UNCONVENTIONALS

Unconventional Asset Optimization Using PetroVisor™

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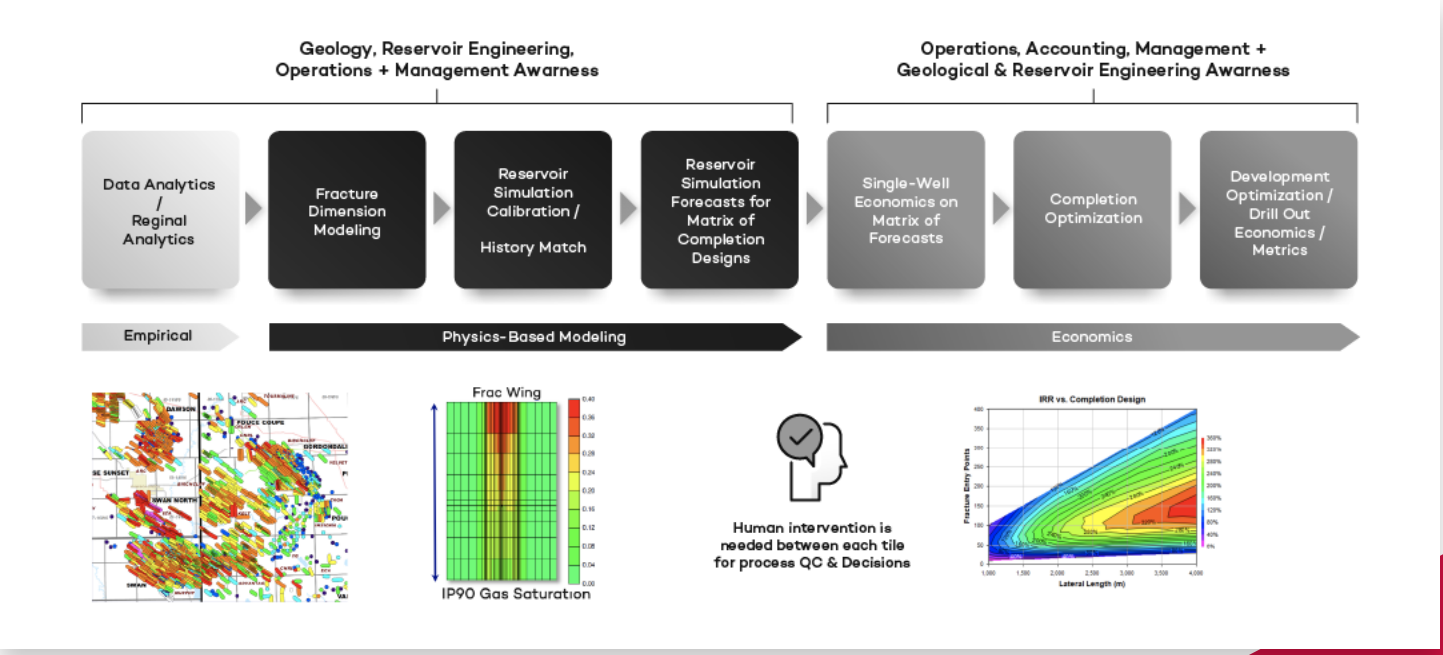
Examples of Automated Data Analytics Processes

While maturing in many North American basins, unconventional oil and gas assets are emerging globally as new shale fields are explored and developed. Optimizing these plays requires advanced technology and sophisticated analysis methods coupled with increasingly complex data collection. Lessons learned and operational methods from the unconventional boom in the U.S. are being transferred to old and new areas to speed development. While many technology developments may make unconventional asset development appear “conventional,” there is still much to discover even within the maturing plays.



