UNDERSTANDING WELL SERVICING RIG EFFICIENCY A UNIQUE PERSPECTIVE UTILIZING KEYVIEW TECHNOLOGY

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ABSTRACT

Recent inflation has caused many in the industry to try and develop methods to improve the efficiency of their well repair programs. BP America, in cooperation with Key Energy, has begun a pilot program in SENM that couples existing KeyView data with a basic root cause perspective to deepen the understanding of service rig delays.

This paper will discuss in general terms, the capability of the KeyView data capturing system, and in specific terms, how the available data was adapted to challenge assumptions about service rig delay times.

INTRODUCTION

Increased well intervention costs in BP America’s South Eastern New Mexico area, were on the rise. Eric Waller, wellwork specialist in SENM, initiated a case study involving three rigs that used the KeyView system to help understand these rising costs. Chad Marshall and Phil Burke with Key Energy’s KeyView division, helped hone the process that turned raw data into usable trends. The project began in early 2006 attempting to discover usable trends. The project initially attempted to understand rig wait times using rig reports. It started utilizing KeyView data by mid year. The project moved from collecting raw data and using KeyView base reports to a methodology incorporating a basic root cause approach in October 2006, and continues to date. The project utilizes an action research approach by applying lessons learned and measuring the results. The project has shown promise, and has had some unanticipated results.

PROBLEM

Recent Increases in well intervention costs have forced many in the industry to look for ways to reduce these costs. BP in SENM, seeing rising well intervention costs, had concerns about where the losses where coming from. There were many opinions as to the increased cost sources. Increased cost was attributed to inflation of service costs, increases in internal regulations surrounding well interventions, increased competition for resources limited by market demands and internal controls, and concerns about the efficient use of resources.
We determined that in order to increase efficiency, we first had to find an objective way to measure their losses. Well intervention cost increases are typically framed in subjective arguments that are not easily measured, and measuring these types of increases is not usually done.

We were also concerned about ways to measure their rig efficiency in comparative terms that were different than past practices. The most common practice to date was a subjective measurement whereby opinions were formed as to the rig or the Well Site Leader’s (WSL) abilities to manage resources in an efficient manner. This common practice is useful in many ways, but it can be biased due to its subjective nature. While we were not ready to abandon this practice because in the end it is about people, not just rigs, it was determined to add another facet to the efficiency measure.

THE SEARCH FOR SOLUTIONS

Initial attempts at measuring efficiency came from daily rig reports. Looking at the reports to determine if there were deficiencies was initially tried with little success. This proved difficult for many reasons. The first and foremost wedge was communicating that we were not trying to measure individuals shortcomings, but rather that we were trying to record any barriers to productivity. Inherent suspicion caused difficulty in this area for a couple of reasons. The first being that the rigs were clearly working in what seemed to be an efficient manner, and the only wait times recorded seemed to be related to lack of equipment or resources. The second difficulty was that people generally resist a complex questioning of their behaviors, especially when work was being performed as fast as safely possible in most cases.

These conversations with rig operators and with WSL's led US to try and find a different method to measure the efficiency of their resources. While these conversations were quite valuable it proved to be too slanted a method to accurately report. We needed clear data that was accurate and measurable.
Turning to the Pulling Unit provider, Key Energy, we began to use the data provided by their KeyView system. KeyView, a rig monitoring and control system that uses satellite technology to upload the data in near real time frames, looked promising and we began to look at the data from past well interventions. The chart in figure 1 is an example of an early report.

In order to get a better understanding of our wait times using this process, we all had to agree to accurately report our performance for both Key Energy Services and BP in SENM. We had to show crews and WSL's it wasn't a measure of how hard and fast they were working.

STARTED TRACKING WAIT TIMES USING KEYVIEW

After deciding that KeyView was our only objective approach to look for solutions, we began to look at some basic reports. The initial efforts focused on using the KeyView reports to determine when the rigs were waiting for goods or services. KeyView had the ability to let the rig operator push "wait" on his console, pictured in figure 2. And the rig pusher then used the system to classify the wait times based on conversations with the operator. As shown in figure 3.

Reports were queried as to the wait times and their particular classifications. The reports used at that time, gave us general information about the type of job, time of each activity group, and notes concerning our wait times. After reviewing several jobs we found the reports lacking. Although there was good information we realized that we were still not capturing all the wait times and not categorizing them correctly. Figure 4 shows sensor data that represents a wait time that may not be recorded. The dead time in the pressure, rpm, and weight indicates work has slowed or stopped for some reason. This prompted us to do more training with the rig supervisor and rig operator. This not only gave us the opportunity to train on how to use KeyView correctly, but also gave us a chance to communicate what we were trying to accomplish with the wait times.

