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Risk Management in Petroleum Development Projects: Technical and Economic Indicators to Define a Robust Production Strategy

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Abstract

In this study, we consider robustness as a risk management method in the development of complex petroleum fields, complementing the well-known techniques of acquiring new information and adding flexibility to the production system. To create a robust production strategy we aim to reduce sensitivity to uncertainty. Our methodology is based on the analyzed performance of an optimized production strategy, covering all possible scenarios. We use technical and economic indicators to objectively identify and quantify refinements in this strategy to assure good performance across possible scenarios. We focus on the robust number and placement of wells, and robust platform processing capacities. We consider the robustness of net present value and of the recovery factor, computed using Multi-Attribute Utility Theory. We quantify the risk through semi-deviation, instead of standard deviation, to focus on the downside volatility. Refining an optimized production strategy significantly improved the optimization process by increasing the expected value of each objective and, dramatically reduced the downside risk.

Keywords: field development; uncertainty management; robustness; production strategy; semi-deviation; reservoir simulation.

1. Introduction

1.1. Managing uncertainty in petroleum field development – Information, Flexibility and Robustness

The upstream sector, particularly in offshore fields, is considered high-risk, comprising considerable investment in complex, uncertain scenarios. Various sources of uncertainties may coexist during the development phase, the focus of this study: (1) geological uncertainties, associated with recoverable reserves and flow characteristics; (2) operational uncertainties, related to system availability; and (3) economic uncertainties, such as oil price, capital expenditures (CAPEX) and operational expenditures (OPEX). Thus, uncertainty and risk analyses are fundamental to decide whether and how to develop a field.

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