

Risk Analysis of Exploration Plays: Retrospective and Prospective

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Petroleum explorationists have probably been practicing practical operational play analysis since the first prospector chased similar fields along an extended fault trend. However, it was only in the early 1970's, after (1) Depositional Models allowed us to visualize repeating stratigraphic combinations; (2) early source-rock studies allowed us to visualize HC Source-kitchens and migration routes; (3) Sequence Stratigraphy allowed us to predict genetic stratigraphic units; (4) the Petroleum System concept encouraged us to synthesize and predict different aspects of genetic sedimentary rock bodies; (5) statistical insights allowed us to identify and use statistics to anticipate reserves distributions and PoS for multi-field plays; and (6) computer software facilitated Monte Carlo simulation and statistical analysis of geotechnical parameters, that exploration plays could begin to be analyzed as full-cycle economic ventures.

Most substantial E&P companies now understand that the most important exploration decision is which new play to enter, not which prospect to drill. They utilize sophisticated, company-consistent risk analysis software to evaluate and rank new exploration plays. However, experienced subjective executive judgment also commonly figures in to the entry-decision.

Sequential data-gathering, guided by value-of-information considerations, have greatly improved our ability to economically evaluate and process frontier opportunities, either by correctly condemning overly risky plays, or improving their risk parameters so they surpass critical risk thresholds, thereby qualifying as legitimate exploration programs. Even so, E&P decision makers still have difficulty in correctly recognizing "company-maker" new plays. In addition, real-option considerations are not routinely part of new-play economic evaluations, so new plays are commonly undervalued.

Integrated Play and Prospect Assessment – Maximizing Regional Context and Local Detail

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Evaluation of undiscovered resource potential has traditionally utilized assessment strategies focused on either plays or prospects. Play assessments establish strong regional perspective by relating groups of similar prospects to geologic trends. Field size and chance of adequacy represent the group rather than individual features, thereby synthesizing essential local detail. Prospect assessment incorporates feature-specific information such as fault configuration or amplitude anomalies. The focus on detail, however, may mask regional relationships, especially for prospects that span multiple stratigraphic plays.

Integrated assessment can transcend the trade off between regional and local analyses and build upon the strengths of both. Play assessments advance "top down", by refining the stratigraphic definition of plays and the specificity of families. Evaluations progress toward an end member where feature counts, sizes, and risks are based upon individual prospects. Prospect assessments advance "bottom up", by generalizing specific observations into regional relationships that provide calibration for areas with less rigorous evaluations.

Success of the integrated approach requires flexible iteration between different scales of analysis, a common database for both play and prospect assessments, and analytical assessment support that merges and honors the data at all scales of analysis. Prospects are subdivided into segments that are completely contained within stratigraphic plays. Analyses must support risk and volume dependency relationships both within individual features and among features. The play-level fraction of each prospect becomes part of the regional evaluation. Active integration increases the chances that both regional and prospect level data are used and maintained on a continuous basis.

Play-Based Exploration to Improve Performance

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Shell has a long tradition of regional geology, with several internationally respected regional geologists who have published significant treatises. However, much of this tradition was lost in the late 1990's, in part due to the advent of 3D seismic and associated techniques, and an increasing asset focus. This combination of technology and business drivers enticed explorers to focus on the details of their 3D seismic volume, neglecting regional geology and hydrocarbon plays.

It is recognised in Shell that this adversely effected exploration performance, and now there is a strong management-driven push to evaluate prospects in their hydrocarbon play and regional geology setting. To achieve this regional geology teams and a position of Principal Regional Geologist have been created, to: 1) build, maintain and "own" the Regional Geology corporate memory in key held and target New Venture basins, 2) promote standards and consistency in regional evaluation work and 3) actively leverage and input regional understanding across all exploration activities in close collaboration with the operational evaluation teams.

This is aided by the use of a number of proprietary and non-proprietary computer programmes (e.g. ArcGis) to facilitate the regional and play-based analyses. However, the principal tool is the application of geological concepts and knowledge in line with the techniques and values used by the Shell regional geologists of old.

This increased focus on play-based exploration will not only improve exploration performance, it also makes Shell a more exciting and fun place for explorers to work.

Rigorous Approach to Geological Analysis of Petroleum Potential in Frontier Basins: Dealing with Risk in Regions of Great Uncertainty

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Despite conventional wisdom, there are many sedimentary basins in the world where there has been little or no petroleum exploration. Geologically-based assessment of such basins requires risking the probability of viable petroleum systems and identifying appropriate analogs for the size and number of undiscovered accumulations. In order to do this in a rigorous, transparent manner, a 'basin evolution chart' has been constructed, in which a variety of basin

characteristics (tectonic setting, structural style, paleolatitude, etc.) are interpreted through time. The resulting geological interpretation is then confronted with analog suites of subsidence, heat flow, and rates of clastic input from well known basins. The chart forces integration of diverse data and provides a cross-check that ensures compatibility of information from various sources. In addition, the basin evolution chart provides a consistent framework for determining the critical elements of possible petroleum systems and for directly generating quantitative input data for basin modeling programs. The basin evolution chart has been applied to analysis of the Upper Jurassic Total Petroleum System of Danmarkshavn Basin, offshore Northeast Greenland, an area of extreme uncertainty and great upside potential. The exacting approach maximizes understanding of petroleum potential from limited data.

A Statistical Type Well Approach for the Effective Economic Modeling and Portfolio Selection of Unconventional Resource Plays

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Many firms are pursuing unconventional Resource plays across the globe as a low risk vehicle for growth. Unfortunately, not all of our resource plays have met the expectations of this low risk model. Some plays are product price dependent and others are both price and technology dependent. This talk will provide a brief overview of the North American industry's use of statistically based type curves to assess ongoing developments.

The focus of the paper will be to provide participants with an alternative methodology for the selection of future Unconventional Resource plays. The selection of the correct Unconventional Resource Play is critical to the long-term success of our companies. Pick the wrong play and no matter how good you are, you will provide limited returns to your shareholders. Select the right Unconventional Resource play and you will have happy shareholders. The methodology is similar, yet unique from traditional basin analysis in its use of pilots versus exploration wells and type wells versus a range of reserves in a prospect.