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WEAVING A DIGITAL FABRIC

The oil industry is increasingly relying on digital technology and Internet or web-based concepts in every aspect, from back-office accounting and e-procurement to making decisions based on modeling software, to actually drilling, completing and monitoring wells.

It's called the e-field, the i-field, the smart field, and the digital oil field. And it is a very good thing.

The U.S. Bureau of Labor Statistics said in a report that from 1998 to 2008, the fastest growing area of wage and employment growth will be the computing and data-processing industry—and that the industry with the slowest growth prospects will be the oil, gas and gas-liquids industry.

The Society of Exploration Geophysicists, meanwhile, says that by 2010, 51% of its members will reach age 55 and thus, be vulnerable to retirement or otherwise leaving the industry.

A connection is there that promises to make the oil and gas industry even more dependent on emerging digital technologies.

This report sheds some light on what's available now and how E&P companies are using digital technologies to the best advantage.

You see it in a chilly, secure room full of servers in downtown Houston at the offices of P2 Energy Solutions, a unit of Petroleum Place. There, accounting for Australian energy firm BHP Billiton is taking place. Staff accountants in Melbourne monitor this activity from their desktops half a world away, coordinating with their Houston counterparts who are actually doing most of the work. Outsourcing schemes such as this would not be possible without digital technology.

You see it in real-time operations centers set up by Halliburton and Schlumberger where engineers separated by time zones can monitor and drill together, sharing data and solutions on their respective computer screens.

You see it in offices where the CEO, CFO and the head of accounts payable can analyze company-wide spending to find interesting patterns or trends that might indicate change is needed in the way they do business.

Now internal and external experts from around the globe can have total asset awareness in real time, says Bill Severns, senior director, upstream technology for energy-company advisory firm Cambridge Energy Research Associates. Data can be delivered instantly to the correct personnel regardless of their location. Decisions and remedial actions can be taken quickly to stave off problems or mitigate them.

It promises to be an exciting way to do business.

--Leslie Haines, Editor

CONTENTS

ABOUT THE COVER: Photo depicts Landmark's Asset Management Center in Houston. (Image courtesy of Landmark Graphics, a Halliburton company.)

Does your back-office system deliver these specific benefits?

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The Digital Oil Field Today

The digital oil field of the future is coming into better focus with each passing month.

ARTICLE BY LESLIE HAINES AND DON LYLE

Oil and gas people have always been among the most intelligent, but now with the adoption of digital helpers, they can increase their IQs exponentially. And when baby-boomer engineers and geologists leave the petroleum workforce in coming decades, their knowledge may continue to aid colleagues still working to find oil and gas.

Petroleum information technology (IT), digitized real-time downhole data and computer–aided practices are exploding, giving new impetus to the industry. The frustrations and hesitancy common in the 1990s are giving way to practical solutions and more widespread use by the oil industry. Better, cheaper and more secure data transmission through the Internet is one reason why.

"Oilfield automation is a fact. Further enhancements are evolving quickly," says a Microsoft white paper on the topic.

Hovey Cox, director, digital oil field, Schlumberger Information Solutions, says, "The big trend is to connect the field to the office and the technical side to the business side. Real time is going to be the thing to watch in the next five years."

With the digital fabric in place, incremental reserves can be produced.

