

trend, including motivational bias.

3. Analysis of various geological risk factors (structure, reservoir, trap, charge, etc.) may help improve assessment of discovery probability; however, prior to drilling a prospect, explorationists commonly do not identify which geological factors really do constitute the primary exploratory hazards. Also, many explorationists confuse "exploratory success" and "commercial success".

4. The dedicated technical intellect is loath to recognize and accept the large uncertainties and biases actually involved in his/her professional predictions and, therefore, may encourage exploration management to make unwarranted expenditures for data prior to drilling; this tendency is reinforced by the natural corporate inclination to reduce exploratory uncertainty to a minimum prior to drilling.

Growing evidence exists that professional exploratory performance can be improved through the following:

1. Training to minimize heuristic biases inherent in estimating under uncertainty, as well as decision-making in risk ventures.

2. Postmortem analysis of exploration predictions and decisions.

3. Evaluation of tactics versus declared strategy, by comparing various exploration parameters (e.g., discovery probability, predicted target volume, actual discovered volume, finding rate, working interest, prospect origin, etc.)

Discerned performance trends can then be used to discount or enhance new prospects, to highlight areas for future improvement, and to modify corporate stances and strategies. Such analysis may best take the form of individual professional progress, rather than imposed management inspection.

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Dealing with Risk and Uncertainty in Exploration: How Can We Predict? How Can We Do Better?

Risk and uncertainty are inherent aspects of investing in exploration ventures. Risk, the weight of investment with respect to budget and consequence, is a subtle, variable, but important factor that is intrinsically difficult to apply consistently. Uncertainty, the perceived range of probabilities that a given situation may exist, lends itself more readily to systematic consideration. Professionals may be able to improve their ability to assess uncertainty more reliably. Judgments of both risk and uncertainty are highly susceptible to psychological influences and biases of which most explorationists are unaware.

Two of the most influential considerations involved in exploration decisions are (1) the likelihood that a postulated hydrocarbon accumulation is present, and (2) the probable volumes of oil or gas contained in the prospect if it exists. Both lie within the geotechnical purview. Such exploration predictions are made routinely, and they have enormous financial impact. Nevertheless, few public data have been available as to actual performance records of explorationists' predictions: many organizations do not examine predictive performance, and the few that do are reluctant to publicize their records. The reasons are mostly human and understandable, relating to the forward press of exploration events, individual chagrin, corporate politics, proprietary advantage, and even professional modesty.

Limited data on predictive accuracy in exploration began to be available in 1979 and suggest the following general patterns.

1. Accuracy of hydrocarbon-volume forecasts ranges widely, based on predrilling and post-drilling estimates: there may be roughly a ninety percent chance that a given volumetric forecast will be accurate within about one order of magnitude (power of ten), plus or minus the actual volume of the accumulation.

2. Forecasts of hydrocarbon volumes tend to be overly optimistic. The chief technical reasons have to do with erroneous predictions as to hydrocarbon recovery factor. Other technical forces also appear to contribute to this