SPE 110321

Using "Fast Models" for Selecting the Right Decision—A Norwegian North Sea Case Study

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This paper was prepared for presentation at the 2007 SPE Annual Technical Conference and Exhibition held in Anaheim, California, U.S.A., 11–14 November 2007.

Abstract

The Alvheim field is located offshore Norway and consists of several oil and gas discoveries which contains hydrocarbons in good quality Paleocene sandstones. In the early phases of the development the in-place oil and gas volumes were to a large degree uncertain. Nevertheless, the partners needed to work on the concept selection issues.

The model described in the paper includes a tool for displaying important upside potential seen in geological and geophysical evaluations and parametric model for the production profiles. This results in a "fast model" that could be applied as part of a Monte Carlo model handling all essential elements in the cash flow for various field development concepts.

One of the challenges was to make a model that realistically accounted for the information we knew would appear during production. This was solved using an optimizing inside the Monte Carlo simulation.

The developed model proved useful. Running the model would quickly give comparable economic figures for various concepts. The upside potential and risk associated could also be studied. Another important property of the model was the ability to incorporate the results of the appraisal wells and narrow the uncertainty range in the modeling as soon as the information became available.

Introduction

An offshore field development will go through several decision phases. Even with positive results in the *exploration phase* the risk may be overwhelming and field development decisions may not be possible. In the *appraisal phase* the owners will have to decide on more drilling or not, to reduce uncertainty.

The search for possible field development solutions starts as soon hydrocarbons are indicated. The first phase of the field development work will be conceptual, i.e; all options should be considered without digging into details. The result of the *conceptual phase* should be a small number of possible development solutions. In the next phase, the *feasibility phase*, the selected concepts are examined and the accuracy of the cost estimates is improved, leading up to the concept selection decision. In the next phase, the *definition phase*, the concept details and cost estimates are refined preparing for the final go or no-go decision and governmental approval followed by the *implementation phase* where the plans become reality and investments start.

The focus of this paper is on the early phases, prior to the important concept selection decision. This decision may have a major impact on the economical value for an offshore field development. The selection will be a trade off between the cost (OPEX and CAPEX) and the production capacities.

We treat the problem within the framework of Bayesian decision theory[1]. This theory considers a loss function or profit related to the problem under study and makes a decision rule based on the distribution of possible outcomes. In the current study we consider economical measures related to net present value (NPV) and cash flow.

An offshore field development typically involves a huge investment, and it is no surprise that the oil companies use a lot of resources for developing geophysical interpretations, geological models, flow simulation models and economical models in order to support decisions properly. This workflow may lead to an accurate estimate, but may fail to describe the upside potential and risk involved simply because there is no time to examine the full range of possible outcomes. The approach presented in this paper tries to amend this by establishing a simplified stochastic model using spreadsheets and a Monte Carlo add-in. The goal is a tool for decision support in the early phases of a field development.

Both in-place volumes and production are modeled using parametric models resulting in a "fast model" that could be applied as part of a Monte Carlo simulation covering all essential elements of the cash flow for a range of possible field development scenarios.

A challenge for a total value chain analysis of this kind is to account for future options i.e., information that will be available during production. In the model presented an optimization of the production sequence for the various