Barrier Advisor™ Model

TAILORED DESIGN DECISIONS EMPLOYED BY MACHINE LEARNING TO IMPROVE THE PROBABILITY OF OPERATIONAL SUCCESS

OVERVIEW

Tailoring dependable barriers for optimum placement and long term zonal isolation is critical to wellbore integrity and operational success. Utilizing software services to design for increased probability of wellbore integrity is a common practice. These services, such as the Halliburton iCem® service, use science-based algorithms to assess and monitor critical variables before, during, and after the cement job to help reduce operational risks. Tailoring cement job designs with the iCem service software simulator can help operators optimize the cement operation, regardless of well type or asset. However, software solutions such as the iCem service only deal with the specific job at hand, and do not account for historical job data. In order to provide an increased probability of operational success, Halliburton has integrated the machine learning based Barrier Advisor™ model into our Verified Integrated Design Application (VIDA) platform. The Barrier Advisor model enables engineers to visualize design decisions (i.e., best practices) in similar jobs across the globe, receive a score for their job design based on these decisions, then tailor best practices in the model to improve their job's score. The job score indicates the extent of risk mitigation achieved by the proposed job design and allows an engineer to quickly gauge whether the score of a job is inferior to, on par, or superior to historical jobs with similar well conditions. Having the ability to tailor design decisions in the Barrier Advisor model allows an engineer to identify which decisions positively impact the end job execution and performance, to thereby provide an enhanced probability of operational success.

FEATURES AND BENEFITS

- Machine learning model closes the gap on operational unknowns and complements science-based model recommendations
- Model is integrated into the VIDA platform, which enables access to constantly growing historical data
- Clustering process to identify nearest neighbors enables transferability of job design knowledge from similar jobs across the globe
- Score-based system indicates extent of risk mitigation achieved with job design
- Model provides nearest neighbor scores for job design comparison, evaluation, and improvement
- Model expedites, digitalizes, and automates the entire job design process, which accelerates an engineer's development

Tailored design decisions enhance job score

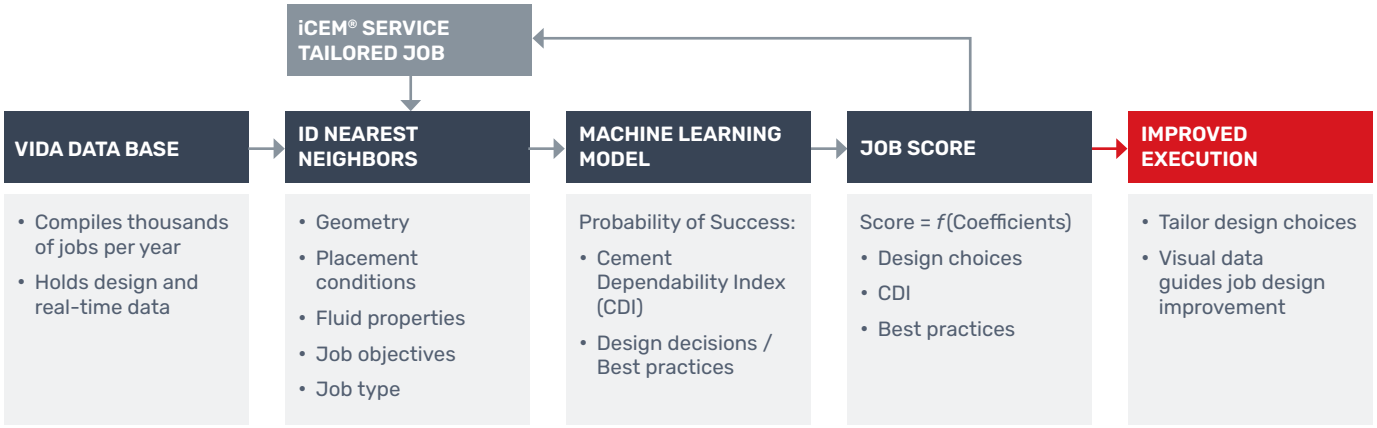
Employing historical data-driven machine learning models to aid in operational risk mitigation has a critical impact on optimum job execution. Integrated into VIDA, the Barrier Advisor model has access to constantly growing data from thousands of historical jobs across the globe. Every design decision has a corresponding Cement Dependability Index (CDI) response, which is used to calculate a score for any given set of design parameters for a specific job. The model identifies similar jobs, which in machine learning is referred to as "nearest neighbors", using a clustering approach based on similar well conditions. Additionally, the model computes and displays each job's score. Evaluating these scores allows an engineer to visualize the critical CDI responses from nearest neighbors and modify the current job design decisions to improve the job score and, ultimately, its execution. The nearest neighbors are identified by clustering historical jobs based on geometry, placement conditions, fluid properties, job objectives and job type parameters. This ability to optimize job designs based on a database comprised of thousands of best practices and design decisions mitigates operational risks to deliver a tailored barrier with an enhanced probability of operational success and therefore minimum effort required for barrier validation.

Machine learning enabled model minimizes risks

In the pursuit to design and deliver sustainable barriers that minimize risk and maximize production, Halliburton has spent several years and significant resources building a reliable machine learning model. Barrier Advisor is a robust model due to the volume of cementing jobs Halliburton executes globally and the VIDA digital platform that holds all of the historical job data. With new jobs constantly added, the historical pool of data increases daily. Thus, the model's learning ability increases while the gap on operational unknowns decreases. Learning from global jobs allows transferability of job design knowledge. This advantage increases the probability of achieving wellbore integrity and minimizes the risk of incurring costly remedial work.

