WHITE PAPER

Mud Reporting:
Streamlined Process and Data Management
I. Challenges

It is a fact that mud engineers used paper forms to record mud properties every morning. With the introduction of Microsoft Excel®, people began to take advantage of electronic filing systems. This greatly enhanced the reporting quality and filing.

However, the part critically missing with this approach is the organization of numeric daily reports and the generation of end-of-well recaps, not to mention the well comparison, which requires obtaining records of numerous drilling activities, of different periods of time, of multiple wells in various geographical areas.

Trying to overcome the limitations of Microsoft Excel® spreadsheets, others have developed simple mud reporting softwares. Unfortunately, these efforts often fall short in the following areas:

• Repeated data input
• Lack of graphs
• Report transmit
• Report management
• End-of-well recap
• Well comparison
• Data archiving
• Continuation of support and upgrade

II. New Approach

The modern approach of mud reporting is to use a software with an advanced database backbone to perform solids analysis, hydraulics calculations, to keep track of all inventory and cost and to quickly generate an overall view of the cost. By looking at the end-of-well recap, mud engineers and company men can easily identify the most costly drilling intervals and make the necessary modifications on the mud program for the next well. As this new technology evolves – it has great benefits of presenting much more meaningful details to both mud and oil companies.

As part of the ongoing efforts to overcome the challenges and to meet the ever-changing requirements of the drilling mud industry, Pegasus Vertex, Inc. and Anchor Drilling Fluids worked together to develop MUDPRO, a drilling mud reporting software. Since its release in 2009, many mud engineers have been using it on daily basis.
III. Basic Function

The software is designed for both mud engineers at the rig sites and the company men in the office. The main function is for mud engineers to record the mud data and generate daily reports. It can also be used by company men for reviewing and managing data, making an end-of-well recap and comparing data between multiple wells.

The software contains many engineering calculations, such as solids analysis, bit optimization, wellbore hydraulics, additive concentration, mud volume, etc. It replaces hand calculations and provides more accurate results. With the input mud properties and hydraulics results, mud engineers will be able to see if the drilling hydraulics is effective. The rheology results and the additive concentration give mud engineers a clear idea if the mud is in good condition. The mud volume calculation shows the exact volume for each section of the hole and the pits volume, and storage volume as well, so mud engineers can be aware of how much mud is required or lost. Solids analysis can work with water-based, oil-based and synthetic based mud. In different types of mud, the software requires different parameters and calculations for different results.

The software also helps mud engineers to select the proper type of mud. Users can input several mud samples with different properties, and let the software predict the cuttings clearance and hydraulics. By comparing the results, engineers can select the best type of mud.

Such software normally has two types of data transmission methods. The first one is “terminals to server”, as shown in Fig. 1, the second one is “terminal to terminal”, or “point to point” (P2P), as shown in Fig. 2. The “terminals to server” model requires an intranet and a server station to support the data transmission. Daily mud reports are created by terminal computers at the rig sites, and then transferred to a central server in the office. The central server stores the data of all the wells. Mud engineers with administrative privileges can log in to the server to review the data and maintain the server. The P2P model, used in this software, is a simpler and more flexible model. It does not require a server station or an intranet. All the terminals are in equal level and one terminal can send data to any other terminals. With the P2P model, mud engineers can send a well file to anyone via email, and the person who receives this file can open it on their computer, so they can review the data or print out the report. If the Internet signal is not available at the rig sites, mud engineers can save the data in their computers and send it to the office later whenever the Internet is available.
Fig. 1. Terminals to server model

Fig. 2. Terminal to terminal model
IV. Usability

The usability of any software is an important factor of the quality of the software. A user-friendly interface not only makes the program’s structure easy to understand, but also allows the users to input data efficiently and accurately, creating a pleasant experience. A main interface is shown in Fig. 3. The interface of the software is so straight-forward that an entry-level engineer can easily understand everything in the interface without receiving any training. The items in the interface are grouped by their categories.

