac OS.

- **McCloud**, a cloud service giving access to DUG’s geophysically configured high-performance computing resource and data center. McCloud users have access to the complete suite of software supporting DUG’s services.

DUG states that in the future Insight will have support from McCloud, with the ability for users to store data and sessions in the DUG cloud. DUG also offers a generic high-performance computing capability based on McCloud for compute-intensive jobs in any industry.
Emerson (E&P Software)

Emerson is a global technology and engineering company providing services and solutions, including process control and automation, to the oil and gas industry. Emerson’s E&P Software business comprises Paradigm and Roxar solution sets for subsurface modeling and analysis. Emerson E&P Software was created in 2019 with the acquisition of Paradigm, a previously independent UMS provider. Emerson is headquartered in St. Louis, Missouri, U.S.

Emerson E&P Software offers an integrated suite of solutions for upstream modeling and related workflows including seismic interpretation and modeling, geological interpretation and modeling, model validation, formation evaluation, reservoir characterization and reservoir simulation.

Several products apply machine learning techniques to interpretation workflows. Among the Paradigm suite products are:

- SeisEarth seismic interpretation
- SKUA-GOCAD for earth modeling
- Geolog for petrophysics-based formation evaluation.

Roxar brand products are RMS for geological modeling, Tempest reservoir simulation and METTE production flow simulation.

Applications are integrated through the Epos data sharing infrastructure that also enables third-party application integration. A range of software development kits are offered to allow users to develop applications, algorithms or plug-ins and integrate with third-party applications. Emerson’s E&P Software portfolio is now offered on cloud platforms including Microsoft Azure and Amazon Web Services (AWS).

Additional Emerson offerings include:

- EarthStudy 360 for full azimuth seismic imaging and characterization
- Paradigm k, a cloud-based oilfield simulator for unconventional plays that models the reservoir, wellbore and surface networks as a system
- Big Loop production optimization solution that uses simulation results to automatically refine and match static model uncertainties

Emerson E&P Software is released on Linux and Windows. Emerson E&P Software is a member of the OSDU Forum.

Halliburton Landmark
Halliburton is a publicly listed major international oilfield services company. Halliburton was founded in 1919 and is headquartered in Houston, U.S. Exploration, development and production software is provided through Halliburton's Landmark business line.

Upstream modeling capabilities are provided in the DecisionSpace suite and DecisionSpace 365. DecisionSpace is an integrated suite of applications for seismic interpretation and modeling, geological interpretation and modeling, petrophysics, reservoir modeling and simulation, and other upstream workflows.

DecisionSpace 365 is a cloud-native suite of exploration and production applications, available as a subscription through Halliburton's iEnergy cloud service. Upstream modeling tools in DecisionSpace 365 include:

- Geosciences Suite for seismic and geological interpretation and modeling
- Assisted Lithology Interpretation for lithology interpretation and prediction incorporating machine learning
- Seismic Engine for interpretive processing, and Scalable Earth Modeling for reservoir modeling.

DecisionSpace 365 includes the Data Foundation data ingestion and sharing platform, Integration Foundation for connection to third-party applications and data stores, along with Real-Time Control-Edge for drilling automation.

Halliburton Landmark makes source code for its products available in the OpenEarth Community, a collaborative open development environment for petrotechnical computing solutions.

Halliburton is a member of the OSDU Forum.

**IHS Markit**

IHS Markit is a publicly listed information and analytics company that has been providing services and solutions in the oil and gas industry since 1968. In 2011, IHS acquired SMT's Kingdom upstream modeling software.

IHS Markit offers two principle UMS solution sets:

- Kingdom Geophysics for seismic interpretation and modeling
- Kingdom Geology for geological interpretation and modeling

IHS Markit also offers Kingdom Analytics Explorer, providing interactive connection between Kingdom projects and TIBCO Spotfire analytics software. Kingdom Connect provides data sharing with TIBCO OpenSpirit-enabled third-party applications. A plug-for connection to Schlumberger's
Petrel is also offered. A number of additional geophysical and geological analysis modules are also available including Kingdom Petrophysics, a petrophysical interpretation tool.