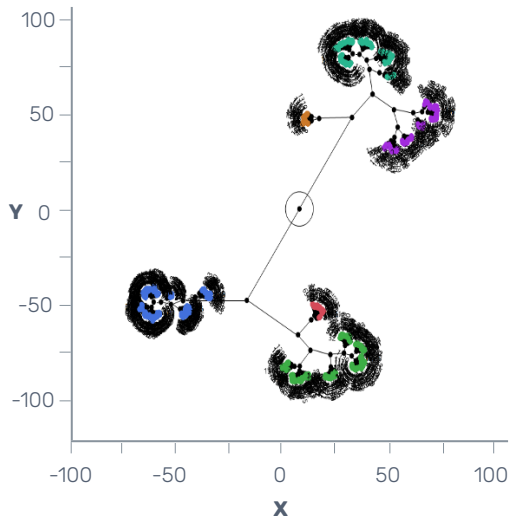
Improves the probability of operational success

Tailoring dependable barriers is critical to wellbore integrity and operational success. Recommendations from the Barrier Advisor model, which use a combination of science-based algorithms and global historical jobs' data-driven models, are more robust in mitigating risks from operational unknowns compared to job specific models. Barrier Advisor enables the evaluation and identification of job design decisions that positively impact the end job execution and performance, to thereby provide an enhanced probability of operational success.

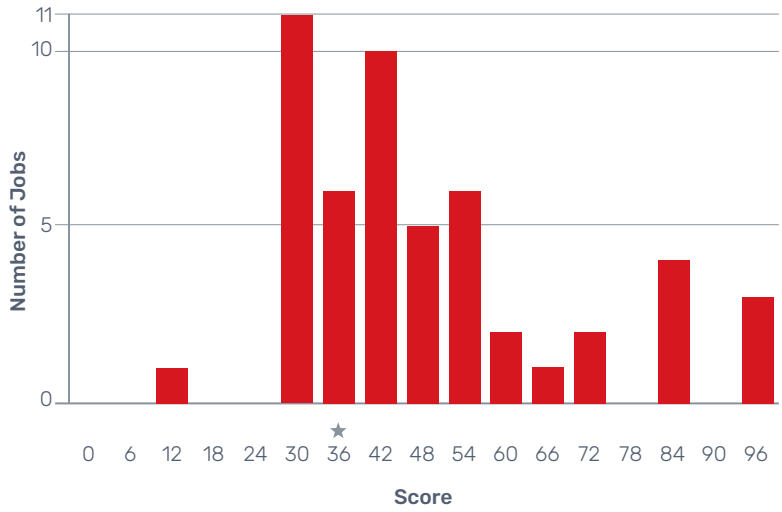


Integrated into VIDA, the Barrier Advisor model has access to constantly growing data from thousands of historical jobs across the globe. This allows the model's learning ability to increase and the gap on operational unknowns to decrease.

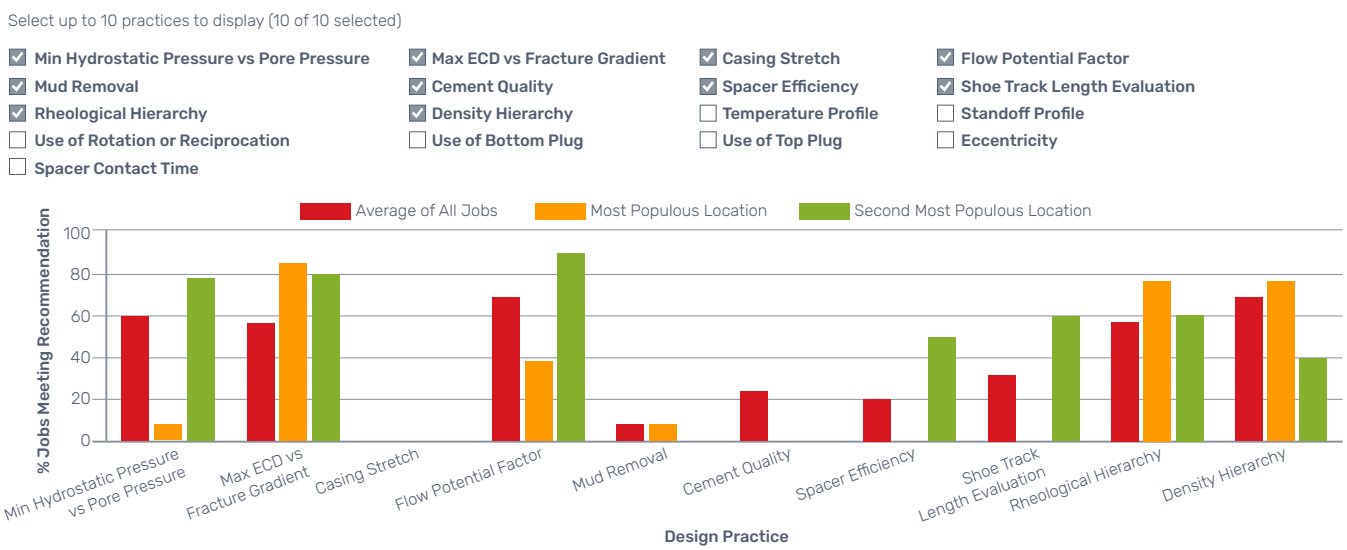
MACHINE LEARNING CLUSTERING APPROACH



SCORE OF RELEVANT JOBS



COMPARISON OF DESIGN PRACTICES



The Barrier Advisor model employs machine learning and a clustering approach based on similar well conditions to identify nearest neighbors. The model computes and displays each job's score and provides visual data to guide job design improvement based on best practices to increase the probability of operational success.

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