E&P information management: beyond Web portals

Jamie Cruise and Ugur Algan of Volantice review the effectiveness of current information management (IT) systems for the E&P and predict changes which will come from focusing on businesss process modelling and software advances from outside the E&P sector.

As knowledge workers, we recognize that the outcome of a project will be impacted by how effectively we are able to gather relevant data and feed these data into the variety of computer applications that underpin our work. However, most of us would rather focus our efforts on the primary goals of the projects we work on, which are dependent on our analysis and design skills, rather than the mundane business of Information Management (IM).

Unfortunately, the history of the E&P business shows that the IM burden is increasing rather than decreasing for information managers as well as end users, even though a number of new productivity tools have been introduced over the past decade. This situation adversely affects the effectiveness of E&P teams and the quality of their decisions. A number of factors contribute to this increase in the IM burden:

- Increase in volume and diversity of available information: real-time drilling operations and production monitoring data; smart wells; 4D & 4C seismic; pre-stack seismic; multi-scenario projects with stochastic models, simulation, and optimization.
- An increasing gap between existing IM standards and best practices, and the IM needs of newly introduced, widely-adopted, innovative tools and applications
- A tighter regulatory environment leading to an increased need to audit our processes for compliance (e.g. Sarbanes-Oxley, Basel II, IFRS etc.). We must be able to identify the provenance of every piece of knowledge, information and data that supports our key decisions
- Continued consolidation of operating companies, resulting in major challenges to resolve differences in technical platforms, skills, culture, and IM practices across previously disparate groups.
- A change in demographics, leading to a shortage of skilled and experienced resources, resulting in increased pressure to preserve and disseminate corporate knowledge.

In this article, we explore opportunities for innovations that may solve the dual problems of delivering information to our geoscientists, engineers, and managers, as well as capturing the results of their work in a way that allows easy re-use in other contexts. We discuss the use of business process modelling (BPM), which we believe will be an integral part of these future solutions. BPM drives the flow of information through the enterprise according to the needs of the end-users rather than forcing the users to adapt their processes to fit with convoluted IM systems.

Furthermore, we believe that these innovations will be spurred on by advances in software developed and deployed by the broader (non-E&P) business community. The emergence of freely available enterprise class infrastructure and end-user components (such as Linux and other open source initiatives) should signal a further move away from proprietary technology for E&P systems. Of particular interest is the widespread acceptance of service oriented architecture (SOA) as the dominant approach for constructing dynamic, process-oriented systems that combine data and functionality from a variety of widely distributed sources.

History

Throughout the 1980s, IM was focused on a central library of master data that contained the bulk of information that we acquired and generated in the process of exploring and producing hydrocarbons. Skilled librarians would respond to requests for information from users, and deal with the messy business of finding, copying, and delivering results to the users. Work products from service companies were sent to the central library where they were indexed and archived for preservation and future re-use. Work products from geoscientists were either submitted to the library or stored in personal cupboards alongside stacks of coloured pencils. Effective information access was about knowing who to ask to get what you needed.

The 1990s saw an escalation in the sophistication and complexity of computer applications and a dramatic increase in the volumes of data employed (or at least deployed). Operating companies and vendors made significant investments in digital data management solutions that aimed to deliver data to applications with the minimum of copying and reformatting:

- Digital master data stores were constructed that inherited the indices and strict document control processes of the old hard copy libraries and aimed to cut out the middle man between the users and their data
- Project data stores allowed a family of applications (and therefore all members of asset teams) to access a single copy

of a working dataset and collaborate interactively to rapidly produce new results
- Corporate data stores were created to move the results of interpretation and analysis away from discipline-specific silos and into the realm of a shared corporate knowledge base.

The quest for a comprehensive, centralized data store technology for managing E&P data led to epic solutions with broad scope and complex implementations that required a correspondingly deep appreciation of data management issues to fully exploit. This dependence on specialist data management tools was making information access increasingly inaccessible for the end-users. By the late 1990s and the early years of the 2000s, the E&P community saw the need for easy to use tools that allowed non-IM specialists to search, review, and access data from across the enterprise. These new solutions recognized that corporate information assets would never be fully centralized; that data would always be distributed geographically; and that data would likely be partitioned according to some legitimate business or technical discipline boundary.