Three things became clear in this initial test. The first was that the rig operators needed to be trained to push the wait button at the right time and under the right circumstances. Initially there was a tendency for the operators not to push the wait button. This stemmed from the earlier concerns that the process was being used to measure their individual efficiency. Conversations about the process and its intent were continual, and the process began to function better.

The second reality was that the wait time categories were not accurate enough to measure efficiency. The second reality was that the wait time categories needed one more level of detail to measure efficiency. KeyView provides the base data as understood by the operator and the supervisor yet many times would not and could not get to the root cause of the delay. The initial reports were still reporting deficiencies that were related to services and supplies. It was assumed that these were correct at the time, but there were still gaps in reporting, both the clarity of the deficiency and the timing of it as well. We began to develop an unambiguous framework to classify the wait times we were seeing, and the rig pushers began entering clearer notes as to the type and cause of the wait time.

The third reality was that the data still didn't fully support any hypothesis related to wait times, and that the data we had was not consistent across rigs. Had there truly been a shortage of goods and services, this would have been spread evenly across rigs and jobs. An example of this was the recording of wait times associated with rig mats, BOP's, tubing, rods, etc. We realized that we were not actually waiting on these items due to unavailability of equipment. With further exploration we concluded that the wait times were more closely associated with planning, scheduling, weather, etc. One example of a wait time that commonly came up was "waiting on rig mats". Rig mats were available, every day. This single wait time discrepancy started the next phase of the project. KeyView has limited categories of wait times to cover a broad spectrum of possibilities. This prompted us to build a spreadsheet that used the data from KeyView to further drill down the wait times.

CHALLENGED ASSUMPTIONS

As stated previously, we had already formed certain assumptions or hypothesis about the reasons for increased well intervention costs. There were three main categories which were: Increased trip times, shortage of equipment and services, and that you just couldn't plan out a job fully due to unknown well-bore conditions. The Trip Time category assumption was based on industry professional opinions that it used to be done faster and that safety regulations, while good and necessary, had slowed the process. The shortage of equipment and services assumption was based on both the initial attempt at mining rig reports as well as the early KeyView data. Both seemed to agree that there was a shortage. Most in the industry would also agree that the recent upswing in activity had put increased demands on goods and services providers, increasing demand and thereby increasing the cost and scarcity of these goods and services. The third assumption, inability to forecast well-bore conditions, was based on conversations with the WSL's and with Production personnel.

Using these assumptions, we began the process of challenging them to see if they would stand up to the data. We then began to develop and use a basic root cause perspective to qualify these assumptions.

BEGAN TO MEASURE WAIT TIMES USING BASIC ROOT CAUSE PERSPECTIVE

The basic model for gathering the data point forward was to use a basic root cause perspective. Using the KeyView end of job reports and the new method of classifying delays along with the increased awareness by WSL's, rig operators, and rig pushers we began to question the wait times that were coming in. Figure 5 is an example of one of the aspects of a typical End of Job Report.

When we saw a delay, we began to ask questions until the underlying cause, if any, was determined. In order for this to happen, it is important to remember that there had to be an agreement to accurately report any wait times and to accurately report the findings. The rig crew had to be shown that the process wasn't a measure of how hard or how fast they were working, rather that it was a method to determine any roadblocks to efficiency that we could remove for them. This took many conversations, and it took full disclosure of the data. Soon after, we saw a marked increase in wait times being reported which was identified by the unique job number assigned by KeyView, by the month and by the rig.
Initial concerns about inaccuracies forced the development of five simple wait time categories initially. Agreements were made as to what would constitute which wait time category.

HOW WE GATHERED THE DATA

An excel spreadsheet was built and the data flow was initially processed into the five categories, with corresponding subcategories. They were: Safety, Weather, Planning, Equipment, and Supplies. These five categories made it easier to process the output information from the spreadsheet. Too many categories would not allow for a short test time of the project. Using just five categories also helped aid in the understanding of the process and of the project during the test phase. Figure 6 is an example of one of the worksheets used in the new spreadsheet.

Once again, turning to the KeyView reports, each wait time was queried. Questions were asked until the root cause of the wait time was determined. The wait times, in minutes, were entered into the spreadsheet and categorized by the job number, the month, the rig, and finally averaged across an area.

