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The Cost of Errors in Estimates Used in Concept Selection

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Abstract

This study examines the loss in project value incurred when concept selection decisions are based on erred estimates of input variables. Estimates of the magnitude of such losses are provided, along with an analysis of which input estimates matter most in determining value loss. A procedure for concept selection is defined to model the decision making process and is used in conjunction with a simplified asset development optimization model to estimate project values. The analysis compares project values resulting from concept selection decisions based on erred estimates and decisions based on an alternate hypothesis. Results suggest that cost of erred estimates for initial costs, expansion costs, and the timing of future expansion projects are comparable in magnitude to the cost of erred reserve estimates. Also, the cost of underestimating expected reserve volume tends to be larger than the cost of overestimating reserve volume; aggressive cost estimates are more destructive to value than conservative estimates; and conservative schedule estimates for the timing of expansion projects are generally more destructive to value than aggressive schedule estimates.

Introduction

During the concept comparison and selection phase of exploration and production (E&P) capital projects, decision makers estimate the value of competing development concepts. These estimates are used to rank options and to select one option to carry forward to the next project phase. The importance of these estimates cannot be overstated, they determine which concept is selected, and have a strong influence on field architecture, initial capacity of facilities, well counts, production rates, and project schedule. Decisions in concept selection have a large impact on the value ultimately derived from the asset.[1,2] These estimates are also used for other important analyses and decisions during concept selection such as value of information (VOI) analysis.

A variety of input variables are required to estimate the value of competing development concepts. These input variables include estimates for the subsurface (e.g. reserves, flow rates, decline rates), estimates for the surface facilities (e.g. CAPEX, OPEX, schedule, reliability), and estimates for exogenous factors such as commodity price. The true values of these input variables are almost always unknown, and estimates are developed based on the current information set available to the decision maker.

The objective of this study is to examine and compare the loss in value incurred when concept selection decisions are based on erred estimates of input variables. Errors can occur in estimates of expected values and in estimates of variance. The conclusion that erred estimates of input variables destroy project value can be made using common sense. What this study attempts to provide are original estimates of the potential magnitude of such losses, and an analysis of which input estimates matter more or less than others.

In practice, one does not know if a current estimate for an input variable is erred, but one can estimate the impact of an alternate hypothesis being true, and this is the framework adopted here. A procedure for concept selection is defined to model the decision making process and is used in conjunction with a simplified asset development optimization model to estimate project values. The analysis compares project values resulting from concept selection decisions based on erred estimates and decisions based on an alternate hypothesis; in both cases, the alternate hypothesis is taken to be true. The difference in value observed, if any, is caused by sub-optimal initial facility capacity (note, the difference in value can also be interpreted as the maximum willingness to pay to confirm the alternate hypothesis). The approach is similar in form to standard VOI analyses.[3-6]

The number of input variables normally required to estimate the value of competing development concepts is immense, and estimates are required from all project disciplines. This study examines the loss in value associated with errors in estimates of three key input variables: (i) reserves, (ii) facility initial cost, and (iii) facility expansion cost and schedule. These three variables have a large impact on project value. The reserves estimate drives most major development decisions, including the depletion plan, well counts, and facility design. Facility cost estimates influence concept type, initial facility capacity, and plans for future expansion. Estimates for the cost and timing of future facility expansion affect the initial facility capacity decision and the value that can be captured given upside realizations of