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Remote Frac Operations with Digital Solutions: A Permian Basin Case Study

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Abstract

The oil and gas industry experiences large swings in activity levels based on commodity pricing. In 2020 the US rig count fell by 57%. This was the third time in a decade that the year-over-year fluctuation in domestic rig count was greater than 50%. In 2021, rig count doubled as activity levels rose sharply from a low of 250 rigs in August 2020 to over 500 in August of 2021 (Baker-Hughes). These large fluctuations in activity cause a major problem for operators and service companies. When activity is high, staffing levels are too low, resulting in an influx of inexperienced, short-service employees. When activity is low, the staff levels are too high, often resulting in reassignments and layoffs to manage the excess staff. This yo-yo effect costs companies time and money. It is imperative for upstream oil and gas operators to better manage the "boom and bust" nature of the industry to remain profitable in an increasingly competitive energy sector.

One way to manage this problem is by leveraging the rapid development in the digital sector, initiated by the need to accomplish work remotely during the Coronavirus pandemic. Oil and gas operators must position themselves to be better prepared for the next period of high activity by training highly experienced employees to become remote experts. Furthermore, there are several ancillary benefits from capturing data that previously went unlogged. The digital realm could facilitate more opportunity for knowledge sharing between operations and engineers by eliminating the physical gap that previously separated the two.

This paper highlights how the Oxy Completions team treated over half of their Delaware frac stages remotely in 2022 and experienced newfound operational excellence and efficiency. This paper will provide several examples of how oil companies can take advantage of rapidly improving data systems and provide a possible solution to limiting turnover when oil price declines.

Introduction

Prior to March 2020, The Oxy Delaware Completions team "called" all frac jobs from the frac company's data van. "Calling" a frac job involves providing supervision and instruction to the frac service provider on how the frac treatment should be executed. This involves managing pump pressures and rates, selecting sand and chemical loadings, and deciding if the treatment should be suspended early. By the end of 2022, Oxy was calling a majority of their Delaware Basin frac stages from the corporate headquarters in Houston, Texas. This paper will explain what took place to generate this shift, why the team decided to engage in this project, and how this model can be the most advantageous for everyone in the oil and gas industry.

This paper also outlines how the completions team leveraged highly intelligent data systems to revamp historical workflows. The use of artificial intelligence led to the team to newfound efficiency and success. This paper asserts that further development of these processes can result in smarter completions designs, resulting in lower operations costs and more efficient operations.

Remote Frac Origins

The onset of the Coronavirus pandemic in 2020 forced Oxy to reconsider how to call frac jobs. Both the frac provider and Oxy were interested in keeping their employees in separate spaces to ensure the safety of all employees and contractors on location. The team was also keen to limit the radius of exposure if someone on-site were to become infected with the virus, as the domino-effect would be costly and frustrating for employees due to the mandatory isolation period if exposed. This created a problem, as the current method for calling frac jobs required the Oxy well-site manager (WSM) to spend a majority of his/her shift inside the frac company's data van within close proximity of the treater, pump operator, and field engineer. The reason for this is that it is imperative for the WSM to always have visibility to the parameters relevant to the frac, such as pressure, rate, and sand concentration. It is also necessary for the WSM to have the ability to communicate with the treater and pump operator in a seconds notice.

Each well has a frac schedule with specified rates and volumes to be pumped; however, these schedules are routinely altered on-the-fly by WSMs as formation properties dictate how the job can be pumped. It proved critical for the team to determine how the WSM could still have access to real-time frac data channels whilst also maintaining a method of direct communication to the treater and pump operator.

Remote Frac 1.0

The team determined a solution in Q4 of 2020. The WSMs began calling the frac jobs from the company man trailer. This

trailer was on the same location as the frac, but only Oxy employees were allowed inside. The WSM watched the job on his laptop and communicated with the data van – only a few hundred feet away - using a UHF radio. The frac data was streamed in a variety of methods. One solution required the frac company's field engineer to stream all relevant channels on their laptop and host a video call with the WSM. On this video call the field engineer shared their screen and all relevant frac channels could be seen by the WSM. This solution could be accomplished on any video meeting service that allowed for screen sharing and did not have a time limit.

Figure 1 – Online meeting with the frac company's field engineer

Another method in which frac data could be streamed is by utilizing various data services whom share and capture data channels on their web-based browsers.

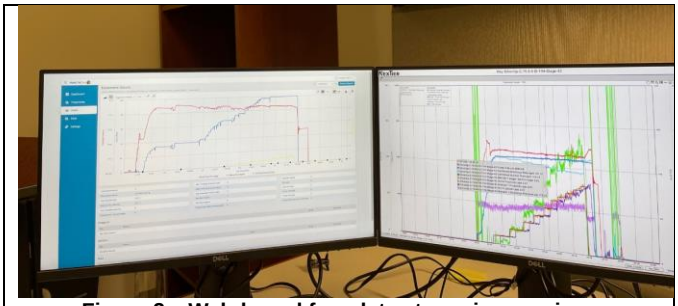

Figure 2 – Web-based frac data streaming services

Naturally, both Oxy engineers and WSMs alike started thinking about what the future of calling frac jobs could look like, because if the WSM could have radio communications remotely, then frac jobs could be called from anywhere. Knocking down the 300-hundred foot barrier that currented limited remote operations was difficult, but it opened up a world of possibilities to optimizing remote operations.

