SPE Paper Number 70002

A Web-Based System to Link Asset Tracking to Performance Improvements in Oilfield Operations

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This paper was prepared for presentation at the SPE Permian Basin Oil and Gas Recovery Conference held in Midland, Texas, 15–16 May 2001.

Abstract

Many oilfield service companies as well as oil producers have manually tracked assets over the years for a variety of reasons. The service companies have tracked assets such as pumps, packers, or other products to assist in R&D efforts. Being able to collect the data and compile statistics on run times and component failures enables the service companies to evolve and improve current products as well as design new products. From a producers perspective, compiling the same or similar data allows for the development of "best practices" in operating procedures and processes. Software products developed to address these needs have evolved with time to provide more functionality. However, many systems implemented to handle the total process of data acquisition, warehousing, querying, and reporting to achieve improved operating results have become more difficult and expensive to support than the value added.

The value of the information has not diminished, but increased due to the fluctuations in oil prices and the continuing efforts to reduce lifting costs through design and process enhancements. The recent development of a web based tracking system incorporates workover management, downhole equipment, and chemical usage while enabling the operator and service provider the ability to easily enter and access the data. The system reduces the problems of database synchronization, multiple entries of the same data, and provides a common means through the Internet to interface with the information. The system links the operator in the field, the service company providing equipment or chemicals, and the district office together through a common database that each has access to.

The system allows a technician in a pump shop, workover foreman in the field, or chemical sales person to easily enter data into the system using a laptop computer or touch screen technology. The data is brought back to the service provider's local office and is accessible to the operator through the Internet. Wells, well equipment, and equipment components can be tracked for run life and root cause of failure. The operation becomes an information network that uses the same data to accomplish different tasks but with a common objective of reduced costs and improved profitability.

Introduction

Service Providers. In the oilfield service sector, the larger service companies began internally tracking their own equipment failures many years ago. Until recently, the service industry's perspective on failure analysis has been much different than that of the producer. By evaluating and categorizing failures, new products can be designed to fill niches or actions can be taken to improve the product over the competition. If a service provider did not have a process improvement cycle in place or a way to continuously improve the current line of products offered, they could fail both competitively and financially.

Over the years, manual tracking and reporting systems were put in place that involved the field service technician, equipment maintenance personnel at the warehouse, warehouse clerk, and local technical engineer or manager (Figure 1). Because of all the "handling" of data from the time a failure occurs until the root cause is determined, the probability of incorrect data resulting from human error becomes extremely high. Each person in the process could potentially enter bad or erroneous data into the system, thereby nullifying or reducing the value in the desired result. In addition, the lag time between the failure occurrence and the reporting cycle producing client reports is generally a month or more. If mistakes are made during this process and are discovered in the reports a month later, some data may be lost forever. Only by acquiring large amounts of data, and having a conscientious attention to detail by all persons involved in the process, can the statistical probability for correct interpretation of the data become more accurate.

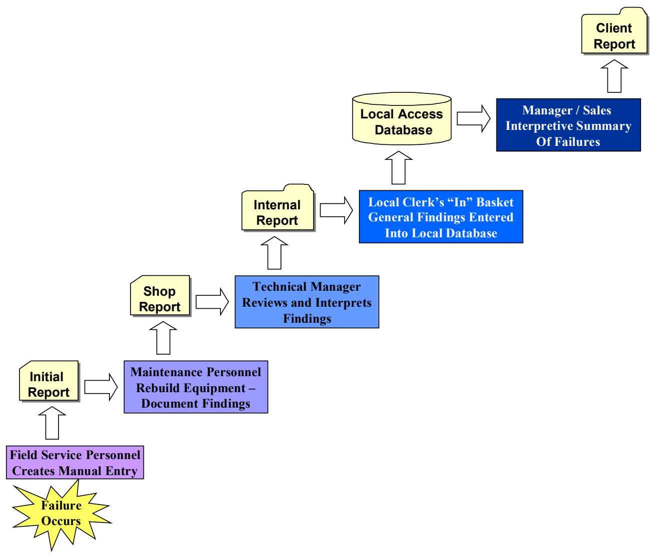

Figure 1 – An example of the typical failure tracking process in a service organization.