The Challenge: Robust, Sound Information in a Timely Manner

The investment analysis required for either acquiring or developing unconventional assets includes oil and gas portfolio management, budgeting, planning and reserves analysis expertise. Within a typical operator three groups carry analysis responsibility—data analytics, engineering and geologic analysis and economics. Most often they are not in the same department, nor is there a unified workflow to guide daily collaboration and interaction. Silos result, and intermediate results are often focused on only one end-user, either the geologist, completions engineer, asset manager or the investor. This presents a problem when quick, accurate results are needed to determine the next step in the life-cycle of an asset from a technology, optimization or investment perspective. PetroVisor resolves this challenge by providing a single source of truth in a collaborative environment.

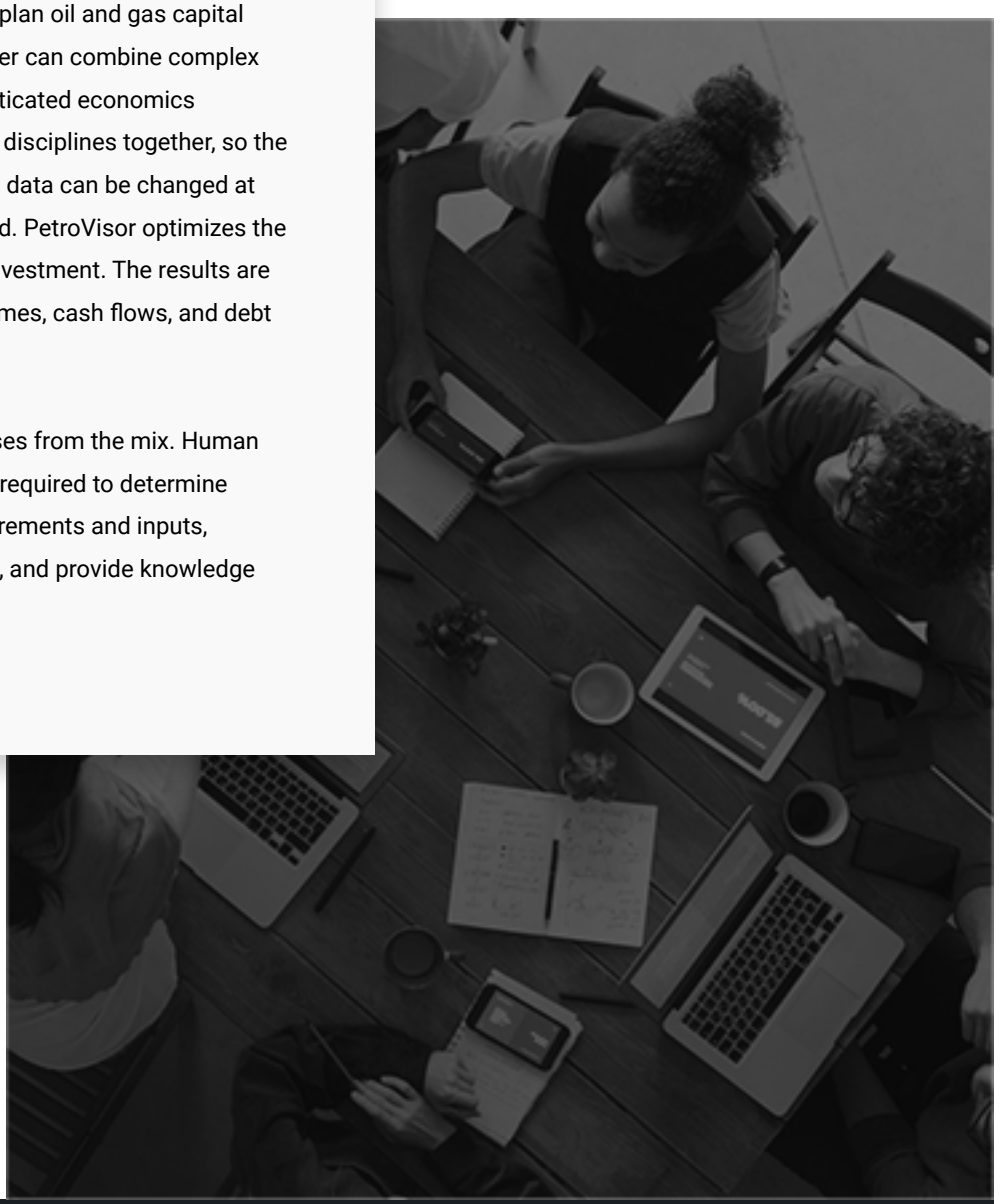
A common deficiency in unconventional asset optimization is the lack of physics-based modeling in the workflow. Traditionally, physics-based reservoir models take too long to build and execute to be useful in time-critical workflows. It often takes months to build, history match and produce production forecasts for a variety of completion and lateral spacing designs. The complexity is increased in horizontal wells that are drilled through layered formations with numerous frac stages. Companies considering an acquisition may only have data room access for 30 days, which means that reservoir modeling must be executed quickly. Asset planning or budgeting often requires information on most recent well performance to deliver an optimized drilling and completion plan in the required timeframe.