WHAT WE DID WITH THE DATA

Initially, the wait time categories were reported as a percentage of total wait times. While this proved dramatic, it was less accurate than reporting wait time categories as a percentage of total time on the job. The difficulty in gathering the total time came from the current inability of KeyView to report all billed times. Simply stated the system only reports time on location. BP in SENM had to have daily tickets gathered and input them into the total time in the KeyView database. Key Energy agreed to do this for a limited time to test the project and total times were recorded rather than rig run times. Key Energy has plans to alter the KeyView system to be able to capture the full billed time in the future automatically. At present, it only records the time that the rig is active and the system is powered.

Each wait time was recorded in the spreadsheet with a comment inserted for later use. A short explanation as to why the wait time was recorded was inserted. This would later prove effective when explaining the data and leaves open the possibility for future in depth analysis, figure 7.

The next step involved looking for trends in the data. Each category was graphed and analyzed for changes. To insure accuracy of the data points, when one category lowered or rose, the other categories were perused to make sure there was no change in reporting from one category to another. This was to insure an actual total decrease or increase, rather than a movement of wait times across categories due to a misunderstanding or change in the category definitions.

One unique feature of this project was the ability to translate wait times into dollars. Using the unique job number, the capability exists to divide the total dollars spent by the total hours worked and come up with a rudimentary average cost per hour. Using this average cost per hour multiplied by the wait time hours, a figure for cost of wait time can be determined. This method is still under scrutiny, but thus far it is the most accurate method if determining well intervention wait time costs. The scrutiny comes from the fact that not all hours are as costly as others in a well intervention job. This number changes from hour to hour and from day to day. Still, it is an average of the total job and has promise for a good benchmark number to qualify intercession measures. It is important to point out that even though reductions in wait time dollar losses may be seen with the right intercessions, they may or may not translate into actual dollar savings. Most likely they will translate into increased efficiency which will lead to decreased job times, lower costs per job, wells returned to production sooner, and more jobs completed with out adding additional resources.

FINDINGS

After gathering the data for a period of time we faced the challenge of better understanding the basic assumptions about the wait times. After carefully looking at the data, the initial assumptions proved to be inaccurate. The most obvious error was in the category of trip times. Trip times, while not part of wait times, was believed to be a large portion of the inefficiency. The data did not support this. Trip times proved to be only a fraction of total time. Across rigs it was consistent, with only a 4% variation from rig to rig. To decrease the trip times was not seen as of as an option because to do so would carry inherent risks that were unacceptable for a small decrease of total time on job. Figure 8 shows a trip time report for BP IN SENM repair and maintenance jobs.

The next assumption, a shortage of goods and services, was also not as large a factor as anticipated. While goods and services availability clearly had an impact, it was also minimal. The largest impact was not necessarily an adequate number of approved vendors to provide these goods and services. The data suggested that given ample time through better planning of jobs in advance, our vendors and suppliers could and would respond in a timely manner.

The third assumption, the inability to plan for well-bore conditions also played a lesser part in total wait times. Better research and planning could allow the WSL's to set up equipment and services on a contingency basis and reduce wait times. While not all conditions can be foreseen, increased scrutiny of the well failure history and of the current failure symptoms allowed for a reduction in the delays related to planning.

One unanticipated aspect of this project was the emergence of the category of weather as a leading cause of wait times. Weather was not originally factored in as a major wait time, but weather delays to date have averaged 10%. In addition, using accurate monthly trends for weather related wait times should be able to give planners better foresight into costs associated with weather and of days delayed on average during certain months.

Planning also played a larger role than anticipated in total wait times, but has dropped significantly since the projects inception, due to increased focus and of increased awareness of the losses incurred.

FUTURE PLANS

Further analysis is needed to truly understand delays and wait times. With only three months of data, it is possible that trends could emerge that are yet to be discovered. The present plans are to go after the low hanging fruit found in the project to date. This has already begun by increasing the focus on better anticipatory planning methods, and by increasing awareness of actual wait time costs. As we decrease the total wait time percentage, different patterns will emerge.

In addition, increased focus by WSL's on cost control methods have had a secondary effect which appears to be a reduction of total job times on average. It is still premature to quantify, but looks promising.

There are preliminary plans to continue to reduce wait times, and when the controllable wait times are reduced to below 3% on average, we are planning to begin to explore the capability of Key View's Workbench tool. Workbench is a tool designed for process and task improvements. What this tool will do is assist us in recognizing the obstacles and being able to better prepare for them.
Workbench is broken down into four categories:

1. List of activities
2. Planned activity time
3. Actual activity time
4. Delta between planned and actual activity time.

