

Business Impact: Well Failures

Tracking Well Failures is a high-impact return for E&P companies because it affects both revenue generation and operating costs. Most companies focus on large and new initiatives to increase the bottom line like making sure an expensive drilling platform is delivered on time; the impact of not doing so is material and quite obvious. What is not so obvious, but can be equally material, is the impact of having accurate, detailed information available to look for trends and patterns associated with drilling, wellwork and production processes. The purpose of this paper is to focus on the value of accurate, detailed information to track well failures and the underlying value of this approach.

The paper will show using two separate and public case studies that having a database system to provide business intelligence capable of focusing on in-situ patterns and failures can deliver both revenue and cost benefits to the operator. Modest investments in information solutions deliver millions of dollars in benefit on a highly repeatable and practical basis. This is being done now with existing technology for actual participants.

The Wellbore is the number one asset of an oil and gas operator and represents 25-50% of the lifting cost¹ (pulling costs, chemical costs, rod, tubing and pump repairs and other lift equipment maintenance). The well failure module is a process in which well production optimization and equipment repair procedures are implemented and improved over the lifecycle of the well.

It is generally agreed that the Quality Control for properly servicing a well lies in accountability, collaboration and coordination of better diagnostics, pre-planning, procedures and cost estimation. A system of processes and metrics is therefore needed to monitor and determine trends and patterns for optimization purposes. Some of these Key Performance Metrics include:

- ▶ Failure histories
- ▶ Production rates
- ▶ Plot production vs. failures
- ▶ Repair histories
- ▶ Chemical treatments
- ▶ Pump repairs
- ▶ Rods condition
- ▶ Tubing condition
- ▶ Surface equipment conditions & usage

This system of processes and metrics require accurate, timely data for interpretation and evaluation to take out the guess work. This information is best determined by investigating historical well data to determine the underlying causes and what actions can be taken to prevent future problematic areas before they occur.

Some preventative action examples to mitigate well failures:

¹ Bob Kiker, Petroleum Technology Transfer Council

- ▶ Design Optimization
 - Review equipment conditions and designs
 - Regular monitoring of well performance
 - Pump types and sizes evaluation
 - Speed and stroke lengths of pumping units
 - Install pump timers
 - Rod strings redesign
 - Fluid levels shot monthly to monitor pump performance
 - Collect samples for review
- ▶ Preventative Maintenance
 - Controlling scale and corrosion problems
 - Inspect, clean or replace rods
 - Uncoated tubing in injection wells replaced with internally cement-coated tubing
 - Treat tubing w/ inhibitor GIH
 - Run rods w/ tongs, checking coupling displacement, treating w/ inhibitor GIH
 - Check and chart pump action before rigging down

As mentioned earlier, well failures are an expensive proposition because they affect both lifting costs and revenue generation. One case study with the Medicine Bow Operating Co. revealed the company was experiencing excessive well failures, as many as 112 per month from 200 wells. A team effort focused on getting the metallurgy right, lift equipment under proper load conditions, and chemical treatment at appropriate levels. Three years later, well failures were stabilized at about 5 per month (96% decrease) and operating costs alone were reduced more than \$1.5M a year in direct operating costs and labor.² Lifting costs can be literally cut in half, or more, by applying certain actions to reduce failures. A savings of \$4 - 6/bbl of oil is very achievable.³

Another case study shows that 116 of 406 wells experienced 97 rod failures and 75 tubing failures.⁴ The payout analysis showed a total cost to mitigate the rod failures at \$184,044 realizing a total savings of \$268,888 and a resulting pay-out of .68 years. The tubing cost was \$199,726 realizing a total savings of \$421,629, resulting in a pay-out of .47 years. Both cases for this field showed a combined savings of \$690,517 for cost savings alone and didn't include the impact of loss of revenues while the well isn't pumping oil out of the ground.

The two case studies above are documented on the internet for the public's view. The common message for both of them is that well failures have a big impact on costs and the impact is magnified when you consider the amount of downtime and zero oil is pumped out of the ground. There are many reasons for well failures and the only way to effectively optimize well performance is by monitoring relevant historical data. The availability and accuracy of the data impacts the time an operator can react and solve the problem.

Houston, TX
+1 713-956-2165
+1 877-9PETRIS

Toulouse, France
+33 581 330 020

London, UK
+44 20 8202 2433

www.petris.com

² World Oil, April 2004

³ World Oil, April 2004

⁴ Bob Kiker, Petroleum Technology Transfer Council

We have identified some Key Performance Indicators that should be monitored in detail such as production vs failures and looking at histories of rods, tubing, chemical treatments etc. that may all have a major impact on well performance and failure. In summary, the point is that solving well failures is not an easy task and requires a system that tracks detailed well lifecycle information to find trends and patterns to optimize performance.

Just looking at well bore data isn't enough. The system must be capable of tracking detailed historical information as to how production is performing against failures, failure locations & time, well configurations by failure, detailed component histories, services deployed, drilling depths, surface equipment and usage history, environmental conditions, chemical treatments, and a plethora of other detailed data to consider when looking for well failure trends. Another point is that the system that monitors and tracks well failures also lends itself nicely to optimizing well performance by planning for contingencies and emulating what well configurations perform the best for a location, type of well, environmental conditions etc.