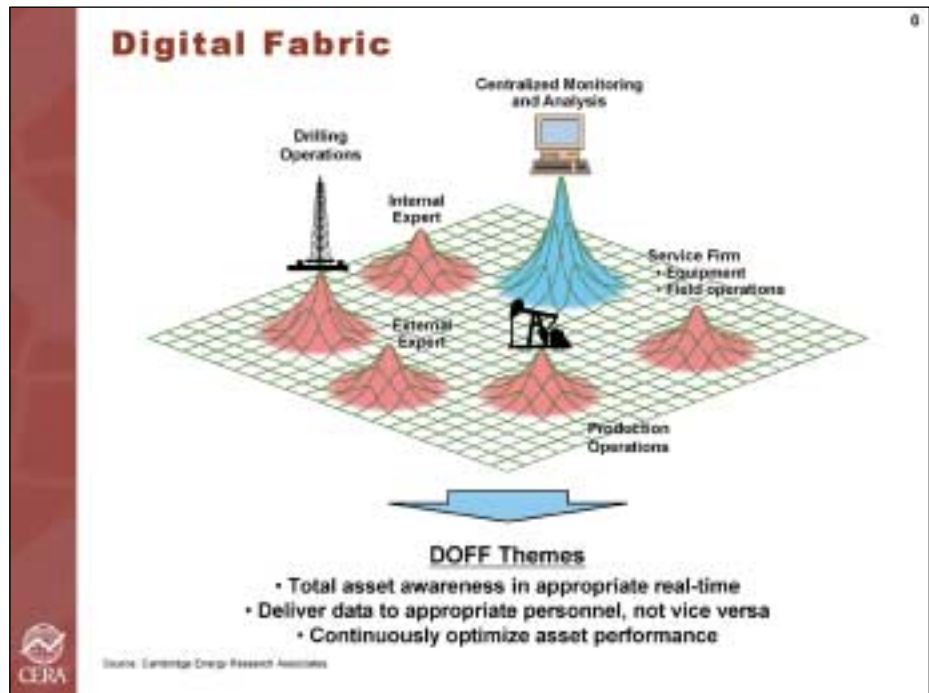> *"An operations center is a decision center."*
> *Alvaro Escorcia,*
> *Landmark Graphics*

Why all the fuss about IT and all things digital? Cambridge Energy Research Associates (CERA) estimates that state-of-the-art well monitoring and reservoir imaging and management technologies could expand global oil reserves by 125 billion barrels by 2013, and reduce costs by 10% to 25%.

"Total upstream energy IT support spending is about 25 cents per barrel of oil," estimates Gary Vickers, chairman and chief executive of Denver-based Petroleum Place.

That figure includes nine cents for technical IT for seismic processing and other geological, geophysical and technical applications, and 16 cents for business-related items such as finance and accounting, forecasting and decision-making.

Looking at just one company, Petroleum Place, gives you a flavor for how far the industry has come. Through acquisitions and start-ups, this integrated service company offers a suite of IT products—software and data management—to about 500 companies, from small private independents who don't want to hire a lot of people, but instead rely on technology, to multinationals managing far-flung assets in every time zone.

Petroleum Place incorporates online auctions though The Oil & Gas Asset Clearinghouse. With its latest purchase, of Tobin International, the company enables operators to map leases and ownership information, overlain with geology and field locations and GIS applications, and use spatial data management.

More than 140 U.S. E&P companies use Excalibur, its system that integrates operational and financial data.

The digital dashboard

Today it is possible and affordable for an oil and gas company to coordinate and integrate data and activities as diverse as forecasting and planning, procurement and invoicing, drilling and production. Add functions such as partner balancing, joint-venture accounting, land and concession data, authority for drilling expenditure (AFEs), inventory control, well monitoring and gas marketing. In the end, these lead to financial statements.

Everyone from the CEO and CFO to the man in the field can contribute data, see other data, plumb the expertise of others in the organization, and react quickly.

With this dashboard concept, companies can see how fast they are driving and if they are low on fuel.