A Rapid and Pragmatic Approach That Does More With Fewer People

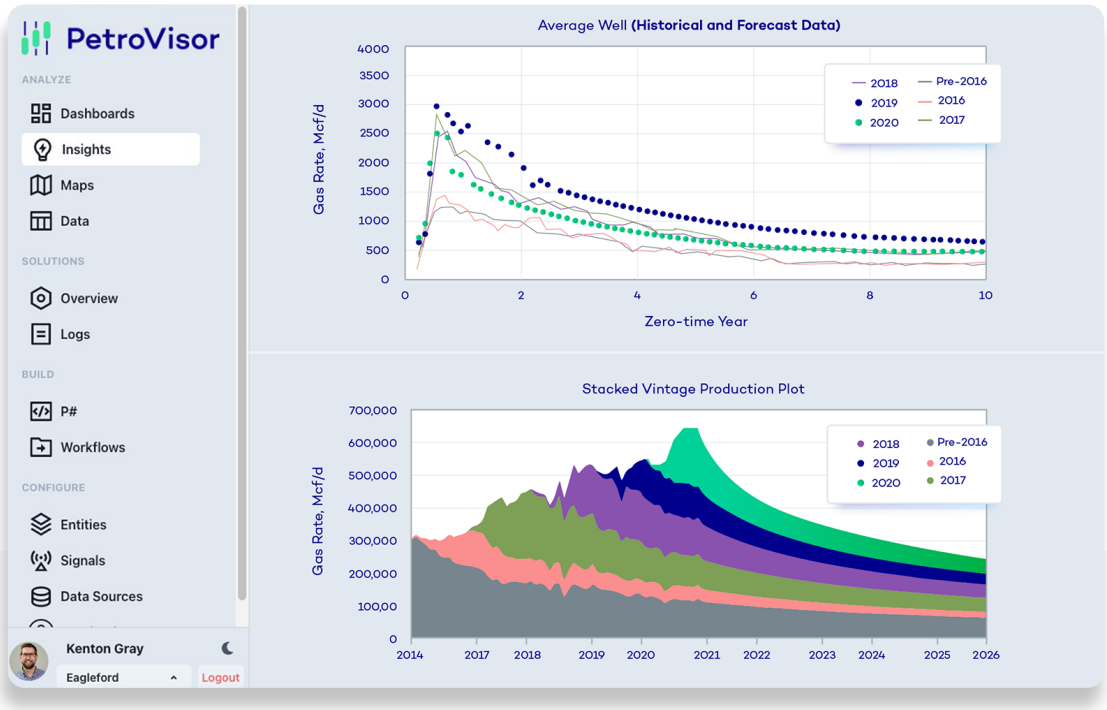
Because of the constraints detailed above, a rapid, pragmatic approach is required to inform decision makers. The ideal solution incorporates data analytics, physics-based completion and development optimization, along with sophisticated economics. The solution requires integration into a process flow that can be completed by a small working team in a timeframe useful to both the operator and investor.

