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Enhancing Value from A Mature Offshore Field: Sweet Spot Identification Leveraging Subsurface Insights and Analytical Reservoir Engineering for Optimal Infill Campaigns

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Abstract

The S-field, located offshore the Sabah coast in East Malaysia, has been producing from multi-stacked, compartmentalized reservoirs for 45 years. Over this period, the field has undergone 10 development campaigns and achieved a recovery of approximately 45% of the Stock Tank Oil Initially in Place (STOIIP). However, identifying sweet spots through dynamic modelling has been challenging due to limitations in data acquisition, quality, and reliability, as well as inherent issues with the modelling approach, which are typical for a mature field.

The recent drilling campaign's first well results were surprising and led to the application of classical reservoir engineering practices. This approach resulted in a highly successful campaign, with higher Estimated Ultimate Recovery (EUR) per well achieved in the subsequent wells. Quick decision-making was facilitated through a focused and integrated multidisciplinary approach, which significantly contributed to the campaign's success.

Building on this experience, targets for an upcoming drilling campaign were identified through analytical reservoir engineering, complemented by robust subsurface risk assessments, encompassing seismic, geology, petrophysical, and reservoir engineering considerations. Reservoir targets were identified based on meticulous analysis of well and reservoir performance, open-hole logs, contact movement, and seismic bright spots. Drainage radii per zone around existing and past drainage points were established based on the EUR. The targets were visually screened on maps to avoid interference with drained areas. They were categorized into untapped reservoirs, attic oil, sweep areas, and low-recovery areas, which aided in summarizing the associated risks.

Targets were optimally strung together by considering the possibility of commingling reservoirs within a single infill well. This approach reduced risks, minimized costs, and maximized recovery. Well trajectories were planned to target the identified sweet spots using fewer platforms and utilizing empty slots or abandoned well slots.

A bespoke approach was adopted to check and mitigate crossflow between zones throughout the well-life cycle through network modelling involving material balance and vertical flow performance models. The targeted zone-level STOIIP was derived based on Gross Rock Volume (GRV) around them, clipped for contacts and faults, and used as inputs for material balance models. The inflow properties for each zone were benchmarked against the productivity of existing wells. The forecast for each proposed well was calibrated with liquid production, water cut, and gas-oil ratio trends observed in nearby existing wells.

This paper introduces a comprehensive workflow developed during the drilling campaign, proving its worth and strength. The same workflow was subsequently optimized for the upcoming campaign to identify more drillable targets, thus

increasing the value extracted from the mature offshore field. The success of such work reaffirms the strength of classical and integrated approaches in achieving value from mature fields.

Key learnings and takeaways include:

- Classical approaches can unlock additional value from a mature field despite high subsurface complexity.
- Thematic categorization of targets aids in screening and ranking, serving as a key enabler.
- Combining material balance and vertical flow models using network modelling establishes a process for predicting crossflow and robust forecasting.
- Multidisciplinary integration and seamless communication optimize locations and reduce campaign costs.