



A Compelling Case for Intelligent Service Rigs

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Introduction

There are approximately 5000 well service rigs in North America generating in excess of \$4 billion in revenue annually. The vast majority of this equipment operates without any electronic capability to gather data and report on the efficiency, quality and safety of rig operations. Using data from rigs that are equipped with data capture systems, it can be estimated that producers pay over \$500 million in excess annual costs, due to service rig waiting time, re-work caused by substandard quality work on wells already serviced, and time and money lost to unnecessary safety incidents.

Over the past 20 years drilling rig contractors – often in concert with the producers with whom they work – have invested heavily in technology. As a result, today’s drilling rigs are not only much safer, they also work much more efficiently, allowing producers to save time and money in drilling operations.

By contrast, until recently the service rig arena has seen relatively little in the way of technological innovation. However, in the last three to four years, technology specifically aimed at service rigs has emerged which allows wellsite service contractors and producers to realize the same gains in well servicing they have seen in drilling.

The purpose of this White Paper is to demonstrate the potential for performance improvements with “intelligent” service rigs Using advanced data capture, distribution and analysis technology.

Background

A wellsite which is experiencing intervention from a service rig is a busy - and potentially hazardous- place. By its very nature, an intervention is an event any producer wants to minimize in duration. At the same time, producers are keenly interested in (1) ensuring that job quality is up to the required standards so that costly re-work does not occur, (2) that safety conditions and procedures are stringently applied so that work can be carried out without undue risk to personnel at the wellsite and (3) that the work is done as efficiently as possible.

However, despite the importance of safety, job quality and the need for work to be performed expeditiously, neither producers nor contractors – who generally are striving for the best possible results - have adequate tools to ensure that these three variables are optimized. Fortunately, the application of an intelligent rig system can transform almost any service rig into an intelligent rig.



Attributes of an intelligent rig (I-Rig)

An I-Rig consists of the following primary elements:

- 1) A sensor-based data acquisition system which can gather data and report on certain rig conditions
- 2) An electronic control capability closely associated with the data acquisition system which is capable of providing intelligent and high speed safety functions
- 3) A data communication capability which allows data to be sent expeditiously from the job site to a central location
- 4) A reporting capability which allows rig contractors and producers to derive certain critical information from the rig on a daily basis. The functions of communication and reporting are central to the concept of the I-Rig as without these capabilities critical measurements cannot be produced, analyzed and acted upon.

An approach to creating an intelligent rig which does not contain these four components will fall short of the ultimate goal of an intelligent rig: Providing the safest and lowest cost approach to managing well interventions for oil and gas producers.

Let's look at the functions of each of these elements and how they combine to produce safe and low cost interventions.

Data Acquisition: A service rig, which has traditionally been regarded as “dumb iron”, is in fact a valuable source of information for both producers and service contractors. Understanding what is occurring on the rig and when it is occurring is critical to producing safe and effective operations. An electronic data acquisition system, which monitors crucial rig activities like block position, hook load, engine rpm and potentially many other rig functions, provides the basic information building blocks required to produce meaningful data.

Data acquisition systems also provide an accountability aspect which is otherwise absent. For instance, in the event of an incident or accident, data logs will provide an accurate historical record of activities at the time of the incident. Where the block was at the time of an incident and exactly how much force was being exerted on the line are two examples of how data logs will allow rig operators and producers to gain a precise understanding of cause and effect in service rig incidents.

Electronic Controls: Coupled with information from the data acquisition system, an electronic control system provides a much higher level of safety and quality of operation than can be provided by humans. For example, an electronically controlled crown and floor saver which takes into account weight on hook and velocity is a much more effective accident prevention tool than the combination of experienced rig operator and mechanical crown trip sensor which is currently standard in the industry. Similarly, electronic monitoring and controlling of force on the main line is a much safer method of preventing overpull accidents – which can be both harmful and expensive – compared to relying on operator “feel” and an analog meter.

