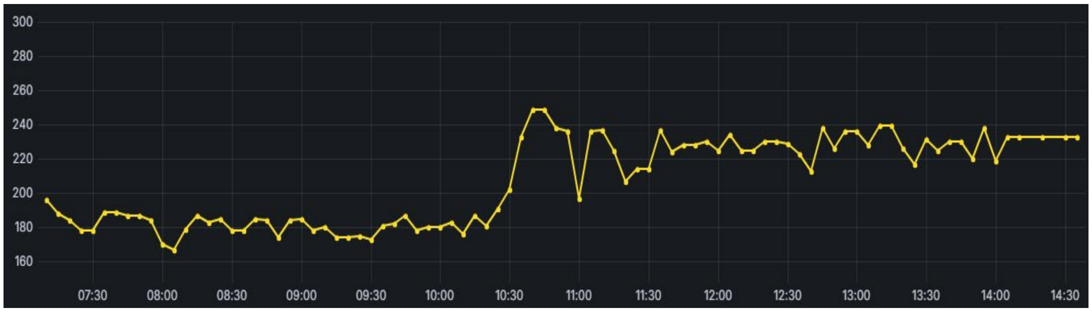
BRIDGE BETWEEN GAS LIFT OPTIMIZATION AND DATA ANALYTICS

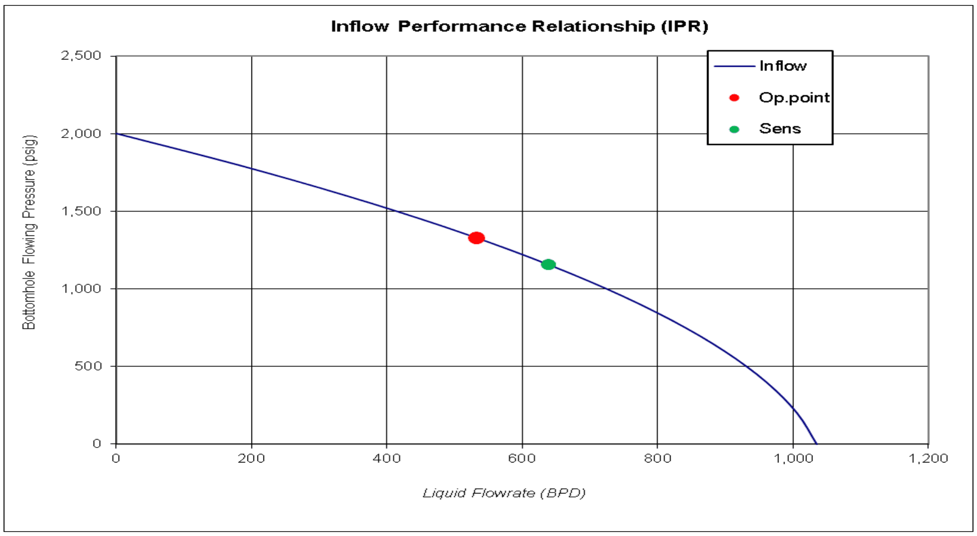
Logan Smart
Enerview

Gas lift has been a cornerstone to artificial lift systems since the late nineteenth century, leveraging gas injection to reduce hydrostatic pressure and facilitate fluid production. While the core principles of gas lift have remained relatively unchanged, advancements in technology and data acquisition have ushered in a new era of optimization. Today, high-frequency production data enables a dynamic feedback loop between field operations and optimization strategies, offering deeper insights into system performance. Yet, despite this progress, gas lift systems present unique challenges that differ from other artificial lift methods such as rod pumps and electric submersible pumps (ESPs). Unlike these systems, where optimization levers such as variable speed drives offer precise control, gas lift relies on injection rate and lifting depth—factors that are more difficult to monitor and adjust. Understanding and leveraging high-resolution data to interpret lifting behavior and identify early signs of failure is now critical to optimizing gas lift performance and reducing deferred production in unconventional wells.