Denbury Case Study

Denbury has been using the PetrisWINDS Operations Center software system for tracking well failures for about 5 years now. Bill McMann, Operations Manager, stated "the only way to effectively track & mitigate well failures is to look for trends and patterns at the granular data level." "Knowing the well bore configuration is only part of the formula for tracking well failures." "To be effective, it is critical to know and compare all the other influential factors at the time of failure like rod failures and tubing wear, drilling depths, mud properties and environmental conditions at the time of failure."

One example of how Denbury tracked well failures was by comparing similar well failures in the same geographic location by drilling depth and directional survey. A trend of unusual rod and tubing failures was determined at a certain depth and direction and Denbury was able to make the necessary changes to quickly put their wells back into production.

The impact of tracking well failures is best expressed by these comments by Bill McMann. "The impact of tracking well failures is like a double edged sword. "Not only is it a costly expense to deploy manpower, new equipment and supplies to solve the problem, but the loss of revenue production due to downtime can be greater impact than cost on the bottom line." "Denbury's strategy to improve results is to capture more detailed data and identify additional trends and patterns that affect well failure and production optimization." "The biggest impact on well failures is having accurate, detailed information available for a quick analysis of the problem without having to dig through well files." "The software provides a paperless well file system for searching the details associated with well failure and performance optimization at your fingertips."

While it is difficult to quantify the actual impact the Operations Center software has had for solving well failures at Denbury, consider the following logic:

Houston, TX
+1 713-956-2165
+1 877-9PETRIS

Toulouse, France
+33 581 330 020

London, UK
+44 20 8202 2433

www.petriss.com

Assumptions:

- ▶ Small field of 100 oil wells
- ▶ Each well produces 20 bbls per day
- ▶ \$65 oil per bbl
- ▶ Ave cost is \$10,000 per well to resolve well failure problem – manpower, new equipment, replace rods, tubing etc.
- ▶ Downtime is 5 days a year because of well failure
- ▶ Average 1.7 well failures a year

Now let's look at the potential financial impact of Well Failures in this hypothetical example:

Impact on Revenues

Number of Producing Wells in Field	Ave. Volume bbl per day per well	Ave bbl Volume per day (Field)	Value of field revenues per day@\$65 bbl	Ave. Days Downtime	With PA ave. days downtime	Revenue generation saved from downtime
100	20	2,000	\$ 130,000	5	2	\$ 390,000

Impact on Costs

Ave. number failures per year	With PA, ave. well failures reduced to:	Percent downtime improvement with PA	Ave. Well Failure Costs - new equipment, expedited parts, rig costs, repair shops	Number of Producing Wells in Field	Field Cost Savings reducing downtime 41%
1	0.5	50%	\$10,000	100	\$500,000

This simple example shows a small oil field of 200 wells that produces approximately 20 bbls a day can reasonably realize a cost savings of \$890,000 on the bottom line because of well failures in one year. Solving this problem efficiently and effectively is only possible with the use of a system that can track detailed historical data for comparison with performance.

Summary

The business impact of well failures varies oil well to oil well but there are patterns and trends that can be identified if a company makes the investment and time to capture and analyze detailed data. To be effective the data needs to be readily available, accurate and at your fingertips for quick resolution. The impact is further magnified because well failures not only affect lifting costs, but production revenue as long as the well is not producing. Having a system that captures, manages and reports this detailed data has the additional benefit of not only solving well failures, but contributes to optimizing production output as well.

A huge ROI for E&P companies is to maximize production efficiency by balancing all of the components that go into drilling and completing a well. Only by examining

Houston, TX
+1 713-956-2165
+1 877-9PETRIS

Toulouse, France
+33 581 330 020

London, UK
+44 20 8202 2433

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the history of well lifecycle information details can one determine trends and patterns that work for different conditions so the optimum configuration can be determined for each oil well.

We have examined 2 case studies open to the general public that each show the potential impact of well failures on the bottom line. The studies we examined showed lifting costs can be literally cut in half, or more, by applying certain actions to reduce failures. In the example case study, operating costs alone were reduced more than \$1.5M a year in direct operating costs and labor. The author estimated the impact of well failures can realize that a potential savings of \$4 - 6/bbl of oil is very achievable and we extrapolated that impact on a hypothetical 200 well field (with excessive well failures) to be about \$18,985 in one year.

Another case study showed a savings of \$690,517 for solving well failures due to rods and tubing and a final case study from Denbury Energy using their logic and assumptions of saving lowering lifting costs and increasing production revenue to better understand the potential impact of well failures on a 200 well oil field. In this example we computed an estimated hypothetical potential impact of well failures to be about \$890,000 on the bottom line for reasons explained.

Houston, TX
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+1 877-9PETRIS

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London, UK
+44 20 8202 2433

www.petris.com