During the planning process we can enter what we anticipate each activity should take. After the job is complete workbench will provide us with the time we planned for each activity, the time the activity actually took, and then give us the delta between them. We can then analyze the information to have a better understanding of what the obstacles are. This will give us better accuracy in planning our work based on data and not on assumptions. It is important to first go after the obvious and easily controlled indicators first before beginning to use the workbench toolset. Figure 9 is a screen shot of one of the workbench tools.

Upon completion of this four month beta project, the decision may be made to include five other rigs in the process to further increase rig efficiency across the asset.

In addition, KeyView has many other quality measurement aspects that will be further utilized, such as down-hole tool data, rod carding data, and make-up torque and quality. Some of the tools we are currently using, and plan to increase the use of are:

1. Procedures in setting and unsetting Downhole Tools
2. Rod Carding
3. Make-up quality on tubulars

Many safety features which include:

1. Hook Load Limiter
2. Crown Out/Floor Out Protection
3. H2S alarms

These features if properly utilized can play a large role in protecting our people and our equipment.

CONCLUSIONS AND FINDINGS

Quantifying rig delays has been difficult in the past. This methodology has provided BP in SENM with a better understanding of the root causes for rig wait times, and promises to produce even clearer results as it moves forward. Using the root cause approach, coupled with KeyView data, we have seen clear trends emerge around wait times. Not only have unexpected trends emerged, they have proven past assumptions to be less than accurate. Wait times have trended downward during the last phase of the project, and there is hope that this trend will continue due to heightened awareness of rig wait time costs, and due to better controls systems around wellwork planning and research. With the recent development of a method to use average costs per hour to calculate wait time costs, the project will allow us to build a better business case for methods to reduce wait time costs.

The next phase of the project may involve adding five more rigs to prove the project further, and may also include utilizing KeyView safety and quality features in a more in depth manner.