The community also understood that typical data access systems all required very similar basic user interfaces: a map for geographic selection; text based searching; table-based result browsing; simple graphical viewers for common content types (such as well logs and seismic sections); and an ordering system that transforms and delivers the data to the applications (See Figure 1).

With these requirements in mind, the E&P industry turned to the technology that had been powering the largest and most diverse distributed database of them all: the World Wide Web. Technical portals used the web browser to integrate disparate information sources inside a single user interface framework. A very rich example of a comprehensive technical portal was described in this journal in 2003 [1].These information access applications could be developed

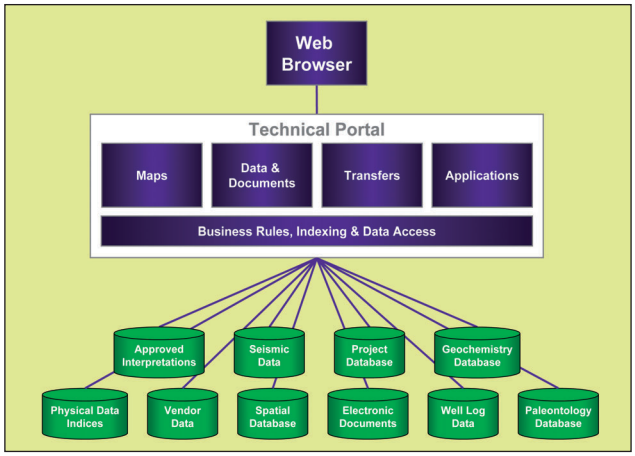

Figure 1 *A technical portal.*

rapidly, deployed cheaply, and learned easily. Rather than using several applications with essentially the same functionality to access each individual data store, a single facade for the basic data access functionality was created and layered on top of multiple data bases.

First generation E&P technical portal products represent a significant advance in the business of delivering information to end users desktops. However, the core functionality of these products is often limited to basic search, review, and transfer activities. The portal environment does provide an opportunity for automating other business processes, and there are some applications that go beyond basic information management. However, these solutions often require a great deal of custom development, increasing their cost and making them harder to maintain.

We believe that custom applications with hard-coded workflows will be replaced by commercial workflow management products that allow systems to evolve gracefully as business processes change.

Business process modelling and workflow management

Workflows are collections of human activities that are combined to realize a particular business goal according to a well-defined business process. As good corporate citizens, we have a shared interest in ensuring that business goals are met efficiently and predictably. Many organizations are already working hard to create libraries of standardized processes that define a controlled environment for delivering key work products. However, simply establishing a library of standard processes will not guarantee efficient, predictable business performance in a complex, knowledge-driven business such as E&P. In process-driven businesses such as the construction industry, the notion of standard process is embedded in the culture with projects tightly constrained by government regulations and client contracts. In E&P, efforts at creating and imposing a set of standard workflow templates often fail due to a lack of appreciation of the complex, collaborative, and iterative nature of technical workflows.

For workflow systems to be successful, they must be perceived to be directly supporting the user's goals rather than primarily allowing management to monitor the team's daily activity. Deploying a workflow management system is somewhat analogous to installing a closed circuit TV (CCTV) monitoring system in a town centre. When implemented well, CCTV helps promote good behaviour and protects the innocent (by providing accountability and monitoring compliance) without interfering with daily life. However, when implemented badly it can generate suspicion and actually promote non-compliance. Workflow management systems that dictate activities too prescriptively will generate negative outcomes, reminding us of the Harvard Law of Animal Behaviour: 'Under carefully controlled experimental circum-

stances, an animal will behave as it damned well pleases.'

Therefore, in order to achieve effective workflow support, we must deploy practical systems that guide the construction of knowledge without hampering the creativity of the individual contributor. This tension between enterprise-level standardization and team- or individual-level innovation may be resolved by taking a leaf out of the environmentalists` book, when they ask us to 'Think globally, act locally', a phrase coined by Rene Dubos. He felt that this goal could be achieved by establishing systems in which 'natural and social units maintain or recapture their identity, yet interplay with each other through a rich system of communications'.

