Geological Risk Uncertainty in Oil Exploration – T. K. Choudhury, D-1A4 Lodhi Colony, New Delhi – 110 003. (E: *tkc@gov.in*)

Introduction

Two of the aims of quantitative economic models for hydrocarbon exploration are the assessment of the likely total value to corporation if production is enabled and the assessment of the range of uncertainty in the likely total value resulting from vagaries in the future, such as unknown selling price of the product, inflation, escalation, production costs, and so on thus, exploration economic models are predictive devices, controlled to some extent by modeling of prior completed situations to ascertain forecast accuracy against known templates. Incorporated into such economic models are the estimated reserves in a reservoir being evaluated and the uncertainty ranges of such reserves. One of the major aims of quantitative basin analysis models is to assess the likely generation, migration, and present-day accumulation amounts of hydrocarbons at reservoir sites (and to estimate the likely locations of reservoir sites in a basin), so that economic arguments applied to each such potential reservoir site can be invoked to assess some form of ranking and priority. Basin analysis models must also assess the range of uncertainty in accumulation amounts at the potential reservoir sites, as a result of uncertainties in intrinsic assumptions of the models, parameters used in the models, numerical discretization's, and data quality and quantity and the sampling frequency used to control model outputs. Thus, basin analysis models are reproductive devices, controlled to some extent by availability of present-day data and by the ability of the models to account for observed hydrocarbon occurrences in well-explored basins analogous to the one being investigated. Incorporated into such models should be models of the physical, chemical, geological, and transport processes being evaluated in a basin and the uncertainty ranges of such processes. Indeed, the basic problem of prediction is there are many unknown factors involved in supply and demand precisely that some assumptions must be made on unknown factors of supply and demand and, in addition, the assumptions being made are now being incorporated there appropriately within for treating processes considered relevant to the predictions to be made. Here both science; technology and economy are complicatedly embedded.

Materials and Methodology

The point about these two types of models (economic and basin analysis) is that both try to predict or retrofit patterns of behavior based on incomplete information, with uncertain parameters, and with different model assumptions and process behavior. There is a growing concern with emphasis on discovery of small fields on the assessment of efficacies of various models being prepared world wide for avoiding geological risk in oil basins supported by geophysical techniques in relation to their predictive and counter productive outputs. In this way we have started getting some idea of the resolution, accuracy and sensitivity of results obtained for each and every model with respect to changes in the sequences of assumptions, parameter uncertainty, and data used. The availability of such quantitative measures of uncertainty on model outputs could thus be used in a probabilistic sense to evaluate the risk, and the relevant strategy to be used, in decisions for advancing exploration and production and the concomitant likely economic returns of any potential reservoir in relation to others: inter reservoir comparison thus reducing risk. In

April 1991, an energy modeling conclave was held at Stanford University to provide assessments of the shortfall expected in the US supply of total hydrocarbon liquids (crude oil plus natural gas liquids) through the year 2000. Different models resulted in different outputs under identical price conditions has the range of estimates from prominent forecasters, and the troubling inconsistency of those estimates with the then observed behavior, lead to skepticism that the state of oil supply has improved was wrong as proved later !! Currently (2016-17) AVO model(s); high frequency models have started substantially improving both findings ; zeroing exploratory drilling; pinpointing developmental drill sites and increased production minimizing overall cost. Indeed, the basic problem of prediction is there are many unknown factors involved in supply and demand precisely that some assumptions must be made on unknown factors of supply and demand and, in addition, the assumptions being made are now being incorporated there appropriately within for treating processes considered relevant to the predictions to be made. Here both science; technology and economy are intricately embedded.

Results

The purpose should be to provide quantitative operational procedures to show how to perform the tasks mentioned, and to show how to use the results in strategic and economic senses, with latitudes being made for the uncertainties intrinsic to basin model calculations. An integrated exploration assessment is very much needed which would underpin in varied degrees to which all available information to obtain robust measures scientifically.

Discussion

In exploration economic models, many parameters occur, either alone or in combination with other parameters, and each of the parameters has its own uncertainty. Presumably this aspect of models is part of the reason for the range of results from the Stanford experiment. We need to have available practical procedures for estimating the combined effects of uncertainty of parameters on an exploration project.

However, the point is that there could be 10-100 estimates of future shortfall or abundance made with different models are now worldwide available but with trade secrets and implicit embargos available. And the tendency of west to pass on second rate models at cheaper prices which at times are not conducive to our environment. First rate models are still costly. Hence in India DGH (HELP), GEOPIC, KDMPIPE, NGRI have to work continuously to keep abreast which they are in fact but we have short comings of infrastructure; problems in exchanges of scientists with abroad and infrastructure as well. With concerted approach we would certainly lbe able to use all of the model results (so that systematic bias, conscious or unconscious, does not affect an outcome and divest geology of subsurface). There cannot be one model for all; and a comprehension understanding of and use of models in well location release (the ultimate point) in order to provide some quantitative measure of likely shortfall, together with an appreciation of the uncertainty of the measure will certainly raise our confidence level. The very purpose is to demonstrate that such an aspiration should eventually lead to eminently achievable goal in a practical sense.