While initial intelligent rig system generally may rely on electronic safety controls, it is anticipated that future systems will utilize sophisticated machine controls to provide high quality operations (which are difficult to achieve manually). Using computers to provide appropriate torque measures to tubing and rods will provide highly reliable well infrastructure and promote maximum production from the well. Similarly, operations such as setting tubing anchors to API and manufacturer specifications can be accomplished much more reliably using automated controls compared to relying on the diligence and expertise of rig crew personnel.

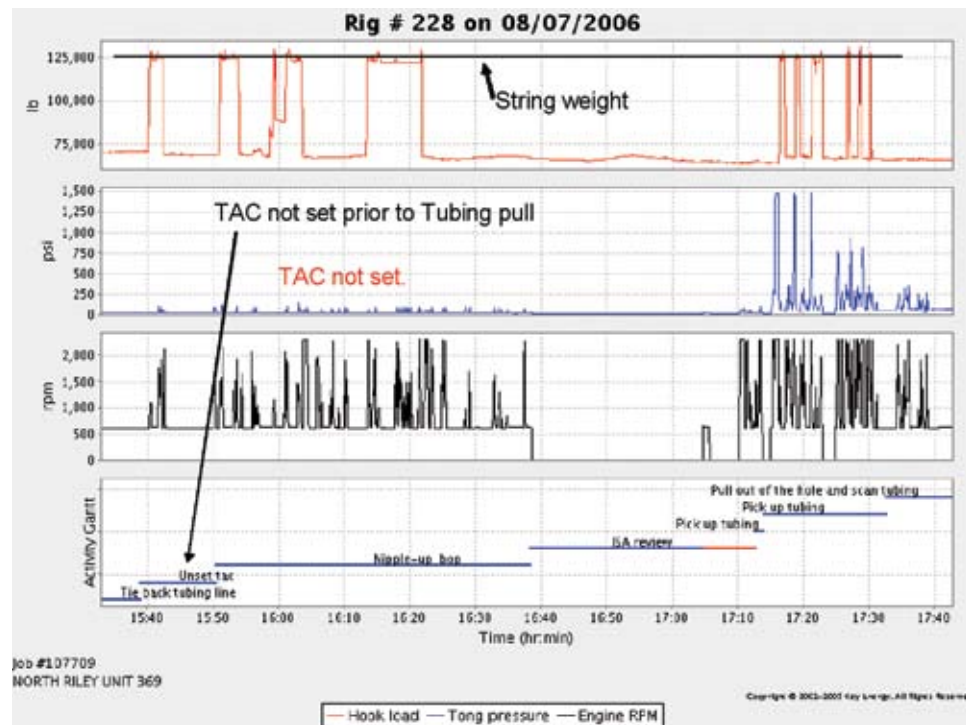


Communication: While information gathered on a service rig has some utility at the local level, the maximum benefit can only be gained by transmitting it to a central database where it is available for analysis and reporting.

The system on the rig needs, therefore, the ability to communicate data in near-real time, typically to an internet hub or database in a central location. Communication would typically occur over satellite and cell phone. Because service rigs are frequently in locations where real-time communication is difficult, periodic communications – by default (hourly, or daily, are commonly the standard. In normal situations, real-time access to information is not required, but same day or next day access is valuable to analyze rig performance or collect work ticket information. The sooner information of this type is received, the better for project management and billing operations.

Reporting: Reporting is where the I-Rig's capabilities of data acquisition, control and communication come together to present real value to stakeholders. It is a basic tenet of quality management that what is not being measured cannot be improved. Similarly, data gathered in measurement activities must be organized and reported so that performance baselines can be established. Once performance baselines have been established, continued use of the data and reports will assist stakeholders – crews, contractors and producers – in continuously improving performance in the areas of safety, quality and efficiency.