We see significant benefits in allowing teams to easily define processes (adapted from a global library of process definitions) that reflect their local working practices. The process models should be expressed in the language of the community rather than the language of the system, empowering user representatives to easily modify the process definitions in response to changes in the operating environment.

Pragmatic workflow systems allow an executable version of these processes to be constructed with minimal effort. Executing the process will generate tasks for team members. Completing a task will progress the process towards its end goal. Some tasks will be simple prompts that ask the user to carry out some activity and notify the system when that activity is complete. A more sophisticated task may present the user with a complex report that describes relevant source data and also provides a form that allows the user to record results for the work that was carried out in order to complete the activity. Finally, some tasks may be completely automated by functions in the underlying system infrastructure. As the workflow is executed, the results of each stage will be recorded and preserved, providing a valuable audit trail.

The goal of the high-level workflow management system is to coordinate automated services and human activity across many applications and data sources. We should not confuse workflows managed by a business process engine that span complete business processes, with workflow support provided within a particular application. Within a single application, the activities in the workflow will be inextricably linked to the features and functions of that particular application. Whilst there is an opportunity to integrate the two levels of workflow, merging application level workflows with higher-level processes will introduce unwanted dependencies and cause the high-level workflow to become brittle.

In general, it is important that workflow implementations are flexible. The organization should be able change how a task is carried out within a workflow without needing to undertake major re-engineering across the whole process. Also, it should be possible to introduce new steps into existing workflows without impacting the original activities. This need to build flexible computer systems that cleanly separate business processes from individual business functions and allow them to evolve separately has driven the horizontal IT industry towards a new conceptual framework called service oriented architecture (SOA).

Service oriented architectures (SOA)

An SOA is a framework for building systems using a network of collaborating services. Services are self-contained, standards-based, platform-independent business functions with well-defined programming interfaces. These services can be easily integrated into a variety of applications that support particular business processes.

In the E&P business, an operating company may integrate services from a wide variety of providers such as: processing companies; real-time drilling operations sites; government repositories; external data vendors; internal financial and document management systems; internal project, corporate, results and master data stores; and joint venture partner systems. A mature SOA implementation will contain a rich library of service functions that can easily be integrated into many different business processes. Services are typically implemented using Web standards that make it straightforward to build an application that interacts across traditional geographic and organizational boundaries.

We expect to see an increase in the number and sophistication of Web services being used to exchange information between multiple systems, using standard XML documents. The E&P industry has already started down this route with the use of WITSML for exchanging real-time drilling operations data between service companies and consumers [2]. The success of this approach has led to the initiation of a similar project for real-time production data [3].

Existing E&P Web applications that are currently only available to Web portal users can be transformed into services that feed a wider variety of applications. Good candidates for re-usable functions include data querying, mapping, and application launching services.