For many years it was also not uncommon for service providers to not inform the producer, or client, about any products which failed to perform as well as might be expected in any particular application. This lack of complete information created an air of suspicion and distrust between service provider and producer that exists to some degree even today. Prior to 1990, failing to meet client expectations, regardless of the reason, meant some form of financial compensation to be paid to the producer from the service provider. This type of relationship creates a "no-win" situation for both parties. Cover up, denial of responsibility, and negotiating service credits was quite common and benefited no one. Incorrect diagnosis of failures created misleading conclusions that in turn fostered a "no problem no solution needed" perception. Similar failures reoccurred and money was wasted repeatedly.

Failures often occur because of technical ignorance or misapplication of a technology or product. In many instances, the failures are a direct result of a poor process or procedure on the part of the producer. It is not uncommon for the producer to hold the service provider totally accountable for the failure regardless of the reason. Since the service provider has no access to the data from the producer, there is little that can be done to defend the product. A root cause analysis is often implemented in an abbreviated form with neither service provider nor producer having all the details necessary to come to the correct diagnosis of a failure and, therefore, a proper solution to the problem.

Producers. Oil producers began tracking failures primarily in artificial lift operations more that thirty years ago to help reduce downtime and, thereby, improve production. As time went on, failure tracking evolved so that in addition to reducing operating costs, producers could identify "problem wells" and poor hardware solutions as well. Much of the data needed was manually collected, compiled, and analyzed. Due to the large number of people employed in the industry at that time and the availability of computing technology for this kind of data collection, the quantity and quality of the data was lacking. The cost in man-hours to collect the data was enormous and the ability to analyze the data was extremely limited. The field operator's commitment to gathering the necessary data waned because of the effort involved versus the benefit.

As computing technology advanced, the first true electronic failure tracking systems built on mainframe computers were introduced. The UNIX operating system was quite common since it had computing and processing capabilities needed to work with large quantities of data and was the system of choice for use in geophysical and geological workstations. Having such a system was expensive to build and support so implementation typically occurred only in high producing fields where the cost was justifiable. In addition, it was the major producers who could afford implementing a system and first recognized the value of asset and failure tracking.

With the advent of personal computers, most production engineers that only dreamed of having "paperless" well files could now see the new emerging technologies as a means to realize these dreams and, in turn, increase operational efficiencies. As many soon learned, building a "homegrown" solution was more of an undertaking than anticipated. Maintaining the database and continuously adding more functionality became a job unto itself. The industry began developing an insatiable appetite for data and many lost site of the goal that the data was supposed to help achieve. To complicate matters worse, many companies found themselves with hundreds of disparate systems trying to accomplish similar tasks that were not only written in different programs and formats, but on different operating systems as well.

Realizing this, many companies formed teams to develop data management strategies and incorporated asset tracking and failure analysis as part of these strategies. Many have accomplished this goal but have become slaves to the systems they built. With reductions in personnel, buyouts and re-organizations in recent years, a multitude of new internal problems have been created. Once again, the task of merging databases and standardizing on reporting formats becomes an issue. Although not insurmountable, the amount of internal resources required to do all this can be staggering.

Traditional Data Management Issues

As previously stated, many oil and gas producers as well as service companies already have asset and failure tracking systems in place. More focus is being placed on service providers to become larger players of the support team. To do this requires the service provider to embrace the technological tools, such as the web, to help improve the overall efficiency of the field operation. There are several traditional data management issues that must be addressed to have a viable system. Those issues are the data processing mechanics, system support, and system usability.