Remote Radio Communications

In Q4 of 2021, the team accomplished remote radio communications by utilizing Radio over Internet Protocol (IP) solutions. The Oxy team leveraged their existing WLAN-00 on-site network and established a Radio over IP connection. The connection was established by installing radios set to the same frequency as the ones used by the frac company and connecting these devices to the Oxy network. This connection served as the host for radio comms and these comms could be transmitted to any computer connected to the Oxy Wi-Fi network, provided this computer is running the necessary radio/IP software. This meant the WSM could remotely communicate real-time with all radios on a frac location. This was a game-changer for the team and as it was now possible for frac jobs in West Texas to be called from over 500 miles away in Houston, Texas.

Figure 3 – Radio/IP Software Dashboard

Figure 4 – Hardware to establish Radio over IP connection

Remote Frac in 2022

Through 2022 the completions team utilized push-to-talk, various data streaming solutions, and cameras to call frac jobs remotely. These jobs were called successfully and with few issues. The new model of personnel usage allowed the team to trial innovative solutions that had not previously been possible. Some of these trials included one WSM calling two frac jobs at once, one WSM overseeing three wireline units at once, and remote coil-tubing supervision.

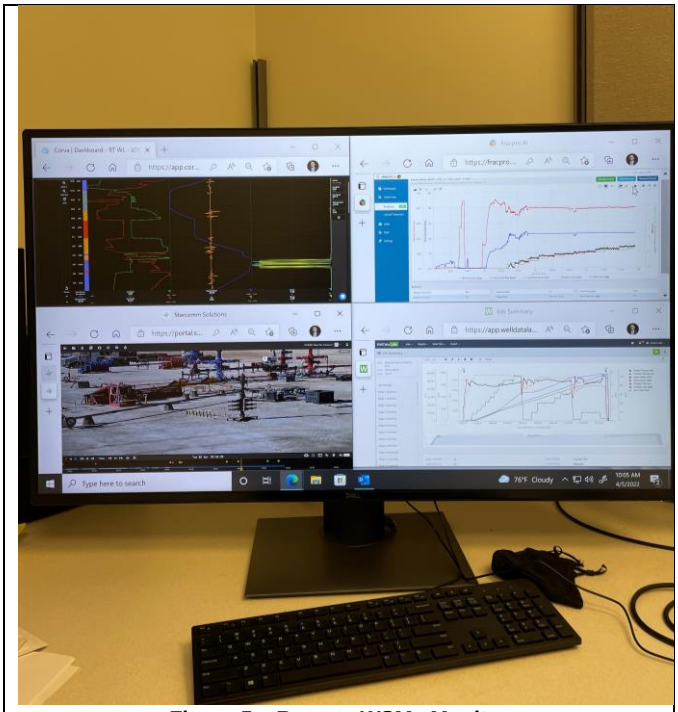

Figure 5 – Remote WSMs Monitor

An unexpected benefit came from remote frac operations: since the data entry were being captured remotely, the personnel on location could focus on safety, communication, and logistics. The team believes that on-site leadership is at its best when the WSM is supervising around location, not in front of a computer. Oxy Delaware's current operational structure on frac sites does not necessitate that one company representative sit in the data van for the entirety of frac operations, nor does it require an on-site representative to be behind his laptop entering data. This is a win for our team, and for the entire industry.

Calling frac jobs from Houston yielded many benefits for the engineering team. By eliminating the physical gap that previously separated Oxy's completions engineers and WSMs, a new line of communication was developed. Drilling and completion engineers, reservoir engineers, geologists, and even IT personnel were fascinated with the remote frac model. Allowing various stakeholders to watch a difficult frac job led to more vibrant collaboration between operations and engineering. The team was afforded the opportunity to get real-time feedback on field trials, and insights into any inefficiencies of the design. In 2022 the team successfully made strides to reduce pump time, chemical usage, and water usage. These initiatives helped the engineering team manage costs during a period of high inflation. Remote frac served as the catalyst for many of the successes that the team experienced in 2022.

Personnel Feedback

It was paramount for the Completions team to communicate with the WSMs continuously through the remote frac trials. It was understood that calling frac jobs remotely would be a significant change to the workflow of the WSMs. It was key for the Completions team to adapt remote frac based on feedback from the WSMs to ensure its longevity. Additionally, it was important for the team to clearly and frequently communicate the vision of remote frac to the WSMs so that all personnel understood the goal of the team. It was never the intent to leverage remote-operations to reduce headcount, but rather optimize personnel to avoid wild swings of overstaffing/understaffing depending on activity level.

It was found that some WSMs did not want to work in an office setting and preferred their previous workflow. There were also many WSMs whom preferred to frac remotely. Some personnel found it easier to focus in an office as compared to being in the data van. Other personnel enjoyed the benefits of not being exposed to the extreme heat and cold of the Permian Basin. The most poignant revelation for our team was learning that all the WSMs were eager to be part of the trials. It was exciting for them to have an opportunity to build skills and gain experiences outside of the oilfield. They also were motivated by the opportunity for more collaboration with engineers, and the opportunity to have input on a project with high visibility.

