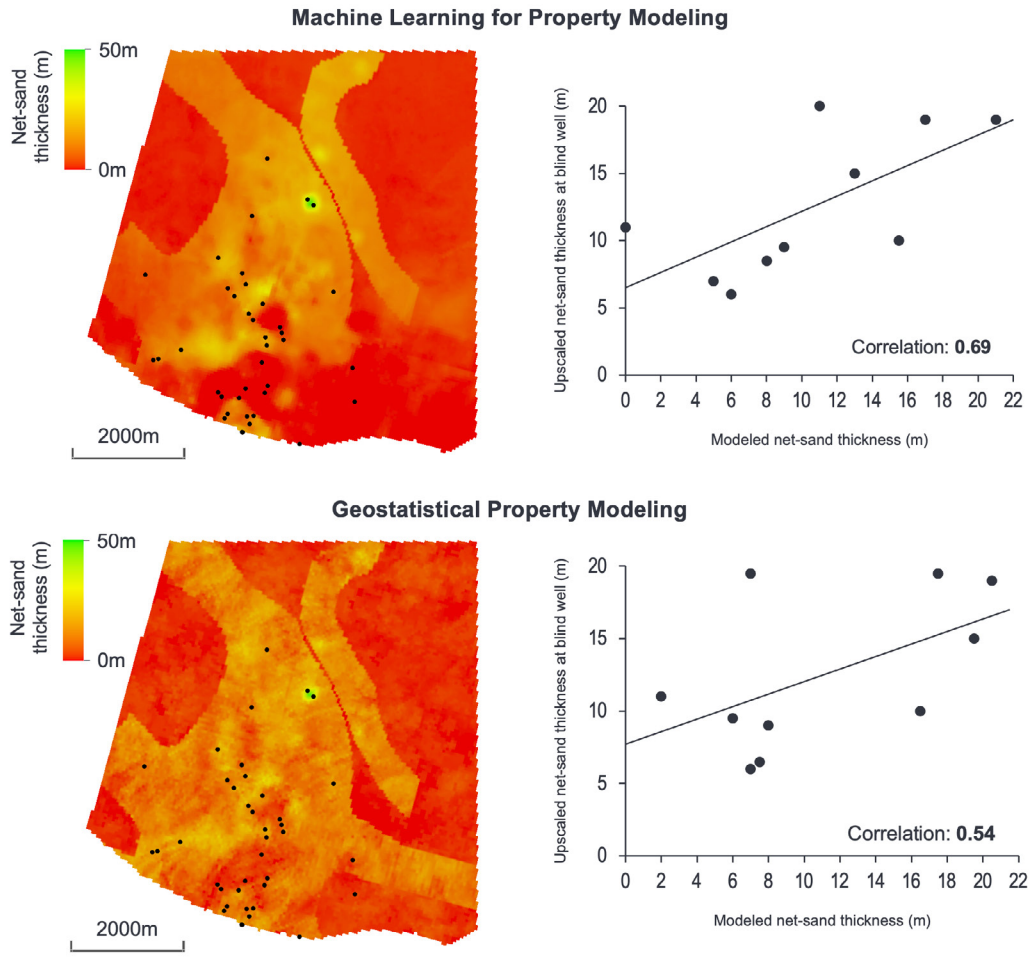
DELFI

Schlumberger

Pertamina Hulu Mahakam utilizes machine learning to reduce property modeling time from 4 weeks to 4 days