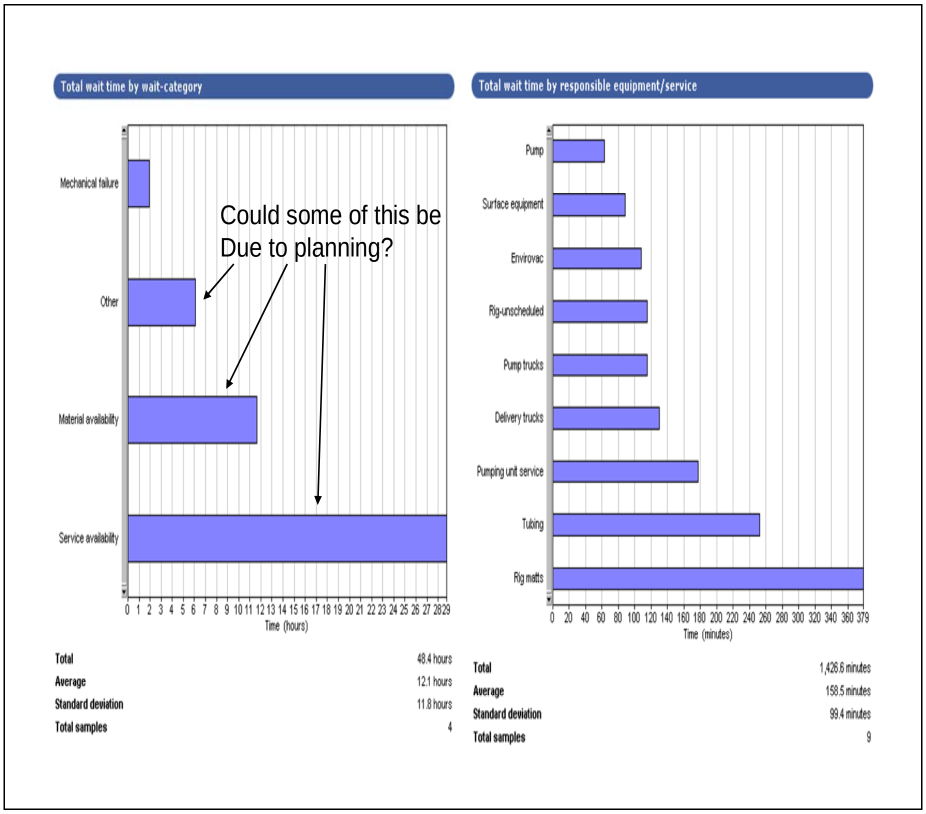

Figure 1

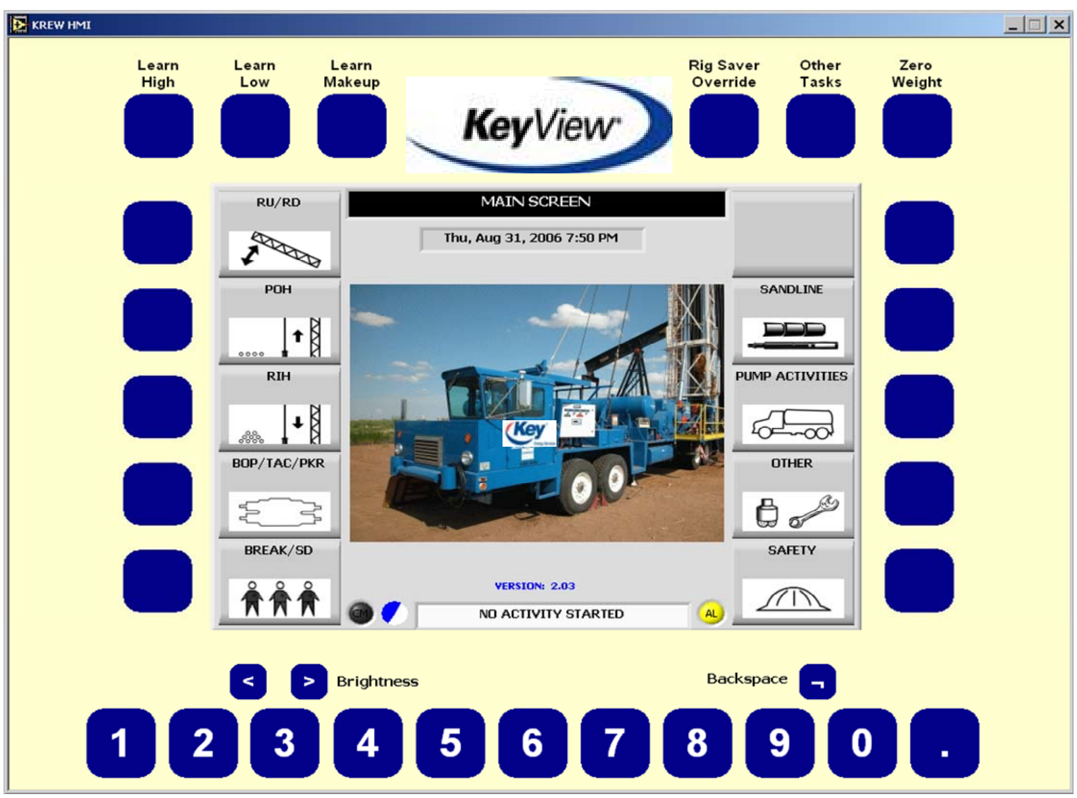

Figure 2

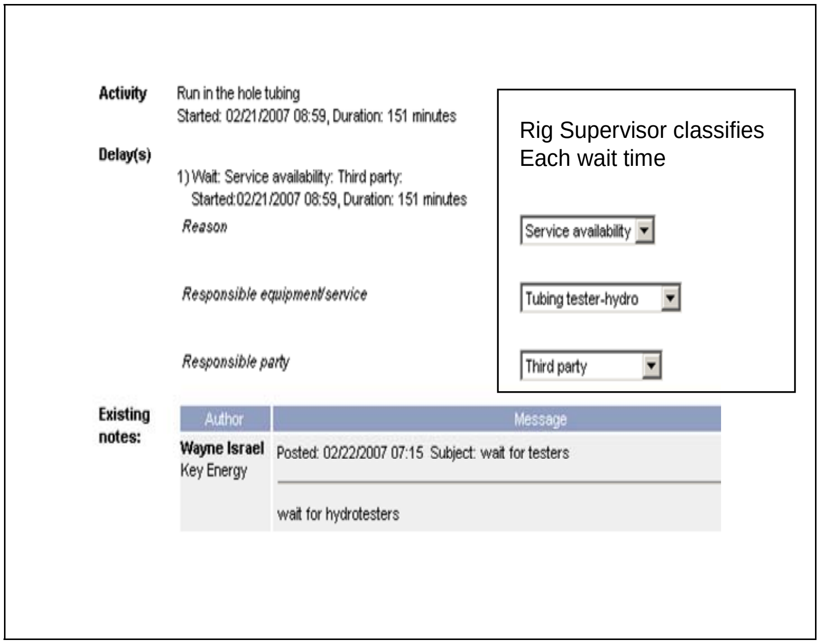

Figure 3

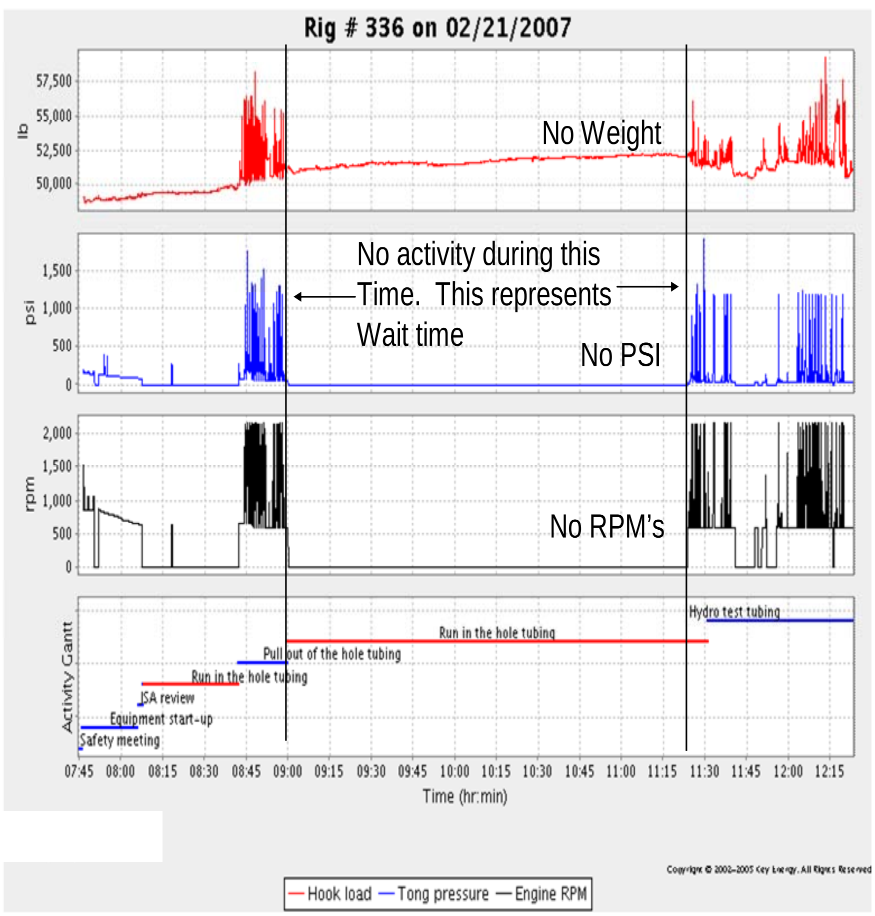

Figure 4

Posted: 02/20/2007 06:19 Subject: wait for orders
ACTIVITY : Road rig (02/19 08:16 To 02/19 09:25)

wait on orders — 40 Minute Wait Time

Posted: 02/20/2007 06:20 Subject: wind
ACTIVITY : Pull out of the hole rods (02/19 10:52 To 02/19 13:24)

shut down due to wind — 120 Minute Wait Time

Posted: 02/21/2007 06:50 Subject: wind
ACTIVITY : Pull out of the hole tubing (02/20 10:57 To 02/20 12:04)

wait for wind to die — 66 Minute Wait Time

Posted: 02/21/2007 06:50 Subject: wind
ACTIVITY : Equipment shut-down (02/20 13:44 To 02/20 16:00)

shut down due to wind — 134 Minute Wait Time

Posted: 02/22/2007 07:14 Subject: wait on testers
ACTIVITY : Run in the hole tubing (02/21 08:08 To 02/21 08:42)

wait for hydrotesters — 34 Minute Wait Time

Posted: 02/22/2007 07:15 Subject: wait for testers
ACTIVITY : Run in the hole tubing (02/21 08:59 To 02/21 11:31)

