ResAssure

A Revolution in History Matching and Uncertainty Modelling

- History Matching
- Uncertainty Modelling
- Reservoir Simulation
- Reserves Estimation

www.ResAssure.com

ResAssure offers users a complete Stochastic Reservoir Simulation workflow, which enables dynamic reserves estimation and history matching.

The impact of uncertain parameters (for example, depth, porosity, thickness) can be evaluated thoroughly by simulating millions of realisations in a fraction of the time taken by conventional simulators - this speed and accuracy saves considerable time and money.

Oil and gas engineers can systematically work through all the underlying technical uncertainties and generate far more accurate estimates of hydrocarbon reserves.

ResAssure provides probabilistic analysis of reserves, and narrows the range of uncertainty in reserves estimation.

ResAssure can facilitate increased revenue by supporting technical and commercial decision making.

What is ResAssure?

ResAssure is an innovation in reservoir simulation and solves fully-implicit, dynamic three-phase fluid flow equations for every geological realisation. ResAssure's robust simulator enables it to conduct the stochastic simulation of hydrocarbon reserves, which significantly reduces field development risks and narrows the range of uncertainty in reserves estimates.

Key functions ResAssure offers include:

History Matching

- Using MCMC and Rapidly Exploring Random Tree algorithms
- Simultaneous handling of reservoir and geological uncertainties

Dynamic Reserves Estimation

- Full uncertainty distribution curve is calculated to provide accurate probabilistic recovery estimates (P10, P50 and P90)
- Field Development Analysis

Uncertainty Modelling

- Explores multidimensional uncertainty space
- Comprehensive subsurface characterization encompassing all uncertainties in the reservoir model

Oil Initially in Place Estimate (OIIP)

- Static Initialization consistent with:
  - Rock and fluid properties
  - Geological uncertainties
- Probabilistic in place and reserves estimation using:
  - Recovery Factors
  - Sampling techniques (Monte Carlo, Quasirandom, FAST, Congruence, Trajectory)

What makes ResAssure unique?

Complex Structural Uncertainty

The robust gridding algorithm incorporated into ResAssure allows users to define structural uncertainty using two maps. This enables a realistic evaluation of fields where geological and geophysical uncertainties have a major impact.

Advanced Statistical Analysis

ResAssure's sampling algorithms facilitate rigorous subsurface risk quantification. New sampling algorithms and their higher dimensional representations can be used for uncertainty studies, ensuring far more accurate reserves reporting. In addition, advanced data mining provides probability recovery maps.

Flex through Multiple Realizations

ResAssure can take multiple realisations generated through geostatistical techniques and utilise the in-built uncertainties to find history match solutions.

100~1000 times faster reservoir simulation speeds

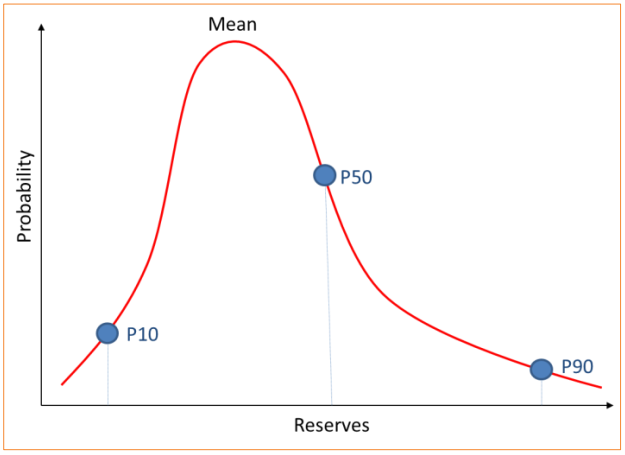
Exceptional speed increase is achieved by ResAssure, whilst still providing advanced features using an innovative numerical solution, aggressive spatial coarsening and time stepping, and robust polygonal gridding.

Deterministic Approach vs. ResAssure

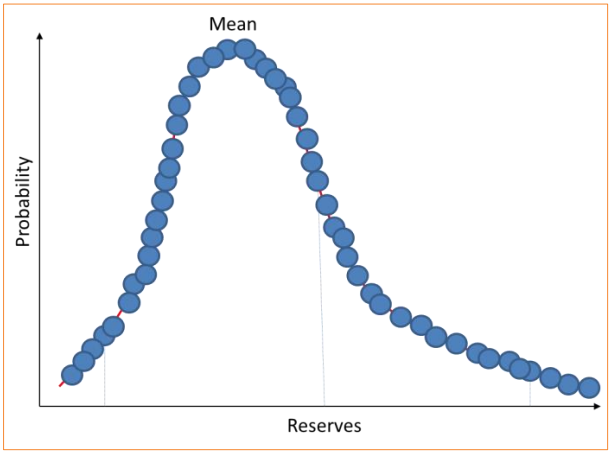
Standard practice in the industry is to employ a single "deterministic" model of the sub-surface, often referred to as the "most likely" case, to guide field development planning. A systematic quantification of other feasible outcomes is seldom carried out as it is often considered too difficult, too expensive and too time consuming.

ResAssure performs the massive computation required to generate a complete analysis of possible field outcomes.

Deterministic Approach – Single Reservoir Model



ResAssure Approach – Full Distribution Reservoir Model



ResAssure rigorously quantifies the full range of probabilistic outcomes on which to base development decisions. Unlike the deterministic modelling approach, each and every field development scenario calculated by ResAssure is fully consistent with all available data.

The starting point for ResAssure calculations is a standard simulation data deck (e.g. Eclipse, CMG), which typically only considers a single possible outcome.

