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Efficient Data Management on the Rig of the Future

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Abstract

In 2000 BP identified an opportunity to collaborate with a major Norwegian operator and develop an initiative for updating the drilling data standards for contractor to operator rig-site data flows to speed and enhance decision-making. This led to the successful WITSML initiative for XML and Web Services standards in the Drilling and Completions domain [1]. This has seen rapid acceptance by all the major operators, service contractors and application vendors (www.witsml.org).

The WITSML initiative started with the objective to update the existing methods for drilling data exchange at the rig for the internet age, and to incorporate the lessons learned from its precursor, WITS [2]. WITS was designed for point-to-point transfers whereas WITSML, which is based on a functional XML and web services approach, facilitates wider access to data. WITSML acquired early success at replacing the WITS standard; however, moving further into contextual and report data to create true application-to-application interoperability required the operator community to intervene.

The intervention by BP has been to stimulate the marketplace and create a foundation to drive additional functionality for data exchange and reporting in the rig based environment and is the subject of this paper.

The approach taken by BP has been twofold: enabling the acceptance of contextual data from data acquisition providers by promoting enhancements of a widely used daily reporting tool; enabling the storage of time-based data within BP's own custodial databases and the merging of contextual data with the same. The deployment of the first trials of these enhanced applications is discussed. These enhanced applications have been used in harmony with "Decision Support Centres" where the opportunities to use improved technology to enable rig-office team decision-making are explored.

Introduction

Data management in today's rig environment has been evolving between three distinct communities on the rig (Drilling Contractor, Service Contractors and Operator) each with different drivers and often at differing paces.

For the drilling contractors, the emphasis has primarily been on standalone, drilling contractor specific applications, such as inventory and maintenance management. Although examples of internally driven performance applications exist, the drilling contractor rarely makes that a technology for differentiation, and the offerings of computer based applications are largely driven by contractual compliance. Today the computer presentation of contractor activity is often through data management systems from the hardware manufacturers, or application vendors specifically targeting the rigfloor marketplace.

The Service Contractor data management is naturally focused on presentation of service data (Fluid reports, Wireline / LWD logs, MWD surveys and resulting trajectories Cuttings Lithology etc.). Service contractors providing access to their data increasingly through internet facing portals, where the data can rapidly be distributed to partners, and the opportunity for incremental differentiation may exist.

The operator focus has been on activity reporting, often at a regulatory level, or a recording of activity (POB, Daily activity).

The end result of this approach has lead to very different systems between the rig based communities, with any integration needing a new approach, such as WITSML, to deliver any cross company integration.

The WITSML philosophy is aligned with BP's FIELD OF THE FUTURE and is now the basis for developing a number of other standards, including the PRODML standard.

Overview

The wealth of data collected by service vendors resides in service vendor data systems and these are efficiently presented to the consumers of that data. WITSML and other approaches allowing the LWD petrophysical data to be autoloaded into operator custodial systems are now well advanced. However post well analysis of detail is often compromised by the lack

of custodial retention of time based drilling data by the operators. That is especially true for data that is gathered when incremental footage is not being made, such as during tripping and casing operations. Data such as this is invaluable to improving the efficiencies of these activities.

The intention by BP was to initiate a project with one of the major vendors of daily reporting applications to initiate the standardization of the collection and integration of this data. The intent is not to displace the service companies adding value to their data through real time display, but to ensure that data was custodially retained and could be readily retrieved in association with related activity and contextual data. There was also a clear intention to drive further integration of the data directly into predictive models, and well to well comparisons, for applications such as Torque and Drag modeling of trips prior to casing running to ease the regular use of approaches to quantify tubular running problems [4].

Vision

The vision for data management on the rig of the future has three key elements to it.

Firstly, in order to minimize the duplication of data entry, where manual entry of information is needed, it should be shared between the different users of the same information. Typically each user of a data object has a different focus and priority, and by sharing the object between users, each consumer of the data ends up with a more detailed data object with less effort. The items of detail on the object that may be outside one user's area of expertise retain their quality, as the information is shared.

A good example of this behavour is the Bottom Hole Assembly description. Typically the retained information is kept in the Operators reporting application, and is currently re-keyed into other applications; however the same object is of interest to the Drilling Contractor, the Fluids engineer, the Directional Drilling contractor, the LWD contractor and the Mud Logger. Each however has a differing focus of interest. The Drilling Contractor is interested in the mechanical dimensions, in case the need arises to fish. The Fluids contractor has an interest in the component ID's, bit jets and pressure drops through complex tools for Hydraulics. The Directional Driller has an interest in the placement of the non magnetic components and details of the stabilizer OD's, for magnetic interference and directional control. The LWD contractor has an interest in the sensor placement details. By using the rig network, and a standard XML description of the BHA (or other objects), common to all applications, an object's details can be shared, added to by those interested in particular data elements, and utilized by all.

Secondly, the speed with which we can assimilate and manage data both in terms of quality, and its use for operational efficiency is a challenge. Visualization offers a number of key advantages to addressing those problems. One of the most effective ways to ensure the data quality of the BHA component deleveloped collaboratively as described above, is then to create a visual representation of the object. Dimensional errors will then immediately be effective.

Additionally using the same object in engineering applications, especially those with a visual representation of the computation, provides a stake in ensuring the data is correct for the post drilling consumer. The visualization can be a 2D presentation of the streaming data or a more complex 3D visualization. Using for example the BHA object to animate the string position in the BOP at sea bed, or while running in the well through a visualization of the caliper and lithology data acquired on the prior trip out, can be an invaluable aid to ensuring effective trips into the well. There has been much focus on visual representation for the onshore collaboration centre, but just as large an impact on drilling performance and flat time management can be obtained by improved visualization for the driller on the drillfloor.