Data Processing Mechanics. The mechanics of the data process involve asking "who", "where" and "how" for all levels of data handling. This includes data entry, storage, retrieval and security. Data entry must be as simple as possible. The easier and less time consuming the process of entry becomes, the more likely of having a quantity of quality data being entered. Knowing what data to store, the frequency of collection, and the "data aging" scheme is important as well. Understanding the requirements of the different applications of the data determine this criteria. The person entering the data is not the only person who must later retrieve it. Therefore, data must be formatted such that it is easily queried into different presentations based upon a user's needs. In addition to everything already mentioned, the concept of security levels must also be integrated into the process.

System Support. One of the challenges that has been created in the industry over the past few years has been how to maintain the value and integrity of these systems with the continuous reduction in human resources. Systems have been built on different platforms and with different priorities in functionality. As time progresses many of the employees dedicated to maintaining these systems have disappeared. Without that level of support, the systems will eventually break down or become obsolete.

In addition, the evolution of the technology of computing technology by non-oilfield companies is advancing at an incredible rate. Ten years ago, the Internet was virtually unheard of, personal computers had very slow processing speeds as well as insufficient CPU memory, and asset and failure data was collected sporadically. What enabling technologies will evolve over the next ten years to further enhance process improvement? This unknown must be taken into account in any processor-based system including asset and failure tracking. These issues are historically viewed as system support and maintenance issues. Although any software designed as the graphic interface with the user may not need to be changed, such things as operating system software which comes from the public domain is constantly changing. Resources must be dedicated to keep the system running. If not accounted for, the cost of maintaining a system or replacing it could be substantial.

System Usability. The third issue in having a viable system is the ability to provide information to a diverse number of users with a diverse set of computer skill sets. Historically, this has been a limiting factor for many systems. Field personnel may lack the computer skills and comfort factor of using a computer based system. The quality of data needed for a number of diverse users may also become diluted due to limitations of data storage. The more users of the data, regardless of the application, the more benefit will be derived from the system. To maximize the number of users of a system requires a certain level of comfort with the interfaces and an ease of "data mining". Intimidating systems that are difficult to use by the average oilfield operator or service technician will undoubtedly not realize their fullest potential.

A Web Based System Facilitates Building a "Knowledge Base"

The advent of the World Wide Web or Internet is truly an enabling technology that has opened up countless opportunities to share knowledge throughout the world. One of the biggest opportunities for web technology in oil and gas production operations is the ability to link many different users, who may be separated geographically, to the same data and to be able to gain valuable insight from that data. A schematic showing the general structure of a system designed to do that is shown in Figure 2. Because there are fewer people in the industry today and a lot of expertise has been lost over the years, it is more important than ever to be able to capture that knowledge in some form that can later be extracted and understood by anyone reviewing it. This includes both service personnel and oil and gas production personnel.

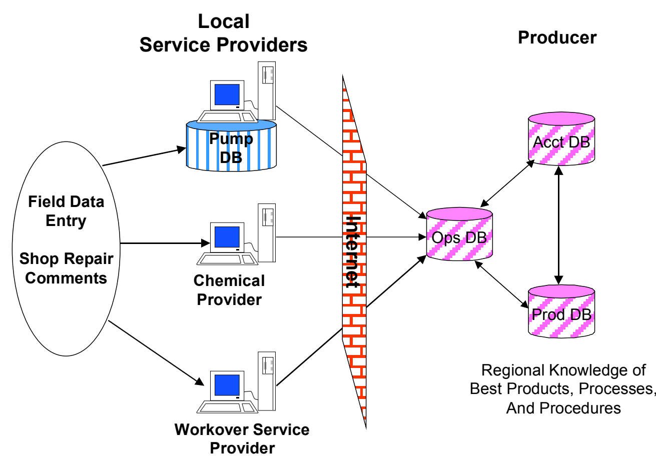

Figure 2 – A general schematic showing a system between the service providers and the producer where regional knowledge is gained.

Now, with different people looking at the same data from both supplier and user perspectives, there is a better opportunity to derive a more thorough understanding of failures, why they occur and then to use that information to build a knowledge base. Having a more thorough understanding of a failure allows the development of a better solution that may involve a better product, procedure, and / or process. This was the basis for creating a web-enabled asset tracking system for oilfield production operations that is capable of linking data between service providers and producers.