Kingdom products are offered as bundled packages containing base applications and various combinations of additional modules for either geophysical or geological interpretation, or both.

IHS Markit is a member of the OSDU Forum.

LMKR

LMKR is a privately held petroleum technology formed in 1994 and headquartered in Dubai, United Arab Emirates. In 2010, it became the exclusive worldwide licensor and distributor of GeoGraphix software and is responsible for research and development, sales, marketing and support for this suite.

LMKR's UMS offerings are GeoGraphix and GVERSE. GeoGraphix includes modules for seismic and geologic interpretation, mapping and geosteering visualization. GVERSE includes applications for petrophysics and reservoir modeling as well as additional seismic interpretation modules. GVERSE Connect is a plug-in for Schlumberger's Petrel platform, providing data exchange with Petrel projects.

The 2019.1 version of GVERSE includes GVERSE NOW, a web-based launch site that links with the iEnergy Core of Halliburton Landmark.

GeoGraphix and GVERSE are supported on Microsoft Windows operating systems.

PANGEA

PANGEA is a geosciences software and services company founded in 1994 and headquartered in Moscow, Russia. PANGEA offers a software suite for geoscience interpretation and modeling that includes:

- ReView — 2D/3D seismic interpretation and geophysical modeling
- MAGISTR — Gravity and magnetic data interpretation and modeling
- Certainty — Gridded data analysis and geological zonal property prediction
- PetroExpert — Well log and petrophysical interpretation
- MapMaker — Mapping (gridding and contouring)

PANGEA also offers ECHO for reservoir characterization through production data analysis.

Base packages for each function are provided that can be expanded with modules, adding advanced additional functionality.
Rock Flow Dynamics

Rock Flow Dynamics (RFD) is a privately held provider of integrated modeling and data analysis software for oil and gas companies. The company was founded in 2005 and is headquartered in Moscow, Russia. The company provides tNavigator, a software suite focused on reservoir management and supporting mainly key reservoir engineering workflows. The suite is designed to use parallel processing and take advantage of multicore CPU and GPU processors to achieve high processing speeds.

tNavigator is offered as a single package including modules for:

- Seismic and geological modeling
- Geomechanics
- Static and dynamic reservoir modeling and simulation
- Fluid pressure-volume-temperature (PVT) calculation and surface network modelling

All modules share a common interactive 3D graphical user interface and proprietary database.

Licensing is available for non-networked and networked environments running Linux or Microsoft Windows.

Schlumberger

Schlumberger is a publicly traded major international oilfield services company, originally founded in 1926. Schlumberger's global headquarters are in Houston, U.S. Exploration, development and production software is provided through Schlumberger Software.

Schlumberger's primary UMSs are Petrel for geoscience interpretation and reservoir modeling and Techlog for formation evaluation. These products can share data and interpretations via the Studio data sharing environment. Subsurface models are constructed and modeled within Petrel and Techlog and then run on ECLIPSE or INTERSECT reservoir simulators. Other products supporting upstream modeling workflows include GPM geological process modeling software, GeoX for exploration prospect portfolio evaluation and PetroMod for basin modeling.

The Ocean software development framework is a development environment allowing users to create workflows and plug-ins for Petrel and Techlog. Users can buy plug-ins developed by third parties from the Ocean store.

Cloud-based UMS capabilities are provided in DELFI, a cloud environment to support workflows across the exploration and production life cycle. The DELFI environment includes:

- A petrotechnical suite including Petrel, Techlog, Studio and other upstream modeling applications
The environment also includes cloud-native applications for well planning and drilling optimization, exploration portfolio evaluation, collaborative field development planning and production optimization. An API gateway is provided to expose the data ecosystem for application development. Access to applications is mediated via user profiles.

DELFi is offered as SaaS on subscription on Microsoft’s Azure and Google’s Google Cloud Platform cloud services.

Schlumberger is a member of the OSDU Forum and has contributed elements of the DELFI data ecosystem to the forum.

SeisWare

SeisWare is a privately held geoscience interpretation software provider. The company was founded in 1996 as Zokero and is headquartered in Calgary, Canada.

