

# Managing E&P Opportunities, and Risks, Hidden by Uncertain Geologic Information

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Geologic information, field and infrastructure facilities flexibility and possibilities to sequence decisions are examined as real options for managing opportunities, and risks, which arise from uncertainties in the geologic model and/or the quantification of reservoir properties.

The steps in the **3V** approach are first to assess the:

1. value of information
2. value of flexibility
3. value of sequencing decisions to gain both information and flexibility.

-and then to:

Phase the project to allow valuable sequencing of decisions and decide the next step

Invest in valuable flexibility

Get valuable information

This paves the way for proactive management where value is created, not only by ensuring progress according to plan, but also by exercising the resulting wealth of options to act (without an obligation to do so) at the right time. Plans that are used to steward

work progress now need to have a predictable flexibility built in.

Value of information is well established in exploration as the value of a discovery times the probability of making it, less the cost of a dry hole times the probability of it being dry. In delineation, the answer is seldom yes or no. Decisions to drill additional delineation wells should be evaluated based on their potential to further reduce uncertainty. Its value is obtained by a change in the need for flexibility.

Value of flexibility is the value created by making use of the flexibility times the probability that there will be a need for it, less the cost of acquiring the flexibility times the probability that it will not be needed. Getting valuable flexibility into a development plan has more to do with capturing opportunity than avoiding risk, even though it works both ways.

Value of sequencing decisions combines value of information which may become available, and flexibility inherent in postponing commitment. Gains must be weighed against the additional costs incurred by foregoing an integrated fast track development.

Information on uncertainty is the key to value creation through use of real options. The challenge is to excel in identifying and quantifying critical uncertainties. Uncertainties in reserves and initial well productivities are likely to be among the top five. We continue to refine tools and techniques for rigorously analyzing uncertainties in these variables. Seismic gravity, magnetic and PVT data are well suited for this as they observe entire reservoirs. Elastic wave patterns, gravity and magnetic fields do, however, not fully describe all relevant properties of reservoirs. Understanding the physics and chemistry of the geologic processes forming hydrocarbon basins and accumulations over time plays a key role in interpreting the observations collected and in judging the probability density functions for the relevant parameters of the reserves and productivities equations.

The processes of

sedimentation,

sediment consolidation deformation and failure (faulting and fracturing) under effective stresses, diagenesis of minerals and organic material,

fluid pressure history, chemical and hydraulic flow and diffusion,

hydrocarbon recovery

Need to be understood. Understanding will not be perfect in quantitative terms required for reservoir

management. Judgement must be made based on a qualitative understanding of the geological processes, and partial information from direct observations. This judgement must be honed on a suite of relevant known analogues.

It is difficult to check the quality of judgements of probabilities. Large numbers of estimates may be examined to see if they average out as expected. The Norwegian Petroleum Directorate (NPD) has published statistics showing that the assessments of petroleum potential of blocks made by license applicants on the average are well above the results of exploration. This is understandable, as the applicant is not indifferent to who gets the block. On this background one may ask whether an exploration department will be indifferent on a decision to drill a wildcat, a production department on a decision to recomplete, a project to have flexibility (regardless of whether the 3V approach finds it valuable) or any other unit to improve its chance of success. It is not wrong to take non-technical factors into account in decisions. However, it will no longer be possible to value real options if technical and non-technical factors are mixed.

Procedures to deal appropriately with uncertainty to create value holds great promise, provided ways are found to deal pragmatically with the much larger workload. Standardization, communication and co-operation amongst partners are key words. Dealing with alternative geologic models, demands for more

information to describe each of them and alternative plans for exploiting the petroleum potentials they portray requires efficient knowledge management. Initiatives to standardize data are welcome. This facilitates data fusion and shared systems among partners and the public domains for generating, retrieving and analyzing information. The efforts undertaken in Norway to achieve this, through POSC, Petrobank and the NPD for a (The Exploration Forum for Improved Oil Recovery Uncertainty Evaluation and Forecasting (FUN) and the Forum for Improved Oil Recovery (FORCE)) are valuable efforts in this respect. The North Sea and the Gulf of Mexico are both cradles for nursing timely and necessary progress in knowledge management for higher petroleum activity efficiency.