![Software interface](image)

Fig. 3. Software interface

V. Flexible Designs

Comparing with Microsoft Excel® spreadsheets or some other reporting tools, this software provides to the user many unique and flexible designs. The well carry-over function is one of them. It can copy the data of a completed well to a newly started well, so that users don’t have to input duplicated information again. Meanwhile, the ending inventory of the previous well will become the initial inventory of the new well. This function is very effective when all that is left of the previous well can be transferred directly to a new well.

Once a new report is created, one click can allow users to copy the data from the previous day to the next day’s report, then users can simply update the new data and leave the unchanged data as it is. In this way, the user does not need to rewrite the same information over and over again.
Keeping track of mud data is vital to mud companies and operators. To make this task easy, the software is equipped with a database for daily mud properties, product inventory, cost and operation parameters. This database can include daily information for multiple wells. The management can import various databases created by different engineers and make an all inclusive database for all the wells drilled within a certain period of time. Well comparison can then be done using the integrated database. Another benefit of the database is that engineers can use an existing well and modify it for the new well so that all the product information does not have to be retyped.

The mud reporting software has an intelligent warning system which can reduce the chance for errors. Algorithms within the program help users input the correct data by providing calculations and messages. It can give users a warning message when some input error is detected or when some required field is missing.

Although past data is rarely changed after the daily mud report has been sent out, the software gives the flexibility to change the data on past reports. However, if the prices of some products change or a mud engineer made a server mistake in the past reports, then the software allows users to come back to a historical report and change the data. If the changed data associates with some other data, then these changes will automatically be applied to all the associated data as well. For example, during the drilling of a well, if the engineer finds an incorrect price, he is able to go back to the beginning of this well and make the correction. Then the software will apply the new price to all the existing reports and recalculate the cost of this product for each day and the total cost as well. Price change can be applied to any specific period of time.

VI. Reporting

The daily report generated by the program not only meets the standards of the API mud report format, but also provides additional information. A sample of a daily mud report is shown in Fig.4. Depending on the requirements, users have the option to hide the product price and cost, and only show the daily total cost instead. This will safeguard the confidential information in case users choose to do so.
VII. Data Management

An end-of-well report, or a recap report which contains all the information of the drilling progress, is always required by the operating company when a well is finished. Manually coping data from all mud reports and then pasting it to a well recap report is a fussy and time-consuming job. Normally to make a recap report for a 60 day well may take about 5 hours or even more. But with the help of the software, generating such an end-of-well report becomes effortless, as simple as a click of a button. A recap report containing data charts and graphs will be generated in a few seconds. In addition, if the planned data is provided to the software, then the recap can display both planned and actual data. A graph of MD vs. drilling days is shown in Fig. 5. In this graph, the green line indicates the planned data, while the blue line indicates the actual data. With the plot of both lines, users can compare them and find out which section of the well is drilled faster or slower than expected. Then users could find out why the drilling progress is delayed and try to avoid similar issues for the next well. A pie chart is created by the software, shown in Fig. 6. This chart shows the cost distribution of each product used in this well and the total cost as well.

![Fig. 5. Planned vs. Actual Data](image-url)
The software is able to set up drilling intervals. Users can define various interval names for a well; such as, conductor, surface casing, intermediate casing, etc. Then the software can summarize the data for one selected interval and generate an interval summary report.

Well comparison is a unique function of this software. It allows users to select up to 10 wells and compare their data, including the drilling speed, daily cost, mud properties, etc. The software can also print out a comparison report. With the comparison results, users can summarize the drilling experience and apply them to the next well.

Fig. 7 shows the comparison of the daily cost of 3 selected wells. Fig. 8 shows the comparison of the cumulative cost. The bar charts can also show the comparison of cost per ft and cost per day. With those bar charts, users can investigate the drilling cost efficiency and optimize drilling operations for the most economical operation.
Fig. 7. Daily cost comparison chart

Fig. 8. Cumulative cost comparison
VIII. Conclusion

Drilling mud business may have been associated with advanced chemistry, rheology, etc., however advanced computer technology, especially software, streamlines the mud engineers’ daily job as shown in the following list:

1. Standardizes the input, calculation and reporting.
2. Reduces chances of errors.
3. Clarifies the communication between mud companies and operators.
4. Reveals and identifies problems.
5. Provides better guidance for future operations.

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X. References