In some software schemes, red lights literally light up the

DOFF Technology Evolution
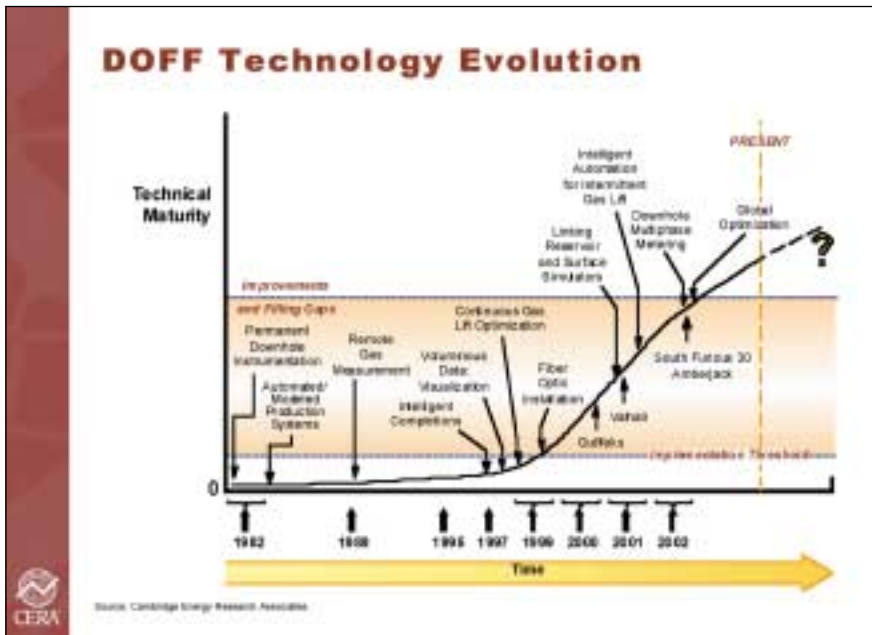
Technology has advanced to the point of automated, intelligent fields.

desktop or laptop screen to tell the employee in real time when something is amiss. He or she then clicks on that item and drills deeper to a new window filled with more detailed data, or to launch an application that will fix the problem. Maybe a well is suddenly not producing according to plan. Maybe an invoice entered the accounting system that is more expensive than the agreed amount.

"The downstream refining and petrochemical segments optimized operations years ago, and…the upstream industry must deploy tools that facilitate 'best' decisions based on the best information available at the time," Microsoft's Marise Mikulis, energy industry manager, said at CERA's recent annual conference in Houston.

With this dashboard concept, companies can see how fast they are driving and if they are low on fuel.

"The current 'alignment if the stars' of new and proven technology, industry drivers [such as the median age of oil employees being 50] and user demands set the stage for the success of oilfield connectivity issues."

She cited BP's Amberjack Field in the Gulf of Mexico, where BP's engineers used a portion of Microsoft's Oilfield Connectivity architecture to link the platform with the desktop to come up with a best-case production scenario. BP operates the field from the desktop. The result? A 7% increase or 600 barrels of oil equivalent per day for a system cost of $860,000.

The dashboard is hard at work for Pioneer Natural Resources in Irving, Texas, too. Using Schlumberger's Decision Point system, it took three months to overlay the latter's new system on Pioneer's existing information systems, according to Tom Halbouty, chief information office at Pioneer.

Now, through a company web portal, employees can access more than 200 computer applications worldwide. There are some 70 corporate communities or "chat rooms" that can access specialized Pioneer data and solutions, based on job descriptions or producing fields.

People get workflow alerts and monitor key events. This involves employees, suppliers and partners. The system "knows" each user and delivers to that person only information tailored to that job description or that is of local importance, or that is allowed by management on a need-to-know basis, Halbouty told a Schlumberger user group in a meeting last year.

The system contains an acquisition and divestiture cycle, an asset cycle (exploration, exploitation and retirement), a purchase-and-supply cycle and ERPs (enterprise resource management) and monitoring to keep track of performance against corporate goals.

Holistic decisions

At Halliburton's real-time operations center in Houston, engineers can sit before screens and direct or monitor well operations a world away. Halliburton's own experts and consultants, as well as those of an E&P company client, can be called at a moment's notice to help, online. In both cases, there is no "windshield time."

Technologies developed to form an earth model are now being adapted to drilling and production operations, says Helen O'Connor, director of strategic alliances and real-time programs, Landmark Graphics. "You don't reap the benefit of real-time surveillance done in isolation, without the connection to the subsurface. If we can drill a well and adjust its target in real time while still drilling, then we have to know where the targets are, and their connection to other wells in the field."