wait for hydrotesters — 151 Minute Wait Time

Figure 5

WAIT TIME REPORT-in minutes- SENM

Month	Nov-06	21-Dec	Jan-07	Feb-07	Rolling YTD Average
Total Jobs	3	8	16	7	10
SAFETY	**0.0%**	**1.1%**	**0.7%**	**0.0%**	**0.6%**
Risk Avoidance	0	498	243	0	247
Training	0	0	0	0	0
	0	**498**	243	0	**247**
WEATHER	**0.0%**	**7.6%**	**17.6%**	**5.1%**	**10.1%**
	0	3371	6146	1062	3526
	0	**3371**	**6146**	**1062**	**3526**
PLANNING	**4.6%**	**6.8%**	**9.5%**	**1.5%**	**6.0%**
Scheduling	0	1143	1077	189	803
Pre-planning	405	655	0	70	242
Planning	0	439	1933	63	812
Procedures	0	479	300	0	260
Holidays	0	300	0	0	100
	405	**3016**	**3310**	**322**	**2216**
EQUIPMENT DELAYS	**5.0%**	**3.8%**	**3.8%**	**1.1%**	**2.9%**
Rigs	0	83	441	0	175
Delivery Trucks	0	174	0	0	58
Forklifts	0	286	60	0	115
Tanks	0	0	0	0	0
Manlifts	0	0	13	0	4
Wireline	0	0	0	0	0
Packers	0	0	0	0	0
Acid	0	0	0	0	0
Hot Oilers	0	273	366	72	237
Bop's	0	0	0	88	29
Other Service & Equip.	434	875	451	68	465
	434	**1691**	**1331**	**228**	**1083**
SUPPLY DELAYS	**1.7%**	**0.1%**	**0.1%**	**0.0%**	**0.1%**
Tubulars	130	0	0	0	0
Rods	23	64	0	0	21
Pumps	0	0	0	0	0
Misc. Supplies	0	0	36	0	12
	153	**64**	**36**	**0**	**33**
TOTALS	**992**	**8640**	**11066**	**2364**	**7357**
Total Hours Wait Time	17	144.0	184.4	39.4	123
Rare #	331	1080.0	691.6	337.7	703
	0				
Total Job Time in Hours	146	736.91	580.97	349.10	556
Wait Time Percentage	11.3%	19.5%	31.7%	11.3%	**20.9%**

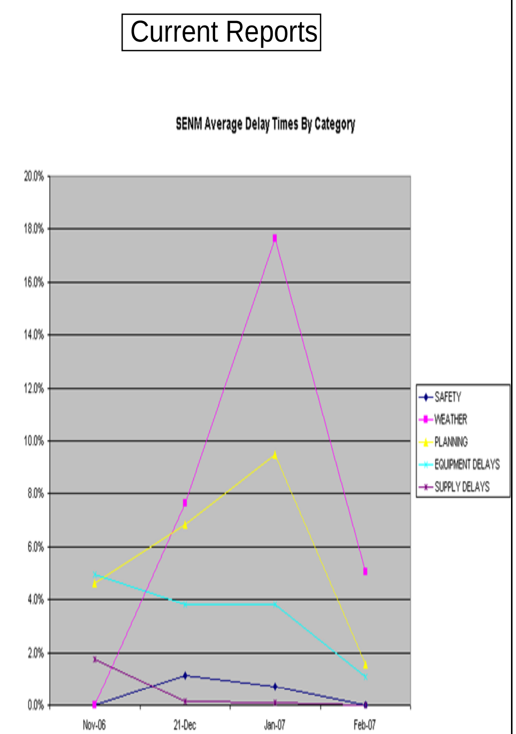

Figure 6

	0	**0**	**0**	**0**	**1143**	**1997**	**161**	**413**
PLANNING	**0.0%**	**8.0%**			**5.6%**	**5.8%**	**0.8%**	**2.8%**
Scheduling					109	263	46	**76**
Pre-planning		405			93	0	0	**118**
Planning					378	342	0	**206**
Procedures					131	0	0	**52**
					0	0		**0**
	0	**405**			**711**	**605**	**46**	**196**
EQUIPMENT DELAYS	**6.4%**	**0.0%**	**0.0%**	**2.8%**	**1.8%**	**8.9%**	**1.3%**	**4.4%**
Rigs				0	0	441	0	**126**
Delivery Trucks				0	0	0	0	**0**
Forklifts				0	168	0	0	**67**
Tanks				0	0	0	0	**0**
Manlifts				0	0	13	0	**5**
Wireline				0	0	0	0	**0**
Packers				0	0	0	0	**0**
Acid				0	0	0	0	**0**
Hot Oilers				0	0	366	72	**110**
Bop's				0	0	0	0	**0**
Other Service & Equip.	434			434	62	117	0	**113**
	434			**434**	**230**	**937**	**72**	**182**
SUPPLY DELAYS	**1.9%**			**1.0%**	**0.5%**	**0.3%**	**0.0%**	**0.8%**
Tubulars	130					0	0	**33**
Rods	0		23			0	0	**30**
Pumps						0	0	**0**
Misc. Supplies						36	0	**14**
	130	**0**	**23**			**36**	**0**	**22**
TOTALS	**564**	**405**	**23**	**992**	**2263**	**3575**	**279**	**827**
Total Hours Wait Time	9.4	6.8	0.4	16.5	37.7	59.6	4.7	**14**
Rare #	564.0	405.0	23.0	330.7	1131.5	510.7	93.0	**511**
Total Job Time in Hours	113.62	84.79	61.23	259.64	210.89	174.53	93.82	**84**
Wait Time Percentage	8.3%	8.0%	0.6%	6.4%	17.9%	34.1%	5.0%	**14.9%**