SeisWare offers a PC-based upstream modeling suite with three principal solution sets:

- **Geophysics** — A seismic interpretation solution designed for use in both conventional and unconventional plays
- **Geology** — Provides geological interpretation tools, including tops picking and log correlation in a dynamic 2D and 3D environment. Geology is fully integrated with Geophysics
- **Field Development** — For well pad and field planning primarily for tight oil and gas fields

SeisWare’s products are compatible with Microsoft Windows 7, 8 and 10.

In April 2020, SeisWare entered a partnership with Sound QI Solutions, a quantitative interpretation solutions company offering QI-Pro, a seismic attribute analysis application. The partnership is intended to allow SeisWare software users to add QI-Pro capability into their workflows.

**Market Recommendations**

Upstream companies make significant investments in their upstream modeling capabilities. Upstream modeling workflows are complex and varied, often depending on diverse geological conditions and the nature of individual plays. Buying decisions can be heavily influenced by the feature functionality preferences of users. These are important but over-prioritization of these requirements can lead to diverse portfolios of upstream modeling tools with duplication and relatively weak integration.
Companies face major challenges due to today’s market conditions. As UMSs mature on modern architectures, CIOs should:

- Examine their existing portfolios and upgrade plans, ensuring they effectively balance cost of ownership with a holistic view of business value.

- Be clear on vendor roadmaps for capitalizing on openness, cloud platforms, modern analytics and facilitating further integration within the vendor suite and with third-party tools.

CIOs should pursue UMS portfolios that:

- Enable faster cycle times while maintaining (or increasing) the accuracy and reliability of reservoir models and simulations

- Connect easily with adjacent workflows, especially surface process modeling

- Offer optimal total cost of ownership along with license flexibility

**Acronym Key and Glossary Terms**

<table>
<thead>
<tr>
<th>Geology formation</th>
<th>A set of rock strata of comparable type or similar properties, typically laid down under given depositional conditions at specific times.</th>
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<tbody>
<tr>
<td>Geoscience interpretation</td>
<td>The process of identifying or inferring relevant features in geophysical, geological and well data and using them to build useful models of parts of the subsurface. Such features can often be ill-defined, ambiguous or unclear and interpretation relies heavily on the expertise and experience of the geoscientist.</td>
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**Note 1**

**Representative Vendor Selection**

We selected the vendors profiled in this guide to represent the breadth of offerings in this market, covering different aspects of UMSs impact on upstream modeling workflows. We endeavored to provide a good geographical spread of vendors.

**Note 2: The Open Subsurface Data Universe**

The Open Subsurface Data Universe Forum is focused on designing an industry standard open data platform for subsurface data types from exploration, development and wells. The OSDU Form takes on work started by a group of international oil and gas companies. These companies first met in early 2018 to discuss exploitation of modern cloud platforms to address long-standing inefficiencies in exploration and production data sharing. The stated aim of the OSDU is to develop
a common data platform on global public cloud services with standard public APIs that will facilitate data access across the range of upstream workflows. OSDU states that working implementations will allow companies to focus on differentiating business activities and reduce the cost of independently developing subsurface data platforms. OSDU Release1 has been made available to forum members to gain data preparation and data loading experience. Full operation will be supported with subsequent releases. The OSDU Forum has 142 members spanning oil and gas operating companies, technology and service providers, and industry standards organizations.

Recommended by the Authors

Navigating 2020 Disruption in Oil and Gas: A CIO Guide
Top 10 Trends That Affect Oil and Gas CIOs in 2020
12 Cost Management Milestones for Oil and Gas CIOs During COVID-19 Response, Recovery and Renewal
2019 CIO Agenda: Oil and Gas Industry Insights

Recommended For You

Follow Gartner’s T4 Process to Optimize Negotiations: Tactics, Templates, T&Cs and Timing
Summary Translation: How to Deliver a Truly Hybrid Integration Platform in Steps
Summary Translation: COVID-19-Induced Downturn Will Disrupt SaaS Pricing Models
Summary Translation: Case Study: Building Blocks for Product Funding (TD Bank)
Summary Translation: The Evolving Role of the API Product Manager in Digital Product Management

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