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Value of Information in the Oil and Gas Industry: Past, Present, and Future

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Abstract

An important task that petroleum engineers and geoscientists undertake is to produce decision-relevant information. Some of the most important decisions we make concern what type and what quality of information to produce. When decisions are fraught with geologic and market uncertainties, this information gathering may take the form of seismic surveys, core and well test analyses, reservoir simulations, market analyses, price forecasts, etc., on which the industry spends billions of dollars each year. Yet, considerably less time and resources are expended on assessing the profitability or value of this information. Why is that?

This paper addresses how to make value-of-information (VOI) analysis more accessible and useful, by discussing its past, present, and future. Based on a survey of SPE publications, we provide an overview of the use of VOI in the oil and gas industry, with a focus on how the analysis was carried out and for which types of decisions VOI analysis has been performed. We highlight areas where VOI methods have been used successfully and identify important challenges.

We then identify and discuss the possible causes for the limited use of VOI methods and suggest ways to increase the use of this powerful analysis tool.

Introduction

One of the most useful features of decision analysis is its ability to distinguish between constructive and wasteful information gathering. Value-of-information (VOI) analysis evaluates the benefits of collecting additional information prior to making a decision. Such information gathering may be worthwhile *if* it holds the possibility of changing the decision that would be made without further information. VOI attributes no value to "uncertainty reduction" or "increased confidence" per se. Rather, value is added by enabling the decision maker to better "tune" his/her choice to the underlying uncertainty. Thus, information value is forever an entanglement of uncertainty and decision making; one cannot value information outside of a particular decision context.

It has been almost 40 years since Grayson (1960) introduced the VOI concept to the oil and gas industry, yet very few real applications have been published. Although some operating company professionals report using it occasionally, VOI assessments do not seem to be used on a routine basis—not even for the largest information gathering investments such as 4D seismic or appraisal wells. Nor does the concept seem to be well known among petroleum engineers and geoscientists. In fact, engineers and scientists tend to believe that more information or data is always better, since, after all, uncertainty is bad and data reduces uncertainty.

This paper is organized as follows. The next section defines VOI analysis and discusses some of its basic properties. The third section discusses the history of VOI. The fourth section provides the first comprehensive review of VOI papers published in the SPE literature. Through a content analysis of these papers, we characterize various attributes of VOI applications and illustrations and show the evolution of the methodology. In the fifth section, we discuss the current status of VOI use. The sixth section addresses the future of VOI and what we believe is required to increase the awareness, understanding, and use of the approach in making decisions on information gathering. In the seventh section, we clarify some aspects of VOI that are widely misunderstood. The final section of the paper contains concluding remarks.

Value-of-Information Analysis

Most of what petroleum engineers or geoscientists do involves "acquiring" information, with the aim of improving decision making. "Information" is used here in a broad sense to cover acquisition of data, performing technical studies, hiring consultants, performing diagnostic tests, etc. In fact, other than to meet applicable regulatory requirements, the main reason for collecting any information, or doing any technical analysis, should be to make better decisions. The fundamental question for any information-gathering process is then *whether the likely improvement in decision making is worth the cost of obtaining the information*. This is the question that the VOI technique is designed to answer.

The oil and gas literature includes a number of different, and sometimes erroneous, definitions of VOI. In the Appendix, we provide a rigorous definition of VOI. In this section, we suppress the mathematical detail and present a simple framework which allows us to explain and illustrate the VOI concepts easily.