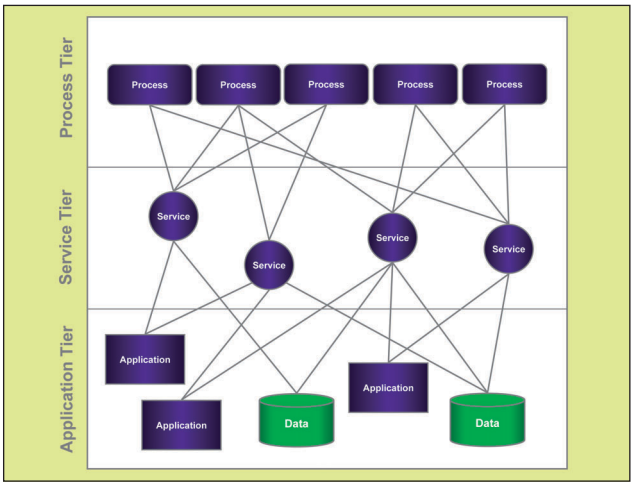

Figure 2 *Service oriented architecture.*

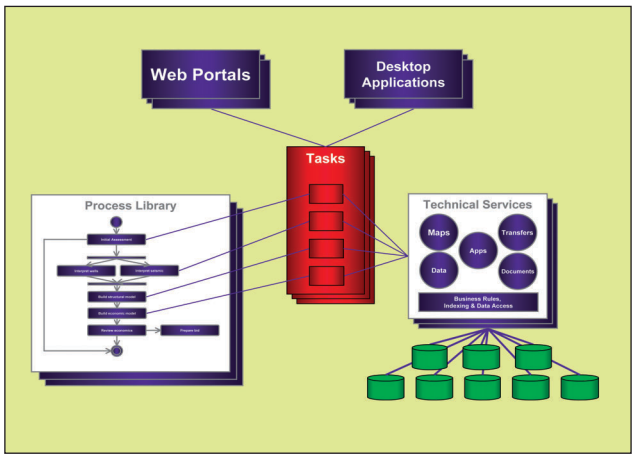

Figure 3 *Integrating technical services with business processes.*

First generation E&P portals provided a common set of online tools and data for a project or team. This concept will be refined as workflow automation solutions are deployed. Each knowledge-constructing task in a workflow may contain its own work area: a collection of information sources, applications, documentation, and results storage, all targeted and pre-configured for this specific activity. This will be deployed for use at the desktop, but maintained centrally as part of the corporate knowledge base. It will permanently retain its association with the specific context of the activity of that user, working on that task, and on that project.

In the broader IT industry, the general concept of services is well understood; however, the standards and best practices needed to drive the implementation of successful SOA projects are still emerging. Much work is being carried out on the standardization of protocols for important operational features such as authentication, authorization, and monitoring. Only when these features can be implemented consistently will collections of Web services be elevated into a true SOA that enables multi-vendor service integration.

We anticipate that SOA initiatives will be widely adopted by E&P companies to enable them to take advantage of technology developed for broader markets with better economies of scale and scope. SOA is being driven through successful implementations that have delivered significant return on investment in diverse industries such as insurance, banking, and travel.

One example category of Web services that is particularly important to the E&P business is spatial data services. It is