Companies utilizing the PetroVisor platform can rapidly optimize completions, evaluate asset and corporate-level cash flows, and plan oil and gas capital expenditures. Within a single unified workflow, a user can combine complex data analytics, physics-based modeling and sophisticated economics modeling processes. This workflow brings all three disciplines together, so the output of one process is the input to the next. Input data can be changed at any point and the outputs are automatically updated. PetroVisor optimizes the completion design of a well and the overall asset investment. The results are used to provide a drilling schedule, production volumes, cash flows, and debt and investment needs.

This automated workflow removes manual processes from the mix. Human intervention in the workflow is minimized, and only required to determine project scope and purpose, develop technical requirements and inputs, identify decision criteria, determine decision points, and provide knowledge conveyance.



The Role of Data Analytics and Physics-based Modeling



A sound optimization program requires standardized processes for acquiring, integrating, performing quality checks, processing, and updating data. Within the PetroVisor platform, data is quickly and seamlessly pulled together from varying sources including customer well data and commercially available public databases. Using the PetroVisor platform the operator can import the required data, then access, process and perform quality checks. Automatic updating routines help users process newly-acquired data effortlessly and efficiently.

A physics-based model that produces production-type curves over a wide range of completion designs and development scenarios provides an investor with detailed economic analysis that can be used to improve completion optimization across an asset.

Physics-based modeling in the PetroVisor platform is a seamless process that produces fast results and includes an economic component to help an operator make a sound investment decision. Conducted in two-phases, the economic analysis provides financial metrics first for completion optimization and then for drilling schedule optimization. Modifications to key inputs at any point, whether investment capital, reservoir data or commodity price fluctuations are automatically incorporated, and the results are updated in real time. The PetroVisor workflow includes both a fracture propagation model that computes the fracture geometry dimensions based on rock properties and completion design, and a reservoir fluid flow model that forecasts monthly production volumes based on the fracture geometry and reservoir properties.

PetroVisor's physics-based modeling workflow incorporates data that is not typically used to generate the production type curves when optimizing completion designs and drilling schedules including:

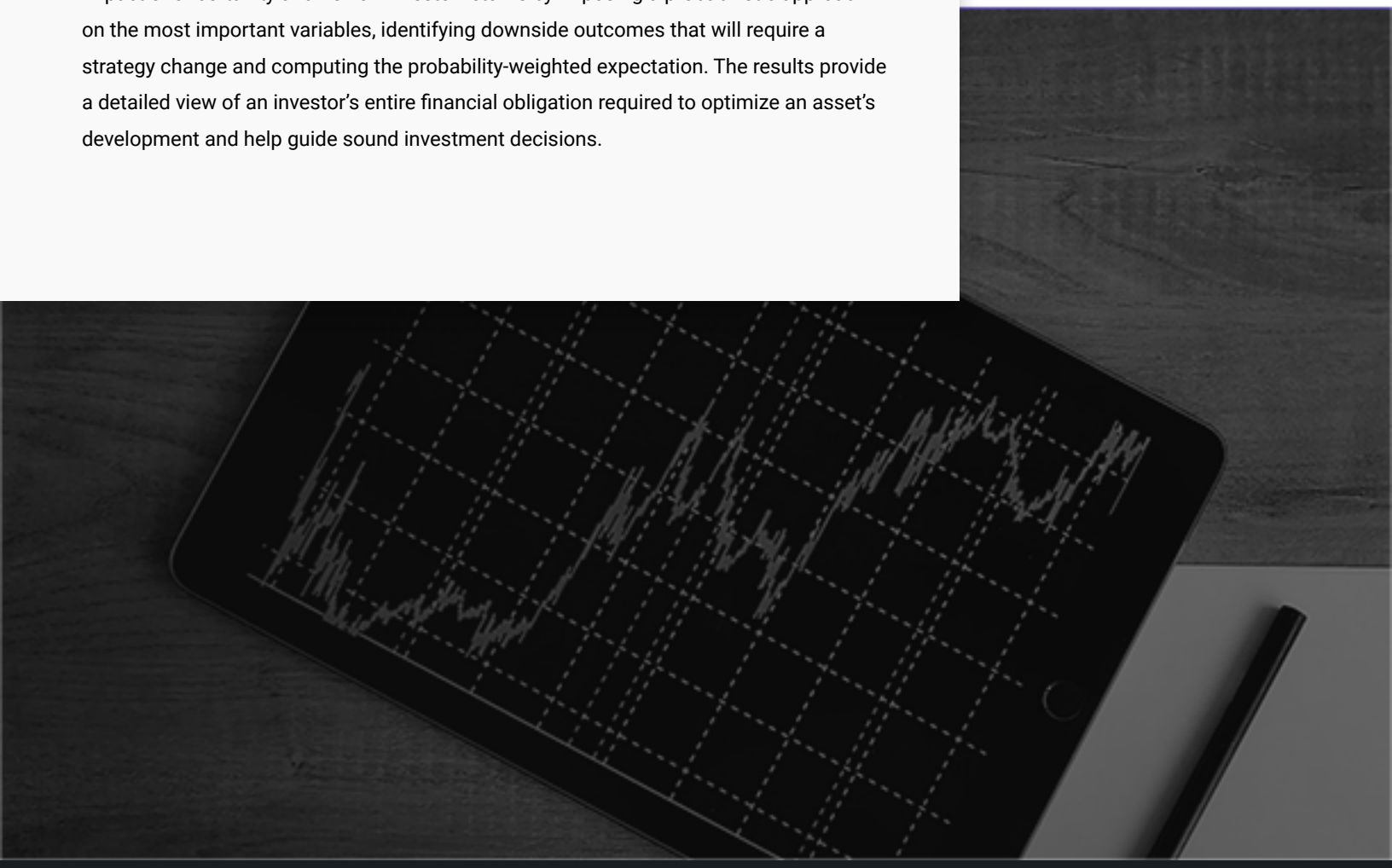
- Drainage area
- Reservoir fluid properties
- Reservoir pressure-dependent permeability
- User-defined surface flow pressures that change with producing time
- Wellbore hydraulics

