Real time data management can improve decisions

COMPUTING POWER and communications technology have combined to provide enormous capacity to acquire data and use it quickly in the decision making process.

Nowhere is this capability more important than in drilling where conditions change constantly.

But it has been the integration of all types of data from a variety of sources that has leveraged this capability to boost drilling performance and increase recovery of oil or gas from the reservoir.

In a key session at the 2001 SPE/IADC Drilling Conference, "Real Time Data Management and Integration of Geoscience and Drilling," to be chaired by **J McCallum**, **Global Marine Integrated Services** and **H Tjotta**, **Statoil**, some key advances are explored.

CT SEISMIC MWD

Significant industry effort is focused on developing tools and techniques to enable seismic measurements to be made during conventional drilling. There are specific requirements of the drilling processes to make such tools widely applicable.

In SPE/IADC paper 67753, "Coiled Tubing Seismic Measurement While Drilling," authors **T S Jackson** and **A J Gorrara**, **Read Well Services**, describe a unique seismic tool that is sufficiently robust and small enough to be included in a coiled tubing BHA and is free of the limitations of other seismic-while-drilling tools, according to the authors.

Measurements can be taken at any convenient stage in the drilling process without removing the drill string from the well bore.

Although the tool is capable of providing traditional VSP images for geophysical applications, a major driving force in its development is the facilitation of accurate well placement. This can be achieved either by referencing the drill bit to seismic structures in the vicinity or by implementing an existing technique to compute its absolute UTM coordinates.

The tool architecture is described by the authors and the development and testing program, and some recent data examples which demonstrate both its integrity and its ability to enhance drilling efficiency are summarized.

VISUALIZATION

Impressive capability is available to visualize formations and evaluate projects. But what is its potential value in well construction?

In SPE/IADC paper 67754, "Visualization: Game Changer, Facilitator, or Gimmick?" the authors evaluate that potential. The paper was prepared for the Drilling Conference by **W Wright**, **Schlumberger**; **J Holt**, **BP**; **I Rezmer-Cooper**, Schlumberger; and **R Minton**, **BP**.

Many in the industry today regard visualization as a gimmick that looks nice and may be good in the Geoscience domain but has no real place in the well construction arena.

However, that perspective is rapidly changing, according to the authors.

In varying environments outside the petroleum industry, three-dimensional visualization has demonstrated many diverse benefits. In this paper, the authors discuss the gains realized so far and assess the potentially rich areas to exploit in the well construction arena.

Visualization allows complicated geometric and computational models to be simply represented. Wells can more easily be linked to the larger picture of the field. No longer is there a need to use terms that confuse all but the individual discipline experts.

A picture is available.

This speeds and facilitates the communication and mutual understanding of problems and potential solutions. Discipline experts can look for creative solutions to be suggested from their extra-discipline peers. Small and subtle changes are much more easily dealt with.

A common language can be established for future communication among a multi-disciplinary team. Mutual understanding and appreciation of problems can greatly enhance team performance.

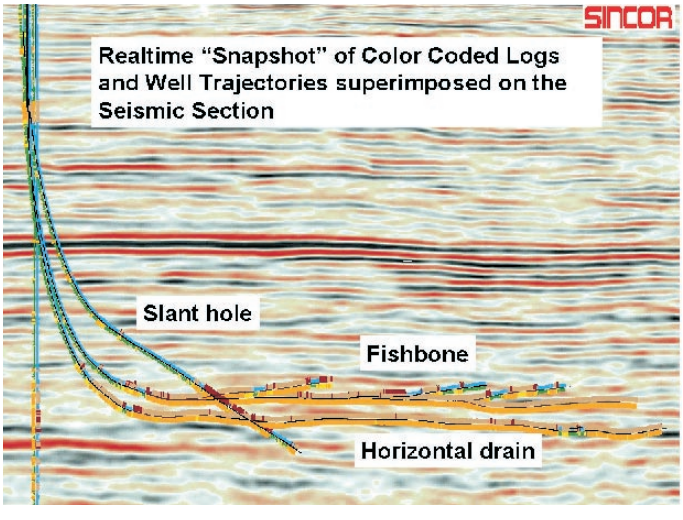
Once a field model is created, including well data from the drilling of the wells, we have an intuitive repository of knowledge for future well construction projects that can be used by rig-site engineers for real-time decision making.

Directional drillers can use it for assessing anti-collision risks, and a simple and effective tool is available for current or future peer reviews to interrogate and more easily understand historical information.

Perhaps the most powerful benefit of all for the technique is the draw that it provides to bring people together, according to the authors.