The real-time operations center is scalable as to size and complexity, and does not have to be in a huge room. An empty office will do. In the end, it's not about the room or the hardware, though, it's about making decisions and improving collaborative behavior, O'Connor says.

Up to 15 wells can be monitored at one time, 24/7, from anywhere in the world. As the well is drilling, downhole pressures and other data are fed back into the earth or reservoir model to update it, further refining the way the well is drilled.

Many companies, such as Shell, ConocoPhillips, and El Paso for example, have installed their 3-D visualization or immersive centers for geological subsurface work (the reservoir model) next to their real-time operations monitoring room. Workflows and knowledge-sharing for prospect generation, drilling and completion, field development and production can be easily linked for holistic decision-making.

"An operations center is a decision center," says Alvaro Escorcia, director, real-time reservoir solutions, Halliburton Energy Services.

Industry can use the technology in three broad ways, Escorcia says. An E&P company can use real-time operations when it has

already decided where to drill, to optimize what happens during drilling and completion. It can use the technology when it already has a lot of wells producing, but needs to know how to produce the particular field more effectively for less cost and more ultimate hydrocarbon recovery.

Finally, real-time operations help a company manage its asset portfolio and integrate all the data so that everyone involved has the same information at their fingertips for collaborative decision-making.

The key is to gather the right data in the first place, and that is possible with new fiber-optic tools in wells. Halliburton has 115 so-called smart wells (using downhole fiber optics) installed worldwide, producing from 232 producing zones. Most are located offshore and a third involve subsea completions.

Truly linking the subsurface technologies in geology and geophysics that are used before drilling, with real-time operations—drilling, completion and production—throughout a field is where the industry is headed.

"Optimizing a holistic value chain from start to finish is the aim," says Escorcia.

Next?

Steve Comstock, vice president of upstream technical computing with ExxonMobil, says standardization of computer systems across a company's entire enterprise is a must.

"Getting common is better than getting best," he told the Schlumberger users group. Because the company is so large and operates in so many countries, cost control and integration are important. A piece of hardware in Houston should plug into a piece of hardware in Angola. A person transferring from one job to another needs to be able to get up to speed immediately.

When Exxon and Mobil merged, they had 100 terabytes of online data to manage.

From the company's point of view, this type of standardization was crucial when Exxon and Mobil merged and found they had 100 terabytes of online data. Some 6,000 users around the world were brought into the new Schlumberger system within three years of the massive merger. The company estimates it saved 40% of the cost or $100 million knocked off its computing overhead.

"Why focus on costs when oil prices are high? The 2 billion barrels a year that ExxonMobil finds is in places like Angola, not in West Texas. They are complex, expensive barrels. You can't standardize your way to greatness, but you can lower costs," Comstock said.

Pioneer's Halbouty said his next goals are to further integrate operations, finance and geoscientific data for key people. He wants to get the portal to all desktops and laptops to avoid e-mail administration, and keep all information trackable and accessible. Pioneer's system needs to set alerts to trigger pagers or cellphones held by certain key people when the dashboard sends an alert. ∎

Changing Times– at IT Speed

A year in information technology is like seven years in drilling and production. Here is a snapshot of some of today's key trends in data management.

ARTICLE BY JEANNE M. PERDUE

Use of information technology in the oil patch has undergone a transformation. Five years ago, a portal was a door. Today, it is a place to find information.

The frenzy of Y2K, SAP implementation and the dot-com boom and bust is long over. The focus now is on streamlining business processes and cutting costs with a view to improving the bottom line and the organization's transparency.

Super-servers

One of the current cost-cutting trends is "replatforming," meaning the migration from expensive platforms running Unix to affordable Intel-based personal computers running Windows. The latter's price/performance ratio is much more attractive for both technical applications and enterprise resource management (ERM) systems like SAP.

Calgary-based Suncor Energy Inc. made the move to the Windows server system from the Sun and Oracle environment to reduce total costs. The company estimates that it will achieve a 42% savings in hardware, licensing and support costs during the next six years.