wallce:
waited on acid truck. Left enough time to complete job at initial planning phase, could not advance schedule to meet job.

wallce:
wait on foam air unit to circulate

wallce:
Wait for pony rods from local supply store.

Figure 7

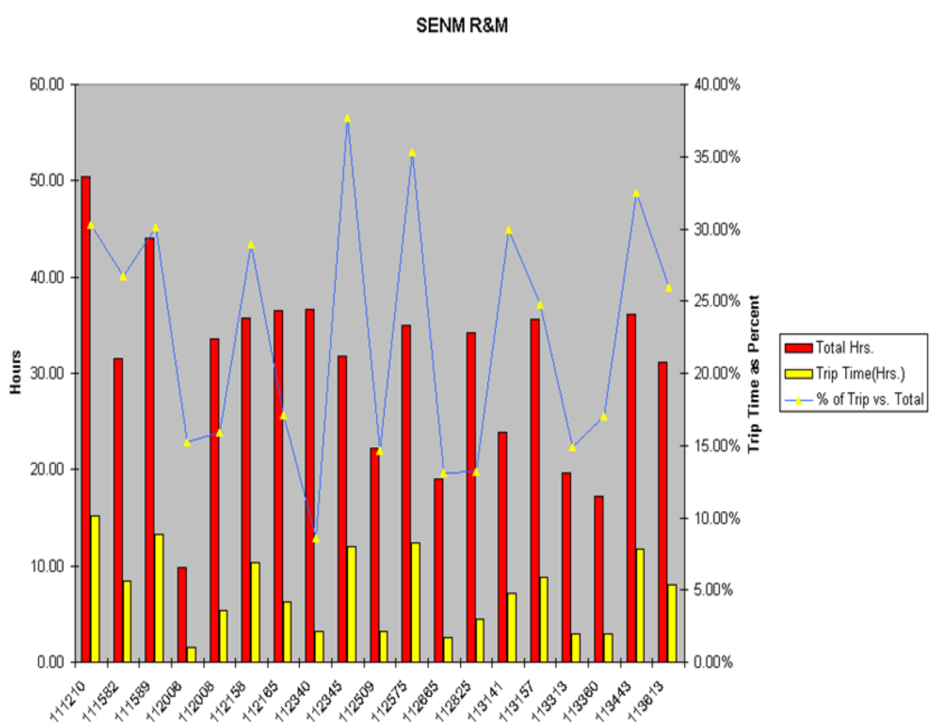

Figure 8

Job planning

	Planned (min.)	Actual (min.)	Delta
Total job time	0	1169	1169

Activity planning

	Planned (min.)	Actual (min.)	Delta
Bleed/ Flow Well		0	0
Cementing		0	0
Changeover tools		233	233
Circulate/ Kill Well		0	0
Cut Parraffin		0	0
Drill/Mill		0	0
Hot Oil		59	59
Hydro Test Tbg.		0	0
Locate casing leak		0	0
NU/ND/Test BOP		0	0
Non Trip Operations		167	167
Other Sandline Activites		33	33
POH/RIH Rods		180	180
POH/RIH Tbg.		0	0
POH/RIH co-rod		0	0
POH/RIH snubbing		0	0
POH/Scan Tbg.		0	0
POH/Strip		0	0
Pick Up or Lay down Rods		0	0
Pick Up or lay down Tubing		0	0
Pick Up or lay down casing		0	0
RU/RD 3rd Party		10	10
RU/RD Service Unit		69	69
Road Rig		37	37
Safety		127	127
Sand Bailer		0	0

Figure 9