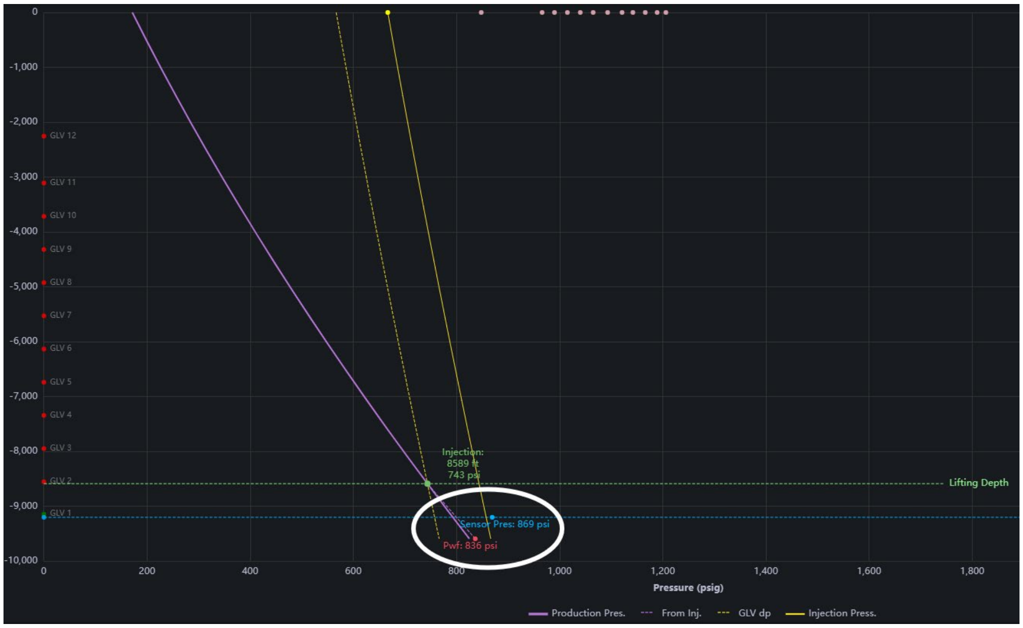
The baseline of optimization is to make the system more efficient; this begins with maintaining flow and injection. Using real-time data, we can identify when the well is shut in, lost injection etc. The faster we can detect a downtime event the faster we are able to accelerate wells being returned to production (RTP). Increasing RTP time adds the biggest return. With all the attention around Artificial Intelligence (AI) and Machine Learning (ML), we are beginning to get away from the basics that led us here. Simple algorithms are still solving operational problems and providing a massive ROI when used in a practical manner.

Now that we got the boring stuff out of the way, let’s dive into how to optimize flowing well from the basics. Identifying increasing surface pressures aid to loss in productivity that requires minimum intervention, for example, simply being able to identify an increase in flowline pressure. Below you’ll see how a twenty-three percent difference in flowline pressure results in a decrease of ~100 BPD. Real-time data analytics allow you to detect and alert out the pressure within the hour rather than the days or weeks that you would get from a traditional SCADA system or manual data entry.





The same concepts apply when we transition to downhole measurements whether you have a downhole gauge (DHG) or are calculating the flowing bottom hole pressure (pwf). DHG’s add real-time pwf readings without needing PVT data, but this is where we begin to get fancy and walk into the ML bubble. Data acquired from DHP’s are fed into a ML model to calibrate the calculation of pwf. Calculated pwf is ~3% off the DHG. The key difference between the calculated and measured pwf is one is real-time, and one is updated when new PVT data is available. With just a DHG, we can apply the same principles in detection and alerting with the pwf increases or decreases.