The system described in this paper uses technology that allows the application user interface to be hosted inside of Microsoft Internet Explorer. A "client heavy" technology is utilized that allows the power of the local computer (laptop or desktop) to augment processing. Data and requests are shuttled across the Internet, allowing the user to view the most current data, make changes or additions, and save it. Upon saving, the data is committed to a server across the Internet. The database residing on the server side can be Microsoft SQL Server, Oracle, or another compliant database. The data passed to the different components is in XML format, which allows software components to be swapped in and out and provides a way to integrate third party software products.

The system allows other database systems already in place such as those used for production accounting, financial tracking, and inventory control to be integrated, allowing reports and graphs from the different systems be displayed within the same program. Whether or not the databases are integrated, it has the appearance of integration, at least from the user's perspective.

The traditional data management issues mentioned before must still be addressed for a system to provide any value. How those same data management issues are addressed in this system are discussed in more detail below.

Data Processing Mechanics. The mechanics of the data process in the web-based system involve the same components as any system: data entry, storage, retrieval and security. The data can be entered from several locations depending on the service provider or producer's requirements. The best place to enter data is at the field level where the failure actually occurs. A field foreman or service provider's field personnel can enter the data into the system on a laptop. Depending on the connection capability, data may be stored on the laptop. If the laptop is capable of a cellular or satellite connection to the Internet, data can be shuttled across as it is being entered. If a connection is not possible or is broken, data will reside on the laptop. As a connection becomes available (this can be set up to occur automatically), the data is then uploaded and synchronized to the server across the Internet.

Validation of data occurs both on the client and the server end. In this way, errors are caught as the user enters the data, not after it has been sent to the server. This is very important if the connection is severed to the server.

The graphical user interface may look different for different types of users. For instance, a workover service provider may have an interface with a grid of equipment he is placing downhole with a diagram beside it. A chemical service vendor may have a calendar with the wells that must be treated for that day. A pump service vendor may have a touch screen, similar to those used in restaurants, sitting next to the teardown bench. He can simply touch the parts in an exploded diagram to indicate that a particular component failed. The data behind these different front ends is melded together into a consistent reporting system that can be shared by all.

Chemical service, workover service providers, and pump vendors may use this information to import into their accounting system to avoid double data entry. This not only saves time, but improves consistency of the data. Producers can review costs before the end of the month. With electronic billing as a part of an integrated process, the service providers could benefit from quicker turnaround time on invoices

Although there are many combinations possible, one way this system could be configured is shown below in Figure 3.

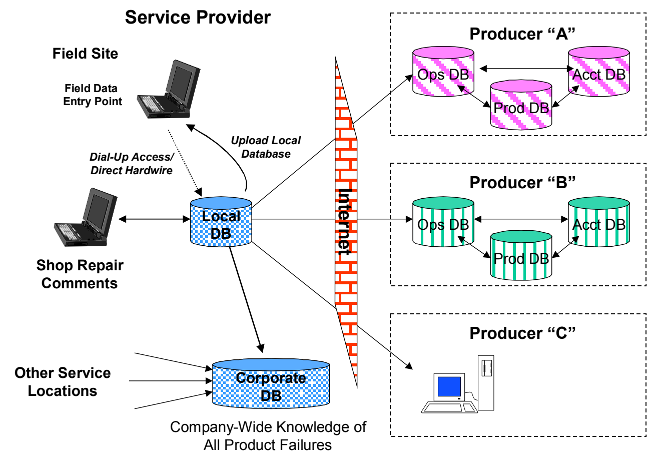

Figure 3 – One of several possible system configurations showing the sharing of data between a service provider and different producers with different infrastructure requirements.

