Oilwell Completion Regression - Literature Review

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Introduction

For centuries, oilwells have been drilled vertically and completed by perforation only. Since the invention of horizontal drilling, literature as shown clearly that various completion parameters have a significant effect on oil production.

Body

Using relevant headings, the body should be composed of sections. They take up each issue one at a time and discuss how the authors of the articles respond to that issue.

Don't forget to introduce and close each section with a sentence focused on the literature (topic sentence and concluding sentence.)

Length of body: about 3 pages or more, single-spaced. (Length of each section will vary, but each typically contains several paragraphs.)

The implementation of geo-engineered designs as described in this paper have shown field success and represents another achievement in completion design workflows for single well applications. Advances in horizontal completion design are rapidly evolving. Recent advances in horizontal completion designs have demonstrated the following: 1. 2. 3. 4. Mega-frac jobs with high proppant loading and large fluid volumes work in nearly every basin. Geo-engineered completions and degradable diversion improve cluster efficiency. A proven 3D earth model is essential in determining lateral landing sweet spots accurately. Big data has value. The current trend towards statistical modeling and machine learning are helping to determine a reservoir's unique DNA attributes which lead to optimizing production. 5. Determining the factors/attributes driving production requires large amounts of data from multiple wells as input to perform multivariate analysis for each potential interval. 6. In the absence of large amounts of data (e.g., exploration settings) the combination of high proppant loading, geo-engineered design and the use of degradable diversion are logical steps in establishing baseline performance to approximate best in class production within a given area.(Fulks et al. 2016)

In conclusion we have demonstrated how efficiently, intuitively and easily data-driven insights can be achieved in not just the planning and design phases of an operation, but also in how these models can be rapidly implemented as prescriptive solutions utilized in the operational phase. The analytical workflows, models and exploratory data analysis carried out in this study are cornerstones to other data-driven methodologies you could implement to address a diverse array of business problems in the upstream. When marrying data-driven analytics with first principles we can establish a robust and repeatable suite of workflows to convert raw data into actionable knowledge. This paper illustrates one such example study.(Holdaway, Laing, and others 2015)

As far as the relative importance of variables is concerned; fracture half-length is very significant where fracture bottom has more significance than that of fracture top in this specific case. Total proppant used has similar significance as fracture height. Pay zone coverage, slurry volume, and average fracture conductivity have similar amounts of significance. The cause-effect (input-output) relationship is shown above for each parameter in Figs. 8 through 16. Data analytics tools have been utilized to analyze the results of a fracture model built with a commercial fracture simulator. Utilization of the fracture simulator with enabled us to investigate the significance of each parameter on the outcome that was used as an input to the data analytics software to analyze the input-output relationship to capture not only the significance of the inputs but also

theSPE-177549-MS 25 direction that the inputs affect the outcome by means of fitting a neural model to the data and displaying it in 3D surface profiler as well as the 2D profiler which were illustrated in figures 8–16. It would not be possible without the use of data analytics tool to clearly show the direction of impact of each input. The conclusions pertain to this specific model, as neural model that was fit is a data driven model and highly belongs to the model used. However, it serves as a use(Temizel et al. 2015)

1. The PCD and IOD visual analysis methodology is suitable for testing any input's impact on production performance with careful consideration of dimensionally normalizing both performance measures and inputs. Multiple performance measures should be used to maximize the number of patterns identified.
2. Given that demonstrable patterns were identifiable in all study areas, this methodology appears to be suitable for all types of plays where inputs have enough statistical variability to see measurable results.12 SPE-185077-MS
3. This approach is effective at communicating nuances in the data, such as thresholds and correlation windows that are not easily identified using other techniques. Further, specific threshold values and correlation window ranges can be valuable inputs to other regression techniques or modelling efforts.
4. The approach is scalable, accommodating datasets containing greater than 1000 wells down to as few as 80 wells.
5. Inexplicable patterns are an effective way of identifying the need for analogue review and subset selection. It is essential that analogue subsets be explored to refine insights before drawing discernable conclusions.(Groulx et al. 2017)