Thirdly, data management and common standards need to occur not only at the database level, but also at the application level, so that integration can be possible using the available applications, irrespective of their underlying data structures or internal formats. The value in data management comes from data preservation, coupled with integration over time and varied projects where data can be reused as informational and decision support. As an example, a directional drilling company should be able to both retrieve and insert survey records into the operators' custodial data store from that service contractors chosen application, while preserving the application layer QA / QC restrictions imposed by the operators policies and procedures built into the operators custodial management application.

History

Within BP, and many other operators, there is considerable history of initiatives in this area, but these were historically proprietary in nature, were often application specific and have not all stood the test of time.

The intention of this initiative was to stimulate the commercial marketplace in terms of applications supporting new XML and web services standards, and to build some standards that would apply across a range of different implementations to address similar problems. The oil industry also has had little success with OpenSource as a model for application development, so one side initiative was a small pilot to test the effectiveness of an OpenSource model for some elements of the WITSML standard. An OpenSource pilot was initiated with its initial offering being a data converter for a common legacy ASCII based file format, LAS (Logging Ascii Standard), from the Canadian Well Logging Society, but used universally for file based data exchanges, into the Log Object structure of the XML based WITSML format. A key challenge for the future is to build commercial models which make it attractive for the drilling Contractor community to share in this initiative.

Scope

The WITSML coverage can be broken into 3 main topics, data used as a foundation for other data together, data that has

immediate value for minute by minute (or second by second) analysis and data that provides information and quantitative value for dissemination across an integrated system.

The foundational data consists of a common set of attributes collected and arranged as well and wellbore objects. The informational objects include report objects and data that can be shared across systems to reduce the need to retype report and progress information, where as the last category of data are those values that are tied to immediate activities and need to be monitored (manually or automatically) to ensure safe and efficient processes.

The challenge of the WITSML standard is to allow at least these three focuses to be maintained while allowing room for adaptation to the Operating Companies internal processes and practices; reducing additional burden on the Service Company so as to reduce the impact and costs to the drilling effort; and still effectively feed the analytical and technological processes the raw data they require.

In addition to these WITSML objectives, internally to BP there are efforts to use these data standards to improve the quality of the data and information retention and usage through adoption of the WITSML standards.

Status

The project commenced in 2004 with the creation of a detailed specification. The first activity that was completed was a working design for the QA/QC viewer of the integrated data. (Figure 1).

During 2005 coding commenced and the greatest challenge lay around defining which version of the standard to support for the initial implementation. The original intent was to support a working model around the version of the standard designed for release mid 2005. However that approach created challenges in terms of then arranging a field test around available data sources. In late 2005 the field tests were conducted demonstrating that for these particular applications, the functionalities BP wished to develop in the commercial marketplace. These tests have demonstrated:

- transfer of WITSML contextual objects
- retention of time based data integrated with time summary data (see Figure 1 for an example)
- application to application transfer of directional survey data across two firewalls with legitimate authentication
- the start of an OpenSource pilot.

Next Steps

The next steps are to build on this framework as these applications are deployed across BP, to use the marketplace to stimulate additional support for contextual data, a broader choice and depth of applications, and develop the data management for the rig of the future. The intention is to expand the coverage of reporting data that can be shared with the aim of further time-saving as opposed to re-keying information at different levels from routine rig based reporting, to reporting of that data to the regulatory authorities.

The lessons learned from the WITSML efforts and initiative are being applied in BP's related activities around DTSML and ProdML for Distributed Temperature Sensing data and Production data respectively.

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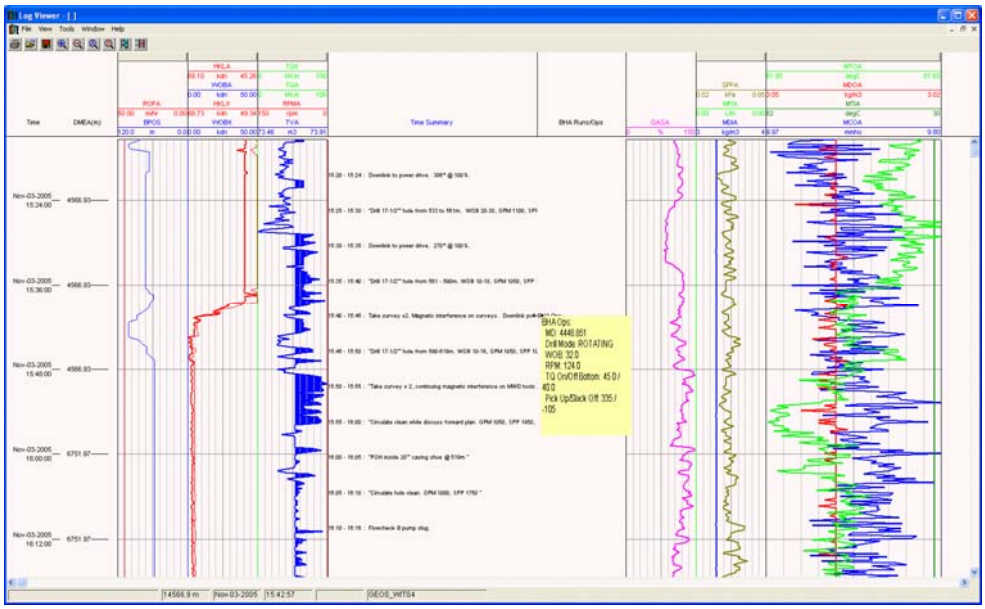

Figure 1, showing the QA / QC log viewer for XML web services delivered time based drilling data integrated with the hand keyed time summary activity log pulled from the common data structure.

Figure 2. A viewer for viewing time based XML data streams.