David Massart, Suncor enterprise IT architect, estimates that the Suncor Energy Products R/3 deployment would have needed to double its two-person IT staff had it remained on Unix. By moving to the Windows system software, Suncor is saving $200,000 per year from that portion of the infrastructure alone.

Another form of replatforming that is popular is replacing servers that are several years old with newer, more powerful hardware. The beauty of this substitution is that far fewer servers are needed. Jim Bettencourt, business productivity advisor at Microsoft, says one energy company was able to replace 108 Microsoft server 2000s with only 78 Microsoft server 2003s.

Web services

The nature of energy-related software applications has changed significantly in the past five years. Applications have been Web-enabled, and rather than buying a "seat license," users now access hosted applications on the Web for use whenever—and wherever—needed.

Using open standards such as XML (EXtensible Markup Language) enable existing software code to be reformatted with a wrapper so it will play in the Internet arena. This avoids the pain

Realizing Potential in Oil & Gas
Eliminate gaps between information, people, systems & devices

The right IT systems, easily updated, will facilitate workflow.

of "rip and replace" when upgrading or changing software. It also gets around the problem of what to do with legacy applications and heterogeneous systems, particularly after a merger.

With major companies…announcing major write-downs in their reserves, you can expect to see new IT tools and software programs springing up this year to document the reserves estimation process…

Web-enabled applications are much easier to update—do it just once on the server, as opposed to on every user's machine.

SimSci-Esscor recently decided to provide its Upstream Optimization Suite and its Process Engineering Suite on a monthly subscription basis via PetrisWINDS NOW!. Houston-based Petris is an application-service provider (ASP) that offers a variety of Web-enabled geoscience and engineering software applications for the energy industry.

"The alliance with Petris provides our user community of process, facility, reservoir and production engineers with an innovative and time-efficient way to access our software," says Marty Kurowski, SimSci-Esscor vice president of marketing.

Managing paper "stuff" is as important as managing structured databases.

Transparency

Due to the Sarbanes-Oxley Act in the U.S. and the Basel II initiative in the international arena, public companies are changing their IT tools and implementing new software to improve reporting and communication.

Mapping the business process, documenting the decisions made up and down the management chain, and providing an audit trail for the various versions of these documents require innovative IT solutions. The silver lining to this regulatory cloud is that managers will get better data faster, enabling them to make better decisions.

One solution to the more rigid requirements is the new Microsoft Windows SharePoint Server (WSS), which is a portal where documents can be posted. Secure controls determine which employees can read, change or print each document. Digital rights management features allow only certain people to edit certain parts of a document.

When a new version is posted, the old version cannot be seen except by administrators and auditors.

With major companies like Shell, El Paso, Forest Oil and Nexen announcing major write-downs in their reserves, you can expect to see new IT tools and software programs springing up this year to document the reserves estimation process with the same thoroughness and transparency as financial reporting applications.

Outsourcing IT

Some operators have decided that IT companies can meet their needs more cost-effectively than their own personnel, so they are outsourcing their IT department completely. In July 2003, Marathon Oil signed an eight-year, $63-million outsourcing contract with EDS of Plano, Texas, to consolidate its servers and streamline its computing systems so it could focus on its core energy business.

EDS is providing mainframe and distributed server management services to Marathon, as well as BP, ChevronTexaco, ExxonMobil and ENI.

An even newer form of outsourcing is "offshore sourcing," also called "offshoring." IT professionals in India, China, Russia and the Philippines are able to perform the same computer support services as domestic employees, but for a fraction of the salary.

Having such a geographically distributed IT workforce brings about its own set of challenges and requires a special project management approach to be successful. Fortunately, the global oil industry is already accustomed to managing global teams to accomplish its goals.

Document management

Only about 20% of energy companies' data are "structured data" in databases like Oracle and SQL, and most applications manipulate structured data. The other 80% of the information that E&P companies own is just "stuff"—mostly paper documents in files.