Proxy modeling is not a new concept and had been in the industry for many years. However, the workflow and approach described in this study are unique in creating "synthetic" big data out of simulations based on fundamental science honoring rock physics, fluid flow, hydraulic fracture propagation in complex14 SPE-189790-MS environments, and numerical reservoir simulation. Using parametric explosion of sensitivity parameters, the synthetic big data use for creating a proxy model to predict hydraulic fracture performance in unconventional reservoirs has been demonstrated successfully. This proxy model allows engineers to design the completions and predict the response to production and NPV almost real-time for the wells to be drilled and completed in the proximity of the base model. As long as the geology does not significantly vary, the directional response for optimum well completion can be derived from the proxy modeling much faster than full field/pad scale modeling and simulations converting the decision making a matter of minutes instead of days and months. The specific learnings and observations from application of the workflow on the base model from Eagle Ford in this study are: 1. A calibrated model is a fundamental step to create a reliable predictive proxy. 2. The Predictive proxy models had an excellent predictability on all four targets of B1, B3, B12 and Cum_5 3. Higher accuracy is achieved for long term predictions (Cum 5 > B1) The predictive proxy has a wide variety of application amongst the domains of completion engineers and management to undertake more informed decision making and completion optimization. Similar approach in the fields of drilling, artificial lift, production and numerical simulation can be applied to speed the model- to-decision cycle.(Pankaj et al. 2018)

The rapid proliferation of sensing and data acquisition systems combined with cheap data storage is resulting in the age of "Big Data" and the most scarce resource going forward is likely to be expert time to go through, clean and label the data. This has led to the rising importance of adopting new strategies and workflows for the development of advanced analytics models. This trend is already visible in other industries and is likely to be a big challenge for the oil and gas industry as well. In this work, we explored the use of active learning to intelligently identify data points with the highest value of information and semi-supervised learning to combine the information from labeled and unlabeled sources in an optimal fashion. It was demonstrated that these advanced machine learning methods show considerable promise and can be integral tools in making the entire analysis procedure more interactive and productive. Effective adoption of these advanced machine learning techniques for interactive learning will be dependent on their integration with excellent data visualization and effective user interface design.(Subrahmanya et al. 2014)

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could implement to address a diverse array of business problems in the upstream. When marrying data-driven analytics with first principles we can establish a robust and repeatable suite of workflows to convert raw data into actionable knowledge. This paper illustrates one such example study.(Holdaway, Laing, and others 2015)

Conclusion

Summarize what the literature says about your topic. Approximate length: about ¼ page.

Fulks, Robert, Simon Hughes, Ingo Geldmacher, and others. 2016. "Optimizing Unconventional Completions-an Integrated Approach." In *Abu Dhabi International Petroleum Exhibition & Conference.* Society of Petroleum Engineers.

Groulx, Bertrand, Jim Gouveia, Don Chenery, and others. 2017. "Multivariate Analysis Using Advanced Probabilistic Techniques for Completion Design Optimization." In *SPE Unconventional Resources Conference.* Society of Petroleum Engineers.

Holdaway, Keith R, Moray L Laing, and others. 2015. "Drilling and Completion Optimization in Unconventional Reservoirs with Data-Driven Models." In *SPE Asia Pacific Unconventional Resources Conference and Exhibition.* Society of Petroleum Engineers.

Pankaj, Piyush, Steve Geetan, Richard MacDonald, Priyavrat Shukla, Abhishek Sharma, Samir Menasria, Tobias Judd, and others. 2018. "Need for Speed: Data Analytics Coupled to Reservoir Characterization Fast Tracks Well Completion Optimization." In *SPE Canada Unconventional Resources Conference.* Society of Petroleum Engineers.

Subrahmanya, Niranjan, Peng Xu, Amr El-Bakry, Carmon Reynolds, and others. 2014. "Advanced Machine Learning Methods for Production Data Pattern Recognition." In *SPE Intelligent Energy Conference & Exhibition.* Society of Petroleum Engineers.

Temizel, C, S Purwar, A Abdullayev, K Urrutia, Aditya Tiwari, and others. 2015. "Efficient Use of Data Analytics in Optimization of Hydraulic Fracturing in Unconventional Reservoirs." In *Abu Dhabi International Petroleum Exhibition and Conference.* Society of Petroleum Engineers.