Reports can take various forms and can be high level (e.g.a wait time report) or detailed (a report analyzing engine rpm and string weight against a specific activity like setting tubing anchors).





Or, as in report xb, summary information can be provided to produce an overall scorecard on rig crew effectiveness. Such information can be used by the crew to assess their own performance and strive for constant improvement.

Operator Report

<i>Start Date:</i> 8/1/2007		<i>End Date:</i> 9/13/2007		<i>Report Date:</i> 9/13/2007	
<i>Rig:</i> 0000163		<i>Grade:</i> 98.20%		<i>164 Correct of 167 Total Opportunities</i>	
<i>Type</i>	<i>Correct</i>	<i>Incorrect</i>	<i>Opportunities</i>	<i>Grade</i>	
COFO (S)	23		23	100%	Safety (S) 100%
Hook Load Limiter (S)	23		23	100%	Job Quality (J) 88%
Engine Kills (S)	14		14	100%	Data Quality (D) 96%
Trip Speed (S)	23		23	100%	
Tie Back (S)	8		8	100%	
Tubing Make-up (J)	8		8	100%	
TAC Set (J)	4		4	100%	
Rod Carding (J)	5	2	7	71%	
End of Day (D)	24		24	100%	
End of Job (D)	8		8	100%	
Activity Selection (D)	24	1	25	96%	

Measuring and improving safety

It almost goes without saying that safety is a matter of paramount concern to producers, rig contractors and the crews who work on the rigs. An intelligent rig has electronic safety features which make the rig substantially safer than a conventional rig.

- 1) Electronic Crown Out Floor Out Preventer
- 2) Hook load alarming and limiting
- 3) Sand line speed and depth monitoring
- 4) Automated BOP testing
- 5) Tank level monitoring
- 6) H2S, LEL

Job Quality

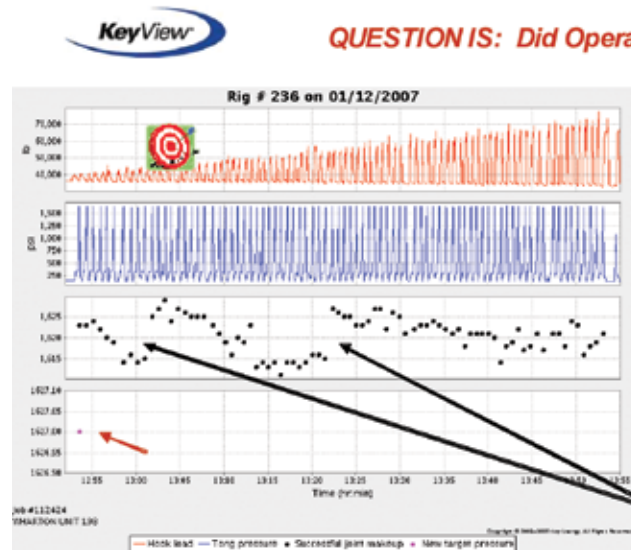
One of the primary considerations in reducing the need for well intervention is the quality of work performed by the crew. Consistent quality repair work performed at required levels will substantially reduce the incidence of unexpected and unwanted events occurring subsequent to the service operation.

Rig crews generally strive to provide the highest possible quality of work. However, without the benefit of electronic measurement and monitoring of work quality, it is very difficult to be sure that critical functions like the application of torque for rod and tube makeup, correct setting of tubing anchors, appropriate trip speeds and many other functions are being performed according to



Standard Operating Procedures. The service rig industry is one of the very few industries remaining in North America where critical work goes on without the assistance of computerized measurement to verify quality standards and assist with the ability to make continuous improvements.

Through active controls and data acquisition, an I-Rig provides guidance, alarms and reporting to allow rig crews, rig contractors and producers to be confident that the work being performed will meet stringent quality requirements.



QUESTION IS: Did Operator.....

...Apply Uniform Torque to all the Pipe as he Ran Into the Hole with Tubing?

