Business intelligence for exploration and production of shale gas and its data revolution.

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Abstract

The economics of shale play development requires large numbers of wells to be drilled and completed quickly. This demands a sophisticated supply chain, leading many operators to adopt an industrial approach to their exploration and production systems. Crucial to this is a new kind of business intelligence hub: the adaptive, real-time database. But the benefits of such an approach are not limited to shale operators. We argue that the data management philosophy applied to shale plays simply raises the bar for the next generation of exploration and production systems. Furthermore, the adoption of a modern business intelligence systems to the enterprise can deliver real increases to asset values - far in excess of their cost of implementation.

Introduction

Traditional exploration and production (E&P) databases were developed with two principal objectives:

- to manage catalogues of exploration and production data
- to improve our understanding of the subsurface.

These databases supported technical endeavour and were often referred to as "data repositories" or "corporate data stores". They were seldom strategic in their scope and were rarely seen as being at the heart of the core exploration task.

Moreover, these systems were far removed from the dynamic business intelligence systems used in, say, the retail or manufacturing sectors. In contrast, E&P databases were only concerned with improving data quality and supporting interpretation applications.

Shale changed all that. Suddenly the exploration task was more akin to a manufacturing process. Shale play development needs the support of a dynamic adaptive database which is increasingly referred to as a business intelligence hub. In truth, this had been needed for many years. Shale's rise to become the object of the exploration effort was the impetus that caused it to happen.

Agents for change

Shale introduced two separate change agents which led to the new generation of adaptive, real-time data hubs.

Firstly, there were what we can categorise as production demands. Shale plays use production techniques based on hydraulic fracturing. This is a process that demands highly organised supply and operational logistics and frequent repetition of workflow deliverables. It also requires a complex support network covering a range of technical and professional disciplines and resources (such as an on-demand supply of fluids and proppants for the fracturing process), demands more traditionally associated with *just-in-time* manufacturing processes.

Secondly, the economics of shale production are very different from traditional exploration and production systems. Shale production is generally more expensive than conventional hydrocarbons, not simply because of its more complicated production techniques, but because more energy is required for each unit of energy produced (to separate the gas from its source rock). There is considerable debate about the economic price of shale gas, and yet more debate when we try to predict the reserves of shale plays using traditional hyperbolic decline curves.

Fig.1 *- Dynamic adaptive databases will become standard in the exploration and production data domain.*

Shale gas is still a relatively new opportunity and requires monitoring from initial prospect evaluation throughout the asset lifecycle. It also requires monitoring in real time by an integrated range of geoscience and engineering disciplines.

Realising value through data

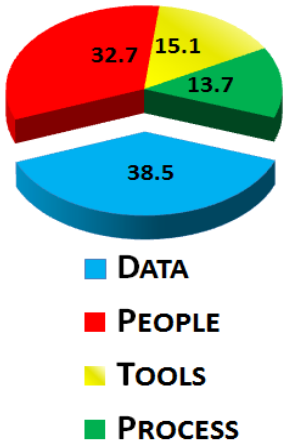

***Fig.2** - Perceived % value of a given attribute as a proportion of the total value of the asset .*

Although shale places the value of data firmly in the spotlight, it is not just shale plays that can benefit from a real-time, adaptive intelligence hub that serves a broad range of integrated professionals. All aspects of hydrocarbon production can be enhanced using these techniques. A recent survey in the UK by Schlumberger and Common Data Access Ltd (CDA) found that senior managers attributed 38.5% of an asset's value to the data, with tools and process contributing just 15.1% and 13.7%, respectively.

Should the processes demanded by the tight gas business be applied to more conventional hydrocarbon production? We would argue "yes, absolutely" and there have been a number of recent developments in computing technology that make this increasingly practical.

The new generation

The new generation of databases vary from supplier to supplier. However, they share some common characteristics. These are:

- data integrated under a digital map
- an integrated, real-time relational database
- an inclusive, collaborative approach
- practicality of deployment
- continuous availability.

The new E&P generation

The new generation of exploration and production professionals have very different expectations of information technology. These users are, in our opinion, justifiably intolerant of systems with lengthy and complex implementation and commissioning cycles.

The systems required by the new professionals need graphical interfaces, must be easy to deploy and must adapt to changes in operational requirements. They require totally different deployment philosophies.

It is difficult to imagine Facebook succeeding if it consisted of a number of different systems with multiple interfaces. Or Twitter or Google going viral if they were hard to use. Customers would simply 'walk' away. Yet that is often what we face at work when embarking on an exploration project.

Collaboration works best when it is convenient. Systems are appreciated when they are genuinely useful.

The map, the database and the cloud

These new advanced, real-time database systems differ from the previous generation, not simply because they operate in real time, but also because they have simple interfaces. These interfaces are implemented via a geographical information system (GIS), which, in turn, may involve cloud-based solutions for partial or total delivery.

Many recent developments in computer technology result from the rapid growth of cloud computing. By this we do not mean data hosting; many E&P companies have, after all, been doing this for years. Rather we are referring to the 'hypervisor' technology which is fundamental to cloud -based software applications. By using multiple virtualisations, integrated by the service provider under a common graphical interface, software vendors can offer a greatly improved user experience. Consequently, a broad range of professionals can access the technologies wherever they are, without exposure to complex systems integration environments.

This is essential when we wish to deliver applications on demand to a wide variety of devices with little, or preferably zero, installation requirements.