Data Capture, Organization, and Analytics

In addition to live streaming frac data, the streaming systems capture and organize the data in real time. This method of data capture was not previously being utilized by the engineering team. Prior to 2020, much of Oxy's frac data was siloed and thus difficult to analyze in bulk. Now, intelligent data systems can be utilized by engineers to analyze frac performance in specific areas and benches. Furthermore, these systems built analytics dashboards that led to insights for the operations teams. One such application of this was comparing frac vendor performance and illustrating each crew's strengths and weaknesses. The systems can also plot how stage cost varies by area, bench, design, fleet, and even by shift. The team also began analyzing how frac stages treat based on data captured while drilling – such as MSE, gamma, gas flow, etc.

All these data were capable of being captured previously, but the use of these data systems significantly reduced the manpower necessary to organize the data. Artificial Intelligence can build plots in a fraction of the time that a human can. These systems allow engineers to focus their time on analyzing the data, and less time organizing it. Focusing efforts into engineering solutions is vital for evolution in our industry and for Oxy to maintain profitability and excellence.

Remote Operations & Data Analytics in 2023 and Beyond

The Oxy Delaware Completions team seeks to call over half of our frac stages remotely in 2023. The team is focused on further utilization of computational programs to revamp historical work processes. In 2022, it was found that the use of artificial intelligence to log data had not proved to be as accurate as using a human-being. This year the team is optimistic that developments will be made in these algorithms through the use machine learning. The goal is to automate much of the reporting that is currently being done by our WSMs.

The team is also interested in trialing remote supervision of rig moves in 2023. For this to happen, strides must also be made

in making high bandwidth communication possible while a rig or frac fleet is not on location. Additionally, the team believes that the WSMs ability to see location from a variety of perspectives may be necessary for remote logistics. For instance, a drone camera could prove to be helpful for rig moves. The team is hopeful that leveraging technology to the logistics department would yield benefits that would ensure safer and more efficient moves.

In 2023 the engineering team seeks to further leverage the use of analytics to reduce costs and improve efficiency. Completions and reservoir engineers alike will be working with data system providers on several initiatives designed to help us understand the impacts of several frac parameters on operational cost and long-term ROR. The team will also explore the relevance of drilling data on the frac. Understanding these variables in real-time, and their ultimate impact to the life of the well could lead the team to further optimize frac designs.

The team is intent on continuing to grow our capabilities to operate remotely beyond 2023. One of the understood consequences of taking on this endeavor is that there is no end-goal, rather it is an enterprise of continuous improvement. The team does not have a vision for what exactly remote operations will look like beyond 2023 – but there are several exciting avenues the team could potentially take. The future will be structured depending on activity-levels and business drivers; by not setting a rigid objective, the team is able to nimbly pivot to dynamically changing external conditions.

As mentioned in the introduction of this paper, the use of remote supervision could revolutionize how the industry looks at staffing during fluctuations in activity. During a period of activity ramp-up like the industry experienced in 2022, it becomes difficult to find sufficiently skilled employees to oversee operations. The use of remote supervision could allow a team to run leaner during periods of high activity and concentrate knowledge in remote experts. Furthermore, developments in computational programs could allow for one WSM to watch more than two frac jobs at once. For this to happen, algorithms would need to learn when to adjust rate, sand concentration, chemicals, etc. based on treating pressure. This sort of predictive feature can be made possible with machine learning. Machine learning algorithms are at their best when they have a large collection of data to analyze. It is understood that further instrumentation and controls may need to be added to the oilfield for these algorithms to compute at a higher level of efficacy.

Further development of remote supervision of logistics could yield two benefits that work in tandem - cross-training for oil ang gas workers, and allowing the team to staff remote WSMs with different backgrounds. This could be possible because a byproduct of remote logistical supervision is that it requires different skills than overseeing in person. Perhaps someone with a background in construction could be suited for this sort of role. Complimentary, it may be that someone with a background only in oil and gas operations is interested in a role in remote supervision, as the skills developed in this role are transferable to other industries.

Conclusions

The team concludes that remote supervision and data analytics proved to be a major factor in our success in 2022. Despite battling attrition, inflation, and higher than anticipated levels of activity, Oxy Delaware Completions accomplished several “Oxy-firsts” as a team. The systems established by our team this year will help to make Oxy Completions safer and more efficient in 2023. Further development of these processes will continue to provide benefits to completions in years to come. The team is eager to continue to explore highly intelligent data systems, develop high bandwidth field communication, and bring the oilfield to the 21st century.

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Nomenclature

WSM = *Wellsite Manager*
Frac = *Hydraulic Fracturing*
Q4 = *Fiscal Quarter 4*
WLAN = *Wireless Local Area Network*
IP = *Internet Protocol*
IT = *Information Technology*
MSE = *Mechanical Specific Energy*
ROR = *Rate of Return*

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