By incorporating this data into the modeling workflow, the operator can optimize completion design and drilling schedule for optimum asset development while the investor receives a comprehensive financial overview.

Economic Modeling for Sound Investment Decisions

With workflows in the PetroVisor platform a user can generate an economic assessment for a drill-out evaluation over an entire range of potential completion designs using standard 40-year monthly cash flow analysis. Half-cycle economics are used to conduct completion optimization for optimal and near-optimal completion designs. Graphs of lateral spacing verses parent/child completion time, color-filled with production measures such as IP90 or EUR aid collaboration between the technical, operations, and management teams and facilitate group ownership of a multi-year completion strategy.

Economic modeling using workflows in the PetroVisor platform can build a capital investment schedule that incorporates debt, equity, working capital, asset retirement obligations, take-or-pay obligations and funds flow back to the investor. We quantify the impact of uncertainty and risk on investor returns by imposing a probabilistic approach on the most important variables, identifying downside outcomes that will require a strategy change and computing the probability-weighted expectation. The results provide a detailed view of an investor's entire financial obligation required to optimize an asset's development and help guide sound investment decisions.



Benefits Across Customer Types

Investment analysis workflows in the PetroVisor platform can benefit any operator or investor group that owns unconventional assets or is looking to acquire or divest properties. These include:

- North American unconventional operators who require optimum completions designs and a sound investment strategy
- Multi-nationals and National Oil Companies that are evaluating emerging shale plays and seeking to transfer existing technology, incorporate lessons learned, or gain operational insight from existing, successful shale developments
- Companies acquiring and divesting properties
- Private Equity groups who want to manage capital allocation among assets by modeling acquisition profitability

Because of the high cost of oil and gas capital expenditures, a sound asset development strategy is one of the most critical programs operators face today. As a result, operators are turning to oil and gas portfolio management programs to help achieve maximum investment returns. PetroVisor's optimization and evaluation workflow provides operators and investors in unconventional oil and gas plays a clear, concise program that optimizes completion technology, provides a full drill out and asset development schedule and guides capital deployment decisions.