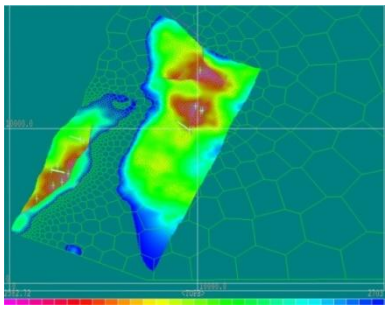
ResAssure then conducts a constrained random walk through the total solution space to locate all other feasible field development solutions, which could number into the millions.

Reduce Uncertainty for Mature Fields

Historical production data is used as a quality check for the existing reservoir models. Current history matching methods to identify good sets of history matched models are limited.

As the industry is moving away from a single deterministic representation of reservoir, the existing methods (ensemble or gradient based approaches) struggle to solve the inverse problem. The non-uniqueness in the history matched solution has been accepted in recent years but long iterative processes requiring a number of simulation runs makes the process difficult. ResAssure can assist in overcoming these limitations.

The Speed-Up of ResAssure



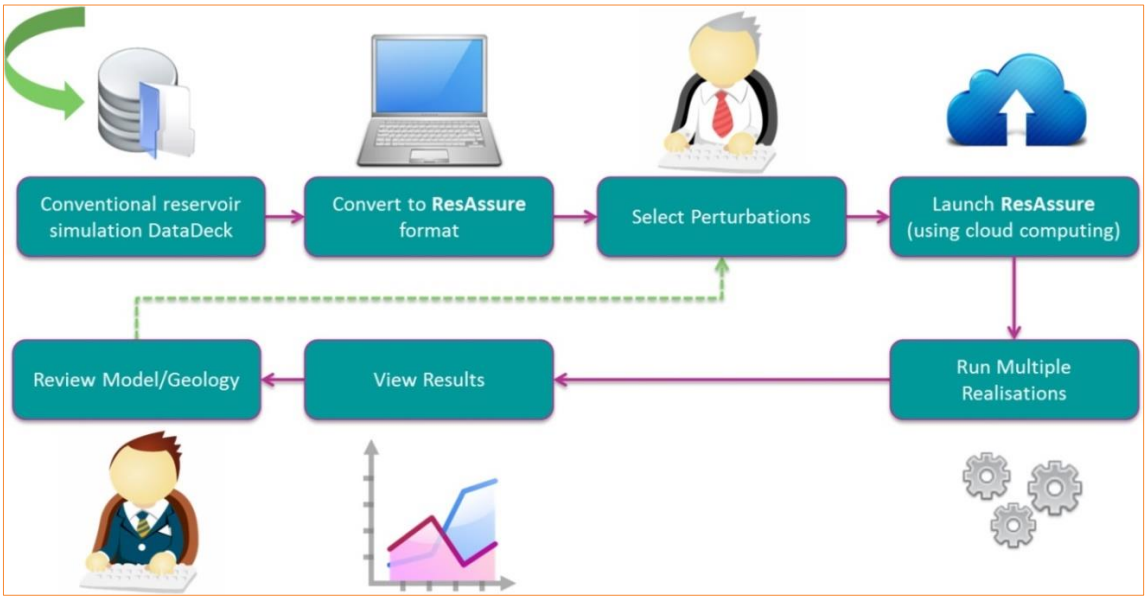
ResAssure's core simulator is built for achieving tremendous simulation speeds using various advanced mathematical techniques.

ResAssure's speed breakthrough is achieved by a combination of proprietary algorithms, polygonal gridding and aggressive spatial coarsening and time stepping.

It provides fully implicit simulation realisations without using proxy or approximation techniques and is able to achieve overnight, what until now would take reservoir engineers years using conventional simulation technology.

Cloud-Based Solution

ResAssure is offered as a cloud-based solution allowing users to evaluate their existing reservoir models from standard simulation packages by directly uploading to a secure cloud environment.



Summary

FEATURES	BENEFITS
Stochastic simulation of hydrocarbon reserves	• Narrows the range of uncertainty in reserves estimation • Better information for production and financing decisions • Reduces the potential for over- or under-investment
Probabilistic analysis of oil and gas reserves	• Facilitates SPE-PRMS reserve reporting requirements • Reduces development and financial risk • Unprecedented level of resource assurance with respect to oil and gas reserves and project profitability
Incorporates existing reservoir data about subsurface uncertainties	• Produces far more accurate estimates of hydrocarbon reserves • Generates timely, accurate statistical analysis of the sub-surface uncertainty
Advanced proprietary mathematical modelling algorithms	• Identifies many thousands of valid models and feasible outcomes as opposed to a 1 single “deterministic” model • Conventional simulators cannot provide timely decision support information • Generates a complete analysis of possible field outcomes
Fast simulation speed	• Enables efficient turnaround of stochastic simulation solutions • 24 hours of computing can generate > 100,000 realisations, each of which is a valid history-match or reservoir forecast • Significantly speeds up the history matching process
Cloud based ”on demand” solution (Amazon Web Services platform)	• Accessible 24hrs a day from anywhere in the world • Data stored securely • Scalable computing infrastructure (turn on or off quickly) • Software updates can be deployed dynamically • Enables increased collaboration • Environmentally friendly - 30% less energy consumption and carbon emissions than using on-site servers
Software-as-a-service	• Minimal or no large upfront capital expenditure required • Flexible licensing • No major onsite installation required
Simple and Intuitive GUI	• Powerful, easy to use, minimal training required • Few, if any compatibility issues – web based interface will work in many locations, on many PCs without extensive system requirements • Simple and fast implementation

For more information please visit **www.ResAssure.com**