The phrase – "The great thing about gas lift is it works… bad thing about gas lift is it works" has been relied on in fast-paced unconventional operations where engineers are responsible for hundreds of wells with new completions right around the corner. With other AL methods, sub-optimal and failure detection is identified much easier. ESP and SRP systems monitor downhole conditions when the motor, pump or rod string hits setpoint limits forcing the controller to shut down the well and alarm out. For example, if a pump is stuck, an ESP will shut down on motor overload and an SRP will shut down on a high load, assuming the shutdown setpoints have been properly set. For gas lift, we can transition from pump to gas lift valves (GLV). When a GLV is stuck open, we don't have the luxury of identifying this in real-time like other AL methods have and the well will continue to produce. Depending on the severity of the GLV failing to close and seal, a failure could go on for months, creating up to 50% in deferred production volumes. How can we enhance detection time and failure solutions?

Tying in real-time measured pwf from the DHG, real-time PVT data from pressure transmitters (PT's) and meters at the production separator or straight from the PLC, we create the perfect partnership. Historically, we have only been able to produce new models daily at best. Often it is a few a week or even monthly. We can now speed up the process of identifying optimization opportunities within the hour. The faster the data – faster we can produce a new model.

However, with a high frequency ETL process comes its own set of challenges. If any PVT variable begins to drift in either direction, the analysis or potential failure detection becomes inaccurate. This relates back to earlier where the calculated pwf being is ~3% off.

Is the calculation off, or do we have inaccurate data feeding our model? Proper statistical workflows must be worked into the process to catch, flag and stop the processing of data. It starts with the aggregation of data and storing the minimum, maximum, mean, median and range for each data set. This is where data sets get cleaned up. Bad data can come in, but it doesn't have to go out.

One effective method is applying standard deviation thresholds to flag values that fall outside of expected operating ranges. Upper and lower limits are set, helping identify outliers or anomalies in real-time before they skew model outputs. While standard deviation aids in certain variables, it may not be logical across all data sets.

Another effective method is Interquartile Range (IQR). IQR is a measure of statistical dispersion that indicates how spread out the middle 50% of a dataset is. It is determined by subtracting the first quartile from the third quartile. IQR focuses on the middle 50% of the data and is less affected by outliers than standard deviation. The surface injection pressure or injection rate should have standard deviation applied since the data remains steady. Well head pressure (WHP) should have IQR applied due to fluid slugs seen at surface resulting in pressure swings more often.

See below a detailed interpretation of IQR vs SD:

Feature	Interquartile Range (IQR)	Standard Deviation (SD)
Definition	Measures the spread of the middle 50% of data (between Q1 and Q3)	Measures how far each data point is from the mean
Formula	$IQR = Q3 - Q1$	$\sigma = \sqrt{(\Sigma(x_i - \mu)^2 / n)}$
Sensitivity to Outliers	Low – ignores extremes; robust to outliers	High – outliers can significantly increase the standard deviation
Use Case	Better for skewed or non-normal distributions	Best for symmetric, normally distributed data
Focus	Focuses only on the middle 50% of the data	Takes into account all data points
Outlier Detection	Based on thresholds:	

In conclusion, optimizing gas lift performance in today's unconventional operations means combining the basics with modern data tools. While gas lift systems are mechanically simple and reliable, they don't have built-in ways to detect problems like ESPs or SRPs do - where shutdowns and alarms help catch failures early. That's why real-time monitoring and smart alert systems are so important. By using high-frequency data from downhole gauges, pressure sensors and production meters, engineers can spot issues faster and cut down on lost production. Once the number of models being produced increases, we also accelerate our ability to understand and predict potential failures. This opens the door to deeper insights—do certain variables like formation, deviation, lateral length, setting depth of gas lift valves (GLVs), or packer versus packer-less designs impact a well's performance or equipment run time? With more detailed data comes the challenge of keeping it clean and accurate. Tools like standard deviation and interquartile range (IQR) help flag bad data before it leads to the wrong conclusions. In the end, better gas lift optimization doesn't always mean using the most complex machine learning models—it's often about applying simple, practical insights consistently and effectively.