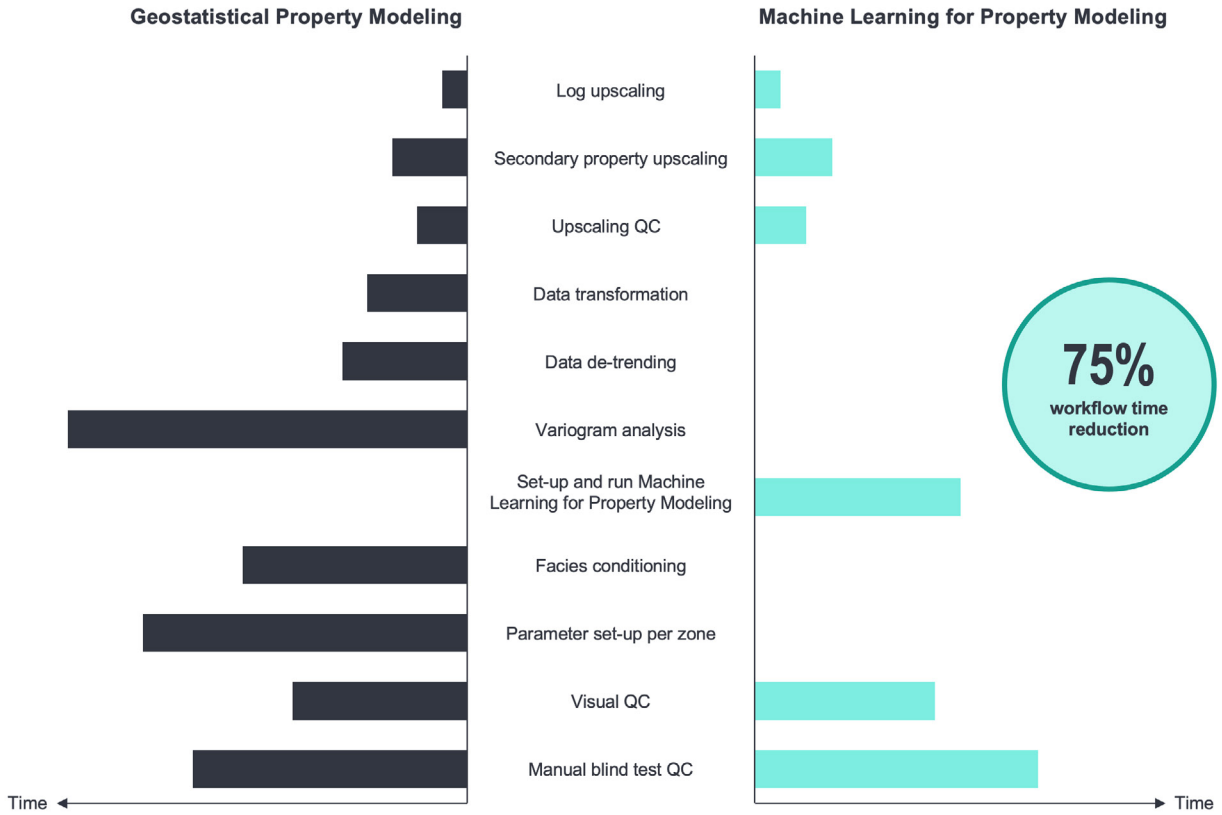


Net-sand thickness maps and cross plots for Zone R8 of the Handil Field, results from Machine Learning for Property Modeling (top), and geostatistical property modeling (bottom). Machine Learning for Property modeling prediction exhibits a stronger correlation (0.69) with the measured thickness at the blind wells than the geostatistical model prediction (0.54). This indicates that Machine Learning for Property Modeling is producing better predictive models.

Pertamina Hulu Mahakam (PHM) successfully applied Machine Learning for Property Modeling, which is available in the DELFI cognitive E&P environment, to accelerate and improve the accuracy of 3D property modeling in its upstream operations. PHM conducted a proof-of-value project at its North Handil Field, to enable geomodelers to spend less time on geostatistical data analysis and parametrization, and more time analyzing property modeling results to improve well site selection and optimize the field development plan.

Challenge

The North Handil Field has more than 300 thin reservoirs, a dynamic oil-water contact, and 45 years of production data from over 500 wells. The field's geology is complex, so a critical challenge was to resolve the complexity and utilize a continuous stream of new data from drilling activities to produce a field development plan that fulfilled technical and economic objectives.



These two graphs compares the relative proportions of time spent on each step of the property modeling workflow for geostatistical property modeling (left, black) and for Machine Learning for Property Modeling (right, green).

PHM required a new approach to building an optimal field development plan based on available data. It needed to evaluate if machine learning could minimize property modeling time and improve the quality of the property model by integrating multiple secondary properties, such as seismic geomorphology and other geometrical properties.

Solution

PHM selected Machine Learning for Property Modeling to achieve a fast and robust estimate of reservoir properties utilizing its available data. Machine Learning for Property Modeling utilizes the Embedded Model Estimator (EMBER) hybrid algorithm, which leverages machine learning combined with classic geostatistical estimation and simulation techniques. EMBER enables a significant reduction in data preparation by removing the need for stationarity assumptions or preparatory work, such as removal of trends, data transformation, variogram analysis, zones, and facies conditioning. EMBER also enables the handling of multiple secondary variables simultaneously.

The solution was implemented on PHM's North Handil Field, where PHM conducted a series of tests to compare the EMBER results with traditional geostatistical modeling techniques. The success of the project was measured utilizing pre-defined success criteria and metrics, such as time reduction and model quality improvement compared to traditional geostatistical approaches.

During the COVID-19 pandemic, PHM and Schlumberger carried out the proof-of-value project remotely to ensure the safety of their employees. Teams from Norway, Indonesia, and the UK collaborated seamlessly in the DELFI environment, delivering hands-on workshops and testing sessions.

Benefit

With Machine Learning for Property Modeling, PHM quickly incorporated all its existing data into a robust reservoir model, enabling quick identification of reservoir sweet spots and delivery of a field development plan that took into account technical and economic constraints.

EMBER passed all blind well test scenarios, delivering a reduction in average prediction error by 18% compared to traditional geostatistical techniques. Geomodelers reduced the time they spent on repetitive and laborious data analysis tasks by more than 75%, enabling them to spend more time analyzing the results and gain a greater understanding of reservoir uncertainty. Because of the EMBER algorithm's agility, PHM can now easily update the models as new field data is received.