Interestingly, companies spend 80% of their IT budgets on the 20% of the data that is structured, according to Tim Taylor, chief business development officer for McLaren Ltd. in Glasgow. Shell Oil, for example, had 2.5 million documents at its Deer Park refinery near Houston that needed to be managed somehow. In a heavily regulated environment with OSHA and EPA watching, there are huge liability issues in not managing this "stuff" properly.

Some operators…are outsourcing their IT department completely.

Say, hypothetically, that a drawing is imported into a document, then the document is approved with some changes—but the original drawing is not updated. Later, the drawing does not match the as-built facility and real safety problems can ensue. Enter Enterprise Content Management (ECM) solutions, which have been customized to meet the specific document needs of engineers.

At the Datatech conference in January in Houston, Documentum and FileNet announced separate partnerships with McLaren to use McLaren's Enterprise Engineer for off-the-shelf solutions for managing e-mail, documents, web pages and drawings. These ECM solutions use metadata, or information about the document, such as approvals, time stamps, and versioning, to add perspective and meaning to the document.

Documentum is used by Anadarko Petroleum and PetroCanada for land document and contract management. The FileNet system used by Duke Energy (known in-house as DukeFlow) serves 13,000 users and manages 12 million documents. Duke has documented substantial benefits using this ECM:

Knowledge management is more than a mere "brain dump."

• 66% time saved in document searches by technical personnel,

• Achievement of 100% regulatory compliance,

• Lowered plant insurance rates and

• 50% reduction in training time for technical workers changing projects.

Interestingly, companies spend 80% of their IT budgets on the 20% of the data that is structured….

Knowledge management

Knowledge management (KM) applications have come a long way from searchable repositories containing "brain dumps" that people typed up on their computers. The latest KM solutions "read" documents and process the contents, comparing them with the database to point out to the user other documents that are similar in content. But, it's not what you know, it's who you know—and who knows you.

"In a fast-paced business like ours there are times when it is better to know the author rather than read the book—in fact, in frontier situations there is no book!" says Guy Wheater, manager at Enerdex in the U.K.

"What is needed is a unified 'yellow pages' of expertise that can be accessed quickly to find people who have been there and done that already, to drive operational effectiveness and minimize losses in the event of a failure."

Enerdex is a new company that combines the expertise of seasoned oilfield practitioners with eminent info-architects to offer intelligent KM solutions for companies in the energy sector. "Our mission is to consolidate organizational know-how through skills and experience directories that intimately link data, documents and skills together, with a focus on the individual, since we know far more than is documented."

Aside from clustering documents and consolidating info-channels, Enerdex extracts data from documents to populate databases, then takes the data and creates agent-based models for evaluating risk and optimizing processes. Agents can be either people or pieces of equipment with a programmed degree of "intelligence" such that they react to the agents and the environment around them. Such a system is good for modeling complex situations to find patterns that are otherwise hard to discern or predict.

One current application for text extraction is for profiling people according to their resumes, then matching them to vacancies through intelligent search capabilities. "Companies are snapping up this service in the U.K., since it eliminates the headache of [resume] backlog and cuts the processing costs by about 80%," Wheater says.