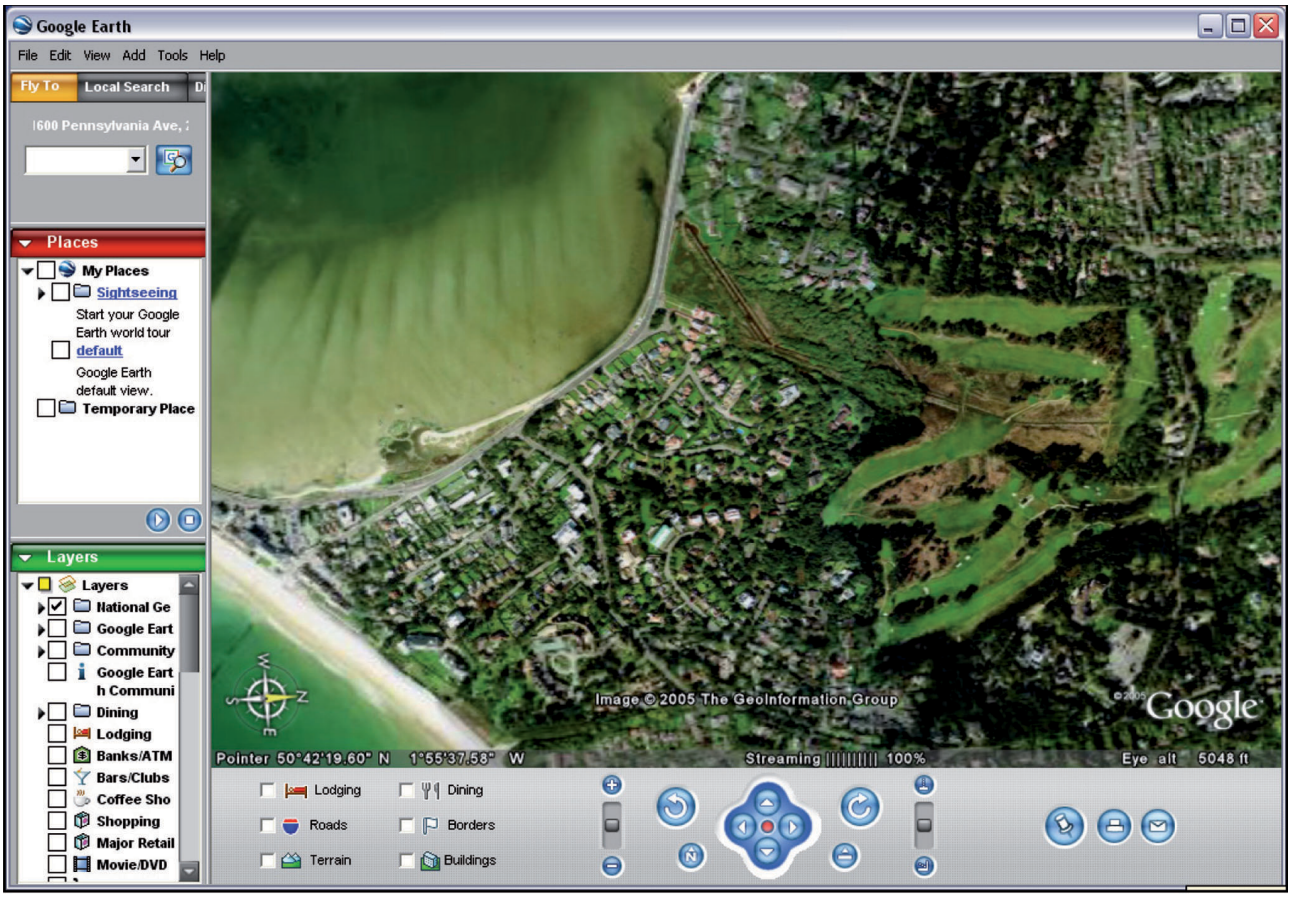

Figure 4 *Google Earth.*

estimated that over 80% of the information of interest to an E&P professional has some kind of spatial association. Spatial data technology is an example of a market that has been transformed by the use of Web services. Spatial data access has emerged from its niche as an engineering application accessible only to a limited audience of specialists, and has been transformed into a ubiquitous source of valuable information for the mass market of Web users.

Google Earth is an example of a consumer spatial data access application that has generated much interest within the E&P community. It is an innovative earth imaging tool that demonstrates the use of Web services outside of a Web portal. Google Earth generates detailed map displays streamed to the desktop across the Internet. This central content is augmented by very active communities of users who load and maintain their own local spatial data layers, or create documents about places of interest and send links to the central Google servers.

We believe that widely available, well supported, and standards-compliant infrastructure software (such as Web, application, and portal servers) and associated tools are changing the 'buy or build' equation within E&P companies. It is now much less risky to invest in development projects using commodity (possibly open source) technology. This means that smaller application vendors can survive (and even thrive) by offering focused, best-of-breed applications as Web services in the same environment as the larger vendors. As a result, the traditional vendors of integrated E&P application platforms may have to re-assess their position as single-source technology providers, and partner more collaboratively with their customers, competitors, and horizontal suppliers.

Summary

The E&P industry is facing a number of challenges to its existing IM ecosystem. In response, the industry must look at ways of providing IM solutions that empower rather than burden the end user. We must embrace user-centric systems that can adapt as the business changes. We must also continuously monitor developments in the broader technology market, and harness these in an E&P environment.

Finally, we leave IM practitioners with some questions for the future:

- Can we present users with a conceptual model for information discovery and retrieval that is as simple and powerful as Google's? IM systems should allow the user to spend less time accessing information and more time assessing it.
- Can we encourage the capture and dissemination of knowledge through communities of proactive publisher-consumers? Contributors should naturally establish networks of excellence founded on self-interest, mutual trust, and reputation.
- Can we combine this personal empowerment with the structured processes that allow a corporation to preserve accountability and maintain compliance with government regulations?

[1] Web technologies for information access and workflow support: technical workspace portals. Ugur Algan & Marco Piantanida. *First Break*, 21, Jan 2003.
[2] For more information on the WITSML standard, visit www.witsml.org.
[3] For more information on the PRODML initiative, visit www.prodml.org.