System Support. The system described in this paper is commercially available. Purchasing a commercial product rather than developing a unique in-house solution greatly reduces the costs associated with support for the system. There are several advantages, in terms of support, to having a system that is "off the shelf". All product support, bug fixes, and upgrades become the responsibility of the third party system provider rather than internal staff. For a third party system provider to remain competitive, new functionality must be aggressively added to meet the demands of the market, which is in this case, the user. The cost of development for the system is further reduced by the cost being bore by many users, not just one company. And, perhaps most importantly, the fast paced changes in computing technology and the underlying operating system become the responsibility of the system provider as well.

System Usability. The system uses a standard interface with a common "look and feel" with user customizable reports. The interface has drop down screens, dialog boxes, and buttons that are common to anyone who uses a PC today. Since there are multiple users with different presentation needs, the reports and graphical summaries are user configurable. Within seconds a new view on a pane can be made. An example of the interface is shown in Figure 4.

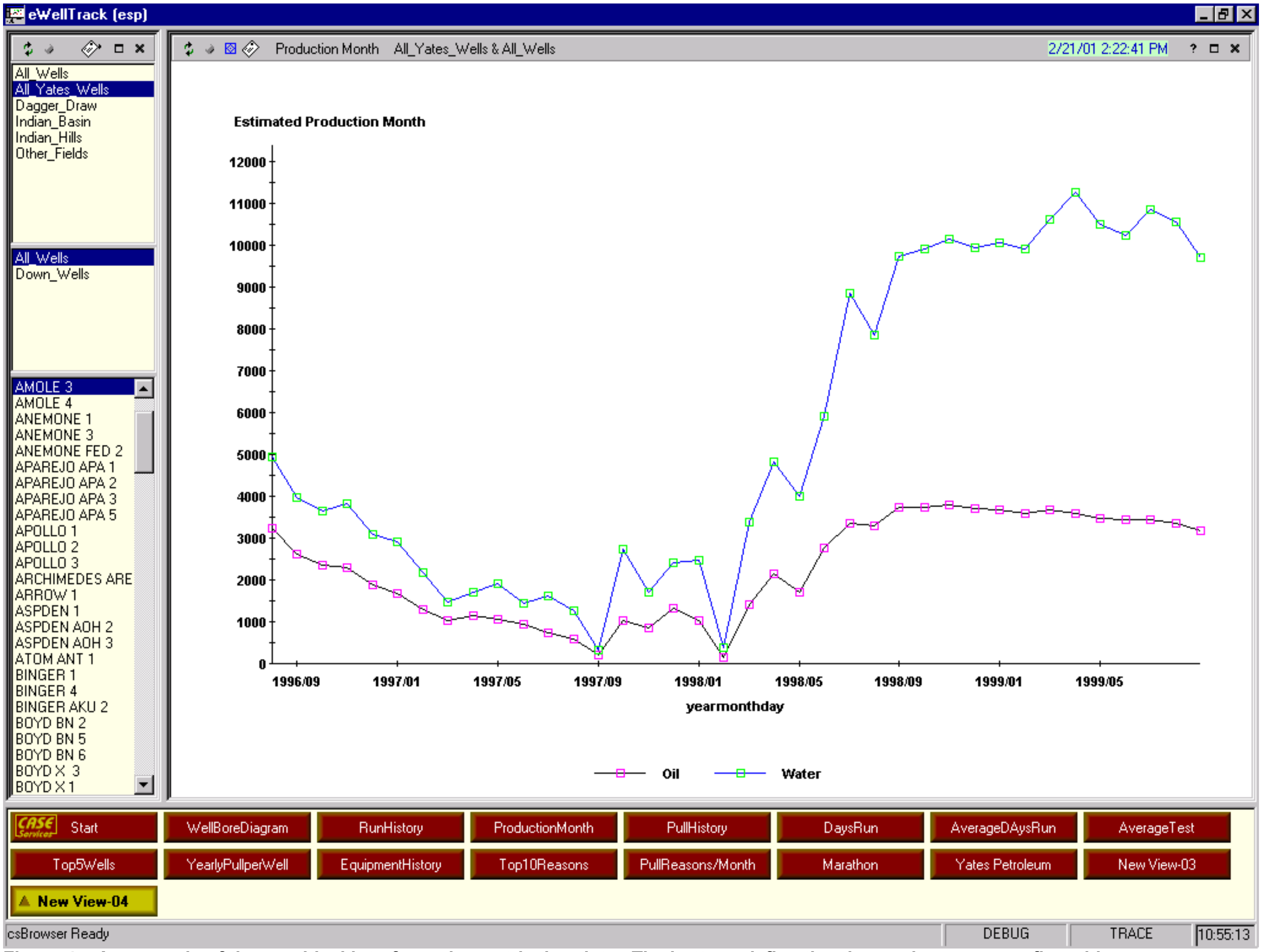

Figure 4 – An example of the graphical interface when retrieving data. The buttons define the view and are user configurable.

Application of the Technology

As with most things, there are at least two sides to every story. Applying web-based technology to the tracking of oilfield failures is no different. Although there is a common ground in failure tracking, service providers and producers each have different perspectives on what that information means in terms of better managing each one's own business. Some examples of this are listed below.

1) By sharing information through common databases with multiple producers, a service provider can recommend the best product for any application.

2) By sharing information through common databases with multiple service providers, an operator for any given field can see which service provider is supplying the best solution and value to fit that field's needs.

3) By recognizing the best procedures to follow for specific products, a service provider can share that knowledge with other producers to improve industry-wide production performance.

4) Recognizing "best fit" products and procedures within any field an operator can reduce the number of failures and, therefore, the number of workovers and associated costs.

5) Understanding the limits of a product's application will help provide direction for the service provider in developing enhancements or new products to better fit the application.

6) Understanding the limits of a product will allow the producer to better manage the risks associated with that product.

An example showing a "data relationship" between service provider and producer can be seen below. In Figure 5, the number of workovers performed is graphed showing good results. The number of workovers is declining over time, leading one to believe that improvements were being made. This data is stored on the producer's computer and may have been extracted from inputs made by the workover company or the producer. If the reason for fewer failures is because of a better pump or of a "special" process being done to the pumps, that information could benefit both service provider and producer, if shared. However, the reason for the reduction in failures is inconclusive with just this information.

