

Efficiencies deliver value

Production can be improved when appropriate technology is combined with a formal problem-solving process.

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Revenue streams stall when gas wells are shut in. A 500 Mcf/d well with natural gas priced at US \$4.50/Mcf loses \$15,750 of weekly revenue when not producing. Ten weeks of 10% increased production are required to replace one week of lost revenue. Identifying and eliminating inefficiencies is the key to improving profitability.

Plunger lift, an efficient, low-cost artificial lift method, removes liquid from a gas well so gas can flow freely to the surface. A controller opens and closes the well to cycle a mechanical plunger, which lifts fluid to the surface. When the plunger fails to surface (missed arrival), the well's performance is non-optimal. Subsequent missed arrivals can lead to unplanned nonproductive time (NPT).

Traditionally, plunger lift operators visit producing gas wells once per day. Some drive more than 60 km (100 miles) a day, observing 50 or more wells. Detailed knowledge of the well state is determined when the well tender arrives on site. In a best-case scenario, acute problems can be detected within 24 hours. Detecting underlying chronic problems can take much longer. Traditional processes used to detect, diagnose, and solve problems can result in excessive unplanned NPT. Combining technology with formal problem-solving techniques generates powerful benefits for plunger lift wells.

Recently, an operator in the Barnett shale sought to understand the root causes of unplanned NPT for plunger-lifted wells. Causes of unplanned NPT were analyzed for 62 wells over 18 months. The study found that low line pressure could

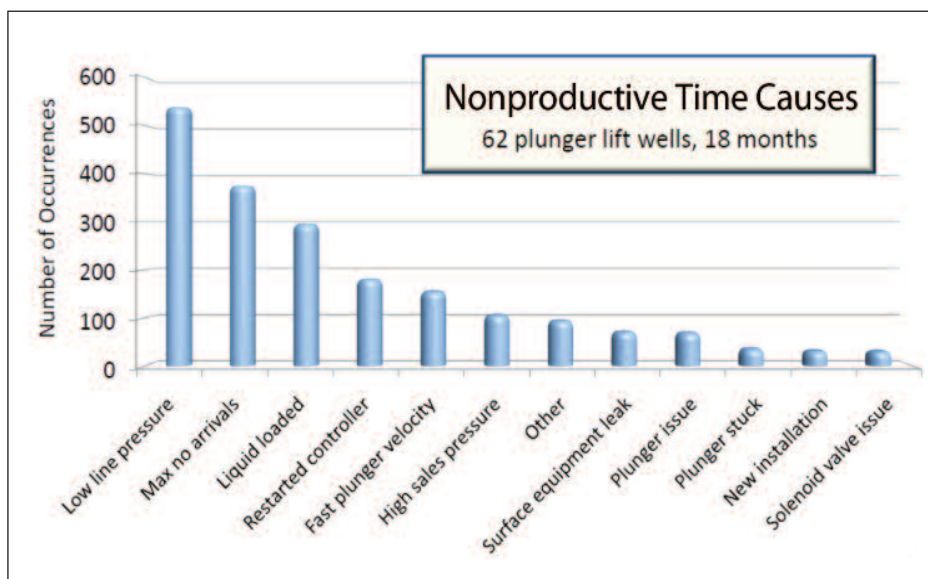
be attributed largely to pipeline and meter maintenance. The second leading cause of NPT was missed plunger arrivals.

A continuous improvement approach enabled the operator to not only determine the causes of NPT but to find a way to act on them.

Continuous improvement

Toyota's problem-solving process is viewed by many to be the best in the world to sustain continuous improvement. This powerful process is unassumingly labeled "A3," simply because it is recorded on a single piece of A3 sized paper (11 in. by 17 in.). The process uses the Deming circle/cycle/wheel, also known as "Plan, Do, Check, Act" (PDCA), as an engine to tell a compelling story. The story's seven sections address seven questions:

1. What is the problem?
2. What are the current conditions?
3. What specific outcome is required?
4. Why does this problem exist?
5. What do we propose and why?
6. How will we implement?
7. How will we ensure ongoing PDCA?



A Pareto analysis illustrates the causes of unplanned NPT analyzed for 62 wells over 18 months. (Images courtesy of Ferguson Beauregard)

When executed correctly, frequently engaging an eraser as understanding improves, this method builds consensus among stakeholders prior to implementation.

Improving operations

Pareto graphs are a tool used within the A3 story. A Pareto is a graph of the frequency of occurrences (sorted most to least) over a time period.

A fishbone diagram, which shows cause and effect, is another tool used within an A3 to expand the story. Fishbone diagrams identify many possible causes for a problem. The problem is recorded at the head of the “fish.” Improvement teams brainstorm major categories of the cause of the problem. Each “bone” is labeled with a major category.

For example, Toyota explores four broad categories, commonly referred to as the “four ‘Ms” that form the basic components of a task – man, machine, method, materials. Measurement and management are sometimes included as well. Next, the team brainstorms and records all possible causes of each major category.

By applying this process to operations in the Barnett shale, it was possible to identify worn plungers as a contributing factor to missed plunger arrivals.

The “5 Why” process can be used within the fishbone method to determine root causes by asking “Why?” five consecutive times.

Using the example of “Why is the plunger missing arrivals?” the process might look something like this:

1. Why is the plunger missing arrivals?

Upward force is insufficient to push plunger to the surface.

2. Why is the upward force insufficient?

No missed arrivals for past three months. Upward lift pressure is the same. Downward liquid load is increasing. Plunger is worn.

3. Why is the plunger worn?

Plungers are only replaced when frequent missed arrivals occur, after production declines.

4. Why wait until profits are lost before replacing worn plungers?

This Fishbone diagram made it possible to identify worn plungers as a contributing factor to missed plunger arrivals, which negatively impacted production in the Barnett shale.

A plunger replacement program has not been implemented.

5. Why isn't there a plunger replacement program?

Once the questions have been asked and answered, an action plan can be developed addressing how to resolve the root cause of the problem. With corrective action implemented, data are collected and analyzed to ensure actions prevent recurrence.

Finally, the solution is migrated across the organization, enabling many to benefit from the detailed analysis of the local improvement team.

In effect, by following this process, the organization is building a toolkit of known solutions to prevent NPT. As new solutions are proven, they are added to the toolkit.

Getting better every day

Some view continuous improvement as simply challenging employees to “get better” each day. Yet continuous improvement as indicated in the Barnett example requires commitment, discipline, a standard, and a measure. The concept of standard work is uncomfortable for some, as it is perceived to infringe on a person’s desire to do it his or her own way. In reality, standards are simply about operators defining the best way to do a task (such as daily well reviews). Once consensus is gained on the best process, standard work should be documented and followed.

Continuous improvement blossoms when problems are embraced. After all, how can improvement occur without a problem? How can improvement be maintained without a process?

Sustainable improvement occurs when root causes are continuously identified and resolved. **ESP**

References available