We've already mentioned the influence of other markets on the new generation of adaptive, business intelligence hubs for E&P. Many industries have had positive experiences of deploying their applications on hypervisors in either public cloud computing environments, such as Amazon's EC2 (Elastic Compute), or in private enterprise clouds. Many such systems use the Eucalyptus cloud computing technology developed at the University of California at Santa Barbara. While virtualisation has gained wide acceptance in the exploration and production business, Eucalyptus-based systems are still relatively unknown in E&P.

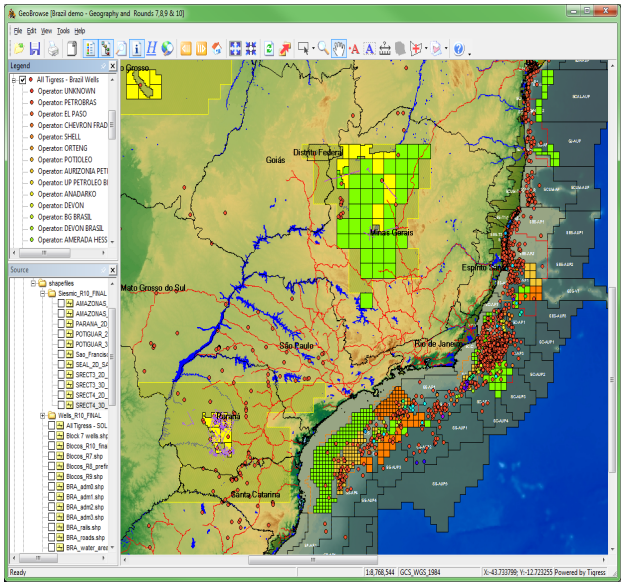

***Fig. 3** - Modern Exploration & production databases use a clear GIS interface to deliver rapid, enterprise wide access to key asset data.*

E&P aware real-time intelligent hub

One of the problems in using conventional business intelligence systems in the E&P domain has been the plethora of proprietary, industry standard and workstation formats used by the industry.

Any system wishing to find a place at the heart of an E&P business must be E&P aware, able to utilise these data formats and transfer data between them. It must also tie together the map and the database with a real-time audit trail. A real-time intelligent hub has three essential data qualities:

- availability
- quality
- provenance.

In the best systems, data provenance is maintained by means of a digital audit trail operating in real time.

The E&P aware intelligent hub must also balance open access – essential for collaboration – with the security demands of a professional exploration company. Again, in the best implementations the access control system and audit trail are tightly integrated.

Commercial benefits

The metrics applied to traditional E&P systems tended to consider reductions in administrative costs accruing from a more efficient data management system. Any potential savings would therefore only amount to, at most, a few hundreds of thousands of dollars. Allowing for the cost of acquisition and implementation, the claims of some manufacturers stretched credulity.

In contrast, the new systems promise real financial gains in two areas:

- very significant cost savings in terms of capital employed by reducing time to market for the whole asset
- significant improvements in the price realised by the asset on disposal.

The second claim is particularly interesting. It is based on the assumption that up to 5% of the value of an asset is discretionary. In other words, we probably know roughly the lowest amount of money the seller will accept. We also know the high-end claims for the potential of the asset. In reality, the price paid will be uncertain, being somewhere between the minimum and maximum price forecast. Sellers attempt to move the price upwards towards the maximum through this area of uncertainty. They do this by attempting to raise the confidence of the buyer in the asset's potential. It is alleged that the real-time, high quality data resulting from an adaptive intelligence hub can raise the confidence threshold by as much as 5%. So the new systems potentially offer a highly significant price support function for the whole asset.

Conclusion

Significant advances in information and computing technology (ICT) require two driving forces. Firstly, there needs to be a significant market demand for the solution. Secondly, the technologists must develop new techniques to develop products to satisfy the demand.

During the last decade most of the ICT developments in the exploration and production business were related to tools and processes. Database systems for E&P tended

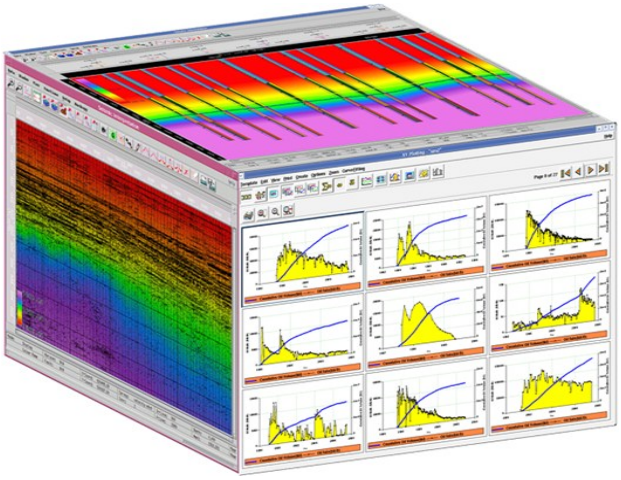

***Fig. 4** - Integration and accessibility of geoscience and engineering data is essential to developing the full potential of the asset value.*

to lag behind. In the latter part of the decade we saw significant technological progress drive by demand. In our opinion this resulted primarily from the technological and commercial demands of shale gas production. That demand has stimulated a new generation of adaptive business intelligence systems, using a range of the latest computer technologies.

Ironically, while shale has undoubtedly been the single biggest agent for change, other aspects of exploration and production may benefit even more. If nearly 40% of the value of a hydrocarbon asset comes from within the E&P data and modern adaptive business intelligence systems can really deliver improvements of 3% to 5% in those asset values, then the largest commercial gains are still to come.

Acknowledgements

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'The business value case for data management - a study' by CDA and Schlumberger, 2011.