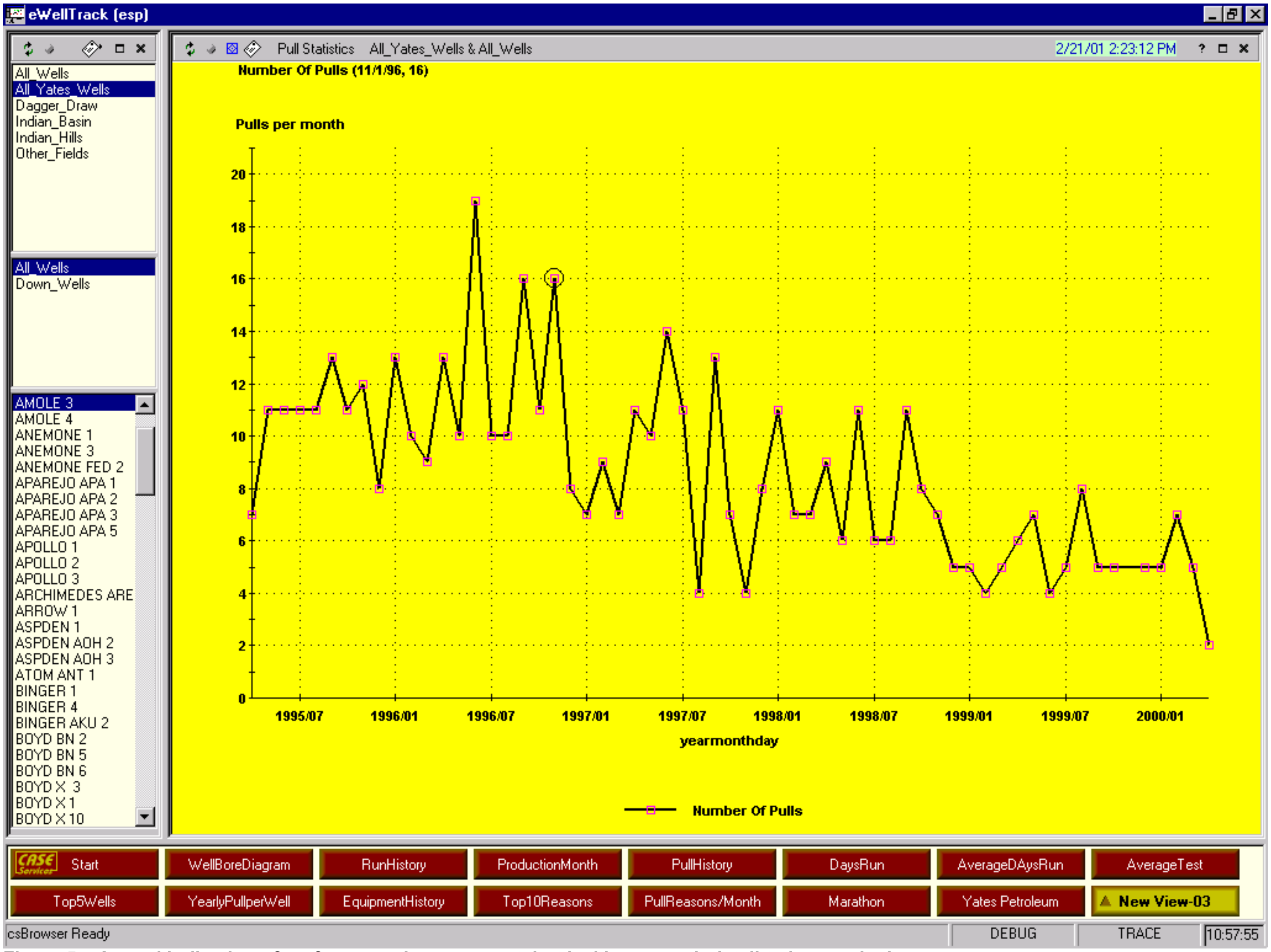

Figure 5 – A good indication of performance improvement, but lacking enough detail to be conclusive.

The next screen in Figure 6 shows a more detailed failure report by assembly and manufacturer. Included in this report are the previous run days for each part. If a service provider reviewed this information and observed consecutive increased run days for a failed part, they would realize that whatever was done to those parts showing increased run time was beneficial. The converse is true also. If parts were showing a decrease in run days, then those could be targeted for R&D revisions or review for a new design. Although the producer may be interested in knowing what company to use for the best results, the service provider can use this same data to help determine what is the weak link in their equipment or if a misapplication of the product is occurring. Both parties benefit from this information.