REAL TIME LWD

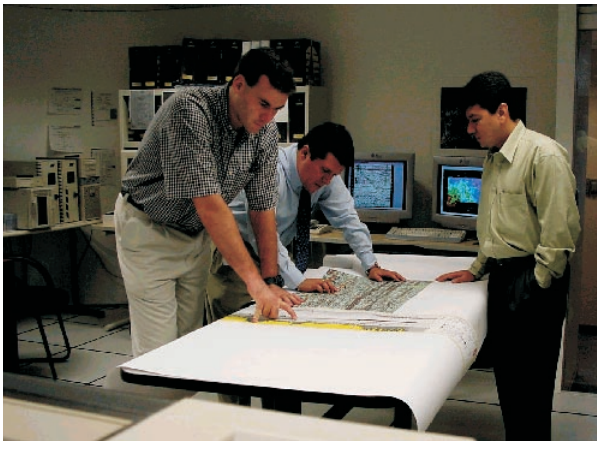
Sincor (Sincrudos de Oriente C A), owned by **TotalFina/PDVSA/Statoil**, is using real time well construction monitoring technology for its field development program in the Zuata area of eastern Venezuela.



Real time data that combines logs, well trajectories and seismic section is an example of information that can be made available to all teams.

The operation is described in SPE/IADC paper 67757, "Real Time Construction Monitoring—A Case History of Sincor's Heavy Oil Project," prepared for the Drilling Conference. The paper was prepared by **A J Branch**, **Sperry-Sun Drilling Services**; **K Andersen**, Statoil; **J L Lavillonniere**, Sincor; **T Larsen**, Statoil; **Y Kremer**, Sincor/TotalFina Elf; and **G A Capacho**, Sperry-Sun Drilling Services.

The authors report that from each rig site, real time logging while drilling (LWD) and surface drilling parameter data are transmitted via satellite 300 km to Sincor's headquarters in Caracas.



The survey information and gamma ray and resistivity LWD data are quickly available for viewing by teams at rig site or office.

The survey information (inclination and azimuth) along with the gamma ray and resistivity LWD data are for the first time directly and automatically loaded into a Landmark Graphics Openworks database, where the well trajectory with LWE curves can be viewed on the seismic profile.

The seismic profile is then automatically posted to the Sincor intranet allowing viewing either by the rig site team members or by Caracas team members from their offices or homes, thus ensuring 24-hr coverage.

Multiple wells are monitored simultaneously.

With this information, the geoscience and drilling engineering teams both in Caracas and at the rig sites can immediately make better informed decisions, including redefining the well trajectory.

In this paper, the authors discuss the processes involved from the initial well design on the seismic section through to the real time acquisition of data while drilling and its subsequent transfer to Caracas.

This allows the LWD curves and actual well trajectories to be viewed real time against the seismic sections and proposed well paths.

INTEGRATING DATA

Throughout the initial phase of development on the Mungo field in the Central North Sea, wellbore instability and mud losses have caused serious drilling problems and additional expense.

Geomechanical modeling around the salt diapir led to refinement of some drilling procedures but the direct cause of the drilling problems still remained poorly understood.

In SPE/IADC paper 67755, "Integration Of Drilling and Geological Data to Understand Wellbore Instability on Mungo (CNS)," **L E Beacom**, **H Nicholson** and **R I Corfield**, BP, explain how data integration helped solve the problem.

The authors report that a detailed fault mapping study was carried out from the Paleocene reservoir interval through the overburden.

Wellbore instability and mud loss zones displayed along the wellbores were integrated with the 3-dimensional fault model and demonstrated that the wellbore instability and mud loss incidents coincide with the location of seismically resolved faults.

However, not all faults in the overburden or reservoir were associated with drilling problems. It was found that the intersection angle between the wellbore and the fault surface is critical to determine whether drilling through the fault will induce instability.

The Mungo data indicate that small intersection angles (between 0-45 degrees) resulted in drilling problems while larger intersection angles (between 45-90 degrees) were not associated with drilling problems.

These results have been incorporated into the current well planning and drilling strategy for Mungo development wells.

So far a sidetrack well has been successfully drilled without instability problems and on budget. The techniques are also being applied in other fields.

This study demonstrates that integrating and visualizing drilling and geological data in three dimensions reduces overburden and reservoir drilling problems—and drilling costs.

RESERVOIR NAVIGATION

In SPE/IADC paper 67756, "Innovations in Reservoir Navigation," **D Allan** and **J Coghill**, **Baker Hughes INTEQ**, describe recent innovations in drilling technology, 3D visualization and LWD sensors that have been integrated into a Reservoir Navigation Service to provide optimal well positioning in the reservoir.

Standard geosteering techniques based on resistivity response modeling have proved to be inadequate in the complex geology of the North Sea.

To provide an effective service, innovative project specific solutions have been tailored for individual developments.

In this paper, the authors cite four examples of recent successful reservoir navigation projects.

The examples described in detail are:

- Integration of the shared earth model into the well planning process to significantly reduce the number of iterations required to reach an approved well plan;
- Effective navigation within the reservoir using Rotary Closed Loop drilling systems with near bit formation evaluation sensors for directional control;
- Fracture identification in a fractured chalk reservoir prior to completion using a novel technique of interpreting LWD resistivity data;
- Navigation within a specific high porosity zone, for example in a carbonate reservoir gas storage project enhanced using effective porosity steering.

These examples show the savings in planning time and other costs and the increased recovery from improved well bore placement.