KeyView is a tool, that when properly used assures the customer that the job was completed with the utmost precision and uniformity.

Note the twice upward shift in the joint makeup values. This is where the rig hydraulic system is heating up and can no longer hit the target. The operator adjusts his pressure upward to compensate for this heat.

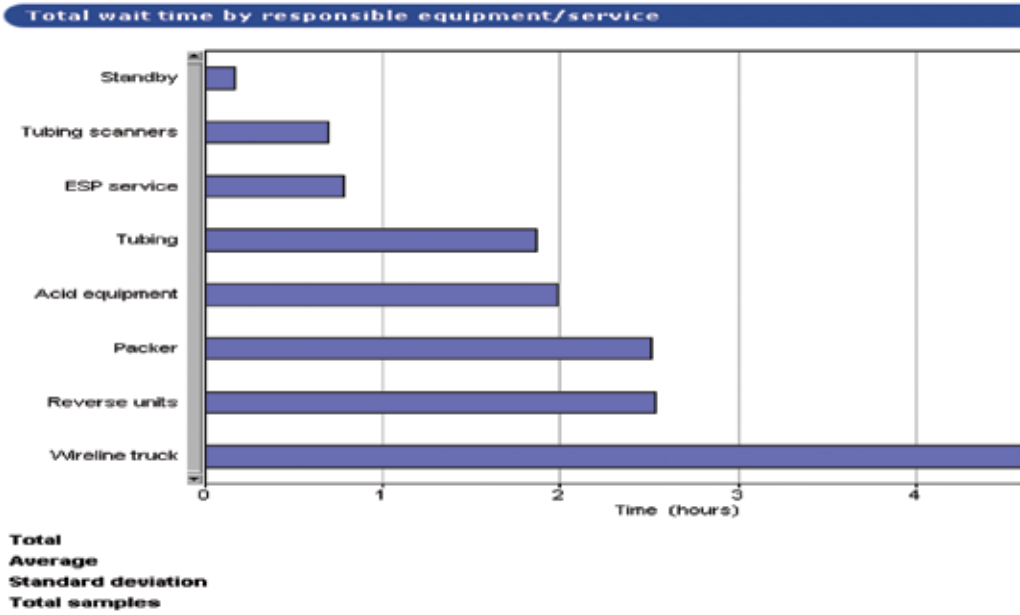
The answer to the question is **Yes**: As the tongs stall and the relief valve bypasses the fluid, heat is generated which causes the hydraulic system to become less efficient. When the operator no longer hears the go horn, he adjusts his pressure upwards to get his stall pressure back within a 5% range.

In the above sample, an I-Rig generated report shows the rig operator properly adjusted hook load and tong pressure in order to ensure proper tubing makeup. The I-Rig data capture and reporting system allows the rig crews, the contracting company and the producers to have access to quality data which demonstrates that a proper job was or was not done. In instances where work performed is not up to expected standards, these reports become an invaluable tool in helping rig crews to work towards the desired standards of performance.

Efficiency

Optimizing rig and crew time on the lease and during moves has the potential to have a major impact on well intervention costs. For instance, data gathered by existing I-Rigs demonstrates that approximately 10% of all service rig time on a lease is spent waiting, that is to say, being unproductive. With total service rig revenue in North America exceeding \$4 billion the cost to producers, including payments made to rig contractors, direct expenses for consultants and other as well as lost production, the annual cost to producers for this waiting time is easily in excess of \$500 million annually.

I-Rigs capture waiting time and categorize it. The information derived from the data allows contractors and producers to analyze waiting time, determine root causes and systematically eliminate it.



Summary:

I-Rigs present an unprecedented opportunity for oil and gas producers to use information to control and reduce well intervention costs, leading directly to higher production. Several leading rig contractors are currently investing in I-Rig technology. For more information on I-Rigs and where to find an I-Rig certified contractor, visit I-Rig.com.