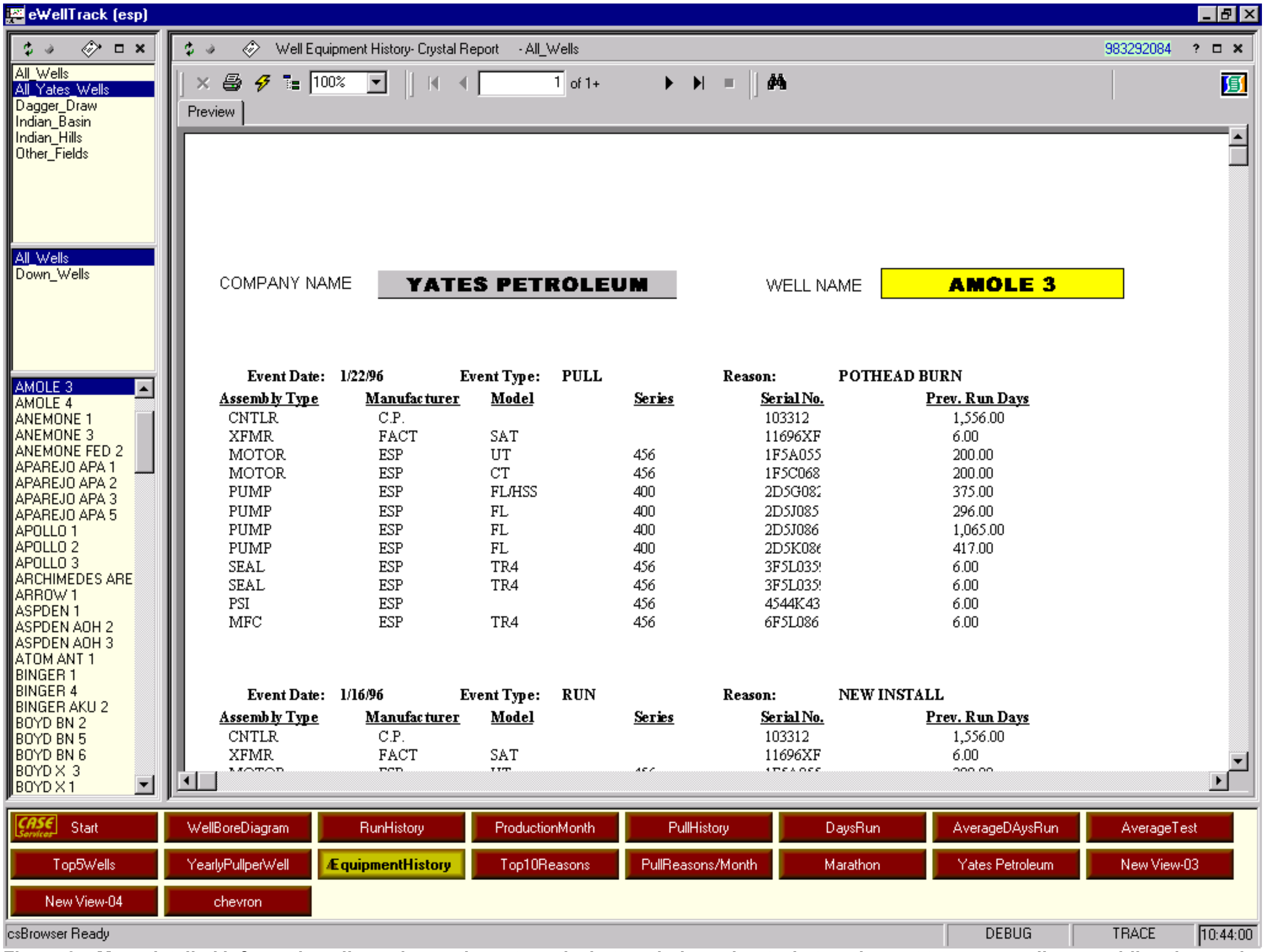

Figure 6 – More detailed information allows the producer to make better choices about what equipment to use as well as providing the service company with where to improve on their product.

Conclusions

Having a "third party" web-based asset tracking system that links service providers and producers improves product performance and, in turn, improves production performance. Because of web technology and the systems that are available today, more people can benefit from asset and failure data within an organization or between organizations. With a tracking system being "off the shelf", the high maintenance and support costs which typically hinder internal systems are greatly reduced.

For the service provider, having access to more complete data in terms of processes and procedures, means having a better understanding of applications of current products and a better direction for product development. Operating in this competitive manner will encourage service providers to focus on providing better technical solutions. In addition, by having this knowledge, the service provider will become a source of information and experience to small independents allowing them to become more efficient to better withstand the fluctuations in oil and gas prices.

Producers can more quickly and easily make better decisions comparing equipment, processes, and procedures across their entire field operations. Better, faster decisions lead to less downtime and ultimately less costs. In larger companies, comparison of fields or different organizational units can be done regularly to determine the best combination of equipment, processes, and procedures in managing the total asset. What used to be internal and sometimes fragmented information is now capable of becoming industry wide knowledge

Acknowledgements

The authors acknowledge Mickey Thompson for his input and constructive comments in writing this paper. We thank Yates Petroleum for allowing us to use their field data and the management of Case Services for their support.

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