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Standardization of Uncertainty Quantification of Sub-surface Geological Models through a Field's Life Cycle

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SUMMARY

Provided in the extended abstract.

Introduction

In the E&P life cycle of any field, quantification of uncertainty and its management play an important role for proper development planning. A hydrocarbon bearing reservoir in a field is developed as a result of certain geological processes. Sub-surface geological models are an attempt to best characterize it based on available data and interpretation. In a field's-life-cycle, the amount of gathered data and the interpretation carried out to understand the reservoirs increase exponentially from "Green" to its becoming "Brown". Subsurface uncertainties reduce in this life cycle due to better understanding of the reservoir.

Today, any standard workflow for developing geological models of a conventional reservoir acknowledges uncertainty quantification as an inherent part. However, when we look at the practices being followed in the industry on geological model's uncertainty quantification, we do not see a uniform standard of this uncertainty quantification in tune with the fields "Life cycle".

Standardization of Uncertainty Analysis

Limited multiple deterministic geological model based uncertainty quantification versus stochastic multi-model realization based quantification has long been debated over their suitability. A true "Green" field which is still being delineated has more serious uncertainties on the reservoir definition along with parameters uncertainty. A well delineated field in its early life has less reservoir definition uncertainty but more parametric uncertainty. Understanding fractures, if present, and quantifying related uncertainties in a field's early life have serious impact on investment decisions. As the field becomes "Mature", conceptual uncertainties become less. However, the magnitude of data giving parametric information and their vintages and understanding the associated uncertainties become of key importance. Managing uncertainty in a brown field is more complicated, with various secondary fluids coming into the reservoir in the form of various ongoing injections for pressure and voidage management. These fluids mix with the original reservoir fluid, affecting subsequent data acquisition. At that stage, focus remains on understanding fluid's impact and the associated uncertainty on the data affecting the geological models.

An attempt has been made to holistically examine the uncertainty quantification in geological models in the life cycle of fields to propose a standard workflow (Figure-1) suitable to a field's current state of development. Following such standard will ensure that the quantified uncertainty coming out of the geological models follows an expected range and makes more sense for planning investment for its development.

Figure-1 : Generic sketch showing uncertainty matrix in a field's life cycle.