AI/ML-Driven Intelligent Forecaster for Oil and Gas Exploration Wells: Predicting Pre-Drilling Preparation Time and Cost Using Historical Data

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Abstract

As many industries begin to implement artificial intelligence and machine learning, the oil and gas industry indicates the potential for unprecedented growth. Several exploration wells are drilled as part of finding and delineating the hydrocarbon potential in a new prospect. As part of exploration operations, there is often a need by exploration geoscience experts to quickly replace proposed exploration wells or propose new exploration wells. Having accurate information about the various pre-drilling planning information would help explorationists to make accurate decisions and schedule the exploration well appropriately. Time and cost are two of the most critical pre-drilling parameters that the stakeholders would like to quantify, before they schedule an exploration well. More proactive models suggest that while the pursuit of new data is invaluable, we need to re-examine our reservoir of already collected data to strengthen future predictions by cross-referencing recommended infrastructure with known issues in similar environments.

This research presents an innovative AI/ML-based forecasting system designed for the oil and gas exploration industry. Leveraging historical data from exploration wells, the system predicts both the pre-drilling preparation time and exploration well cost. The cost prediction model utilizes well attributes such as location, hydrocarbon type, target depth, and rig attributes, including rig type, horsepower, height, move rate, and approximate drilling days for similar wells. The model, implemented with a Gradient Boost algorithm, achieved an impressive R2 value of 0.823 after rigorous experimentation with various regression algorithms like Linear Regression, SVM- RBF, and others.

Furthermore, the system predicts preparation time by analyzing historical data on the number of days required for activities such as staking/surveying the location, site preparation, arrangement of water sources/wells, and obtaining various approvals. A decision tree classifier was employed for this prediction task, with an R2 value of 0.642. These algorithms were selected after multiple trials with different regression techniques, ensuring the optimal model for each prediction aspect. Additionally, the dataset used for training and testing was thoroughly sanitized, with only clear and relevant data for the last three years utilized. The developed tool empowers exploration decision-makers by providing valuable insights for proposing exploration wells, ensuring well- informed decision-making in the planning and execution phases of drilling operations.

It is important to note that the current system has only been trained on data from the last 3 years and that it can be further enhanced by employing data found in the last decade or earlier. Despite minor limitations, initial investigations indicate that implementation of such a system would streamline the preparatory procedures required to schedule and plan the exploration drilling schedule. The largest constraint in the industry is its lack of mobility. The drilling and their infrastructure take valuable time and energy to set up, and although current practices

are reliable, each mistake is extremely costly. The recommended system would augment site productivity by automatically taking into account historical data and making well informed decisions, thus minimizing budget and scheduling overflows.