Collaboration

Collaboration has changed considerably due to IT tools. E-mail was the first generation of computer-enabled collaboration. Unfortunately, e-mail was such an easy and cost-effective way to communicate that today's inboxes are overflowing with non-essential e-mails, jokes and spam, resulting in "e-mail fatigue."
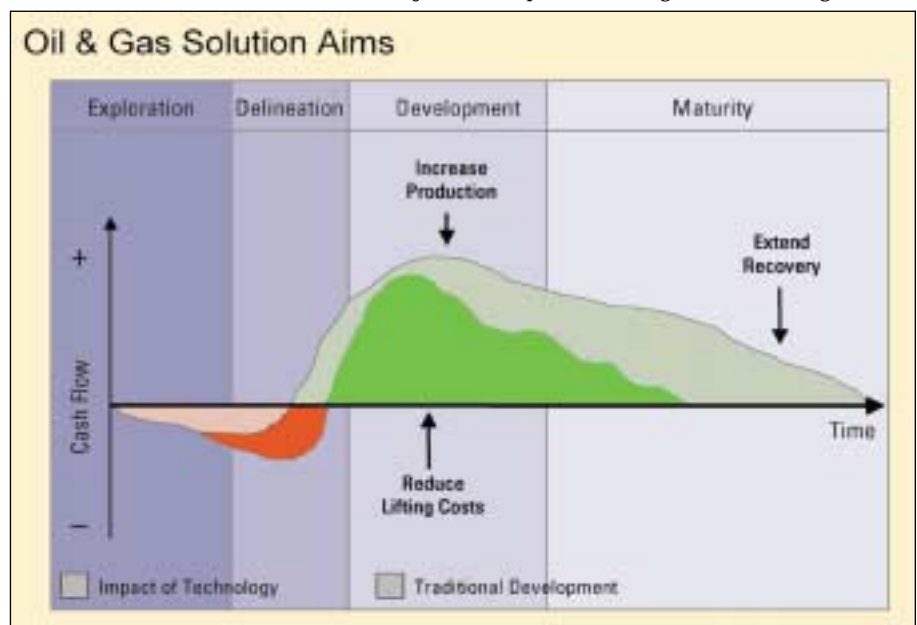
Software used throughout a field's life cycle is converging.

"E-mail is totally uncontrolled," says Tim Taylor of McLaren. "The courts can demand a copy, even if the file has been deleted, because somebody may still have a copy in their desk drawer. What's better is posting a single copy of a document to the server, then sending everyone an e-mail with a link to it so they can read it but can't print it out. Then nobody has a copy of the old version after it is deleted. That was one of the many factors that contributed to the Piper Alpha platform disaster in the North Sea."

Ensuring proper collaboration has a big economic benefit. According to Amar (Hans) Hanspal, senior director of Autodesk collaboration solutions, "Inefficiencies, mistakes and delays account for $200 billion of the $650 billion spent on construction each year in the U.S."

He blames the loss of knowledge every time one silo (design) hands over information to another silo (build). Autodesk recently released Buzzsaw, a collaboration platform that uses a traffic light dashboard to show the status of the budget and the schedule throughout the design, build and operation stages of facility construction.

The application also incorporates processes and approvals and task assignments so everyone on the project is on the same (Web) page. The company also has a free program called DWFit that allows computer-aided drafting (CAD) drawings to be viewed over the Internet. ChevronTexaco uses this program to view the status of its project drawings in real time.

Life-cycle integration

The final trend in oil industry IT is the convergence of all the software used in exploration, drilling, production and processing over the entire lifecycle of the assets.

In constructing facilities, for example, there was 2-D CAD software, then there were 3-D CAD models, then laser-scanning technology enabled 3-D computer models to be drawn for existing facilities. Today there are 4-D plant lifecycle management programs that are used not only by the designers, but also by the operations and maintenance personnel. According to Aspen Technology, integrated asset models could:
- Increase production 5% to 10%, or $15 million per year,
- Reduce lifting costs 5% to 15%, or $10 million per year,
- Decrease operating costs $0.10 per thousand cubic feet, or $5 million per year and
- Increase PIR 0.2 to 0.5 points, or $20 million per year.

In March 2004, AspenTech will be releasing AssetBuilder, the second component of its integrated solution for optimizing upstream production systems based on a simulation model of the facilities. It is built on the HYSYS Upstream solution that was released at the end of 2003, along with third-party applications for modeling reservoirs and pipelines, all integrated using Microsoft .NET technology.

In beta-tests of the HYSYS software:
- Burlington Resources earned $10 million more per year by using the black-oil simulator to select the best enhanced oil recovery (EOR) option, boosting production by 500,000 barrels of oil equivalent per year;
- Adma-Opco in Abu Dhabi earned $13 million more per year by reducing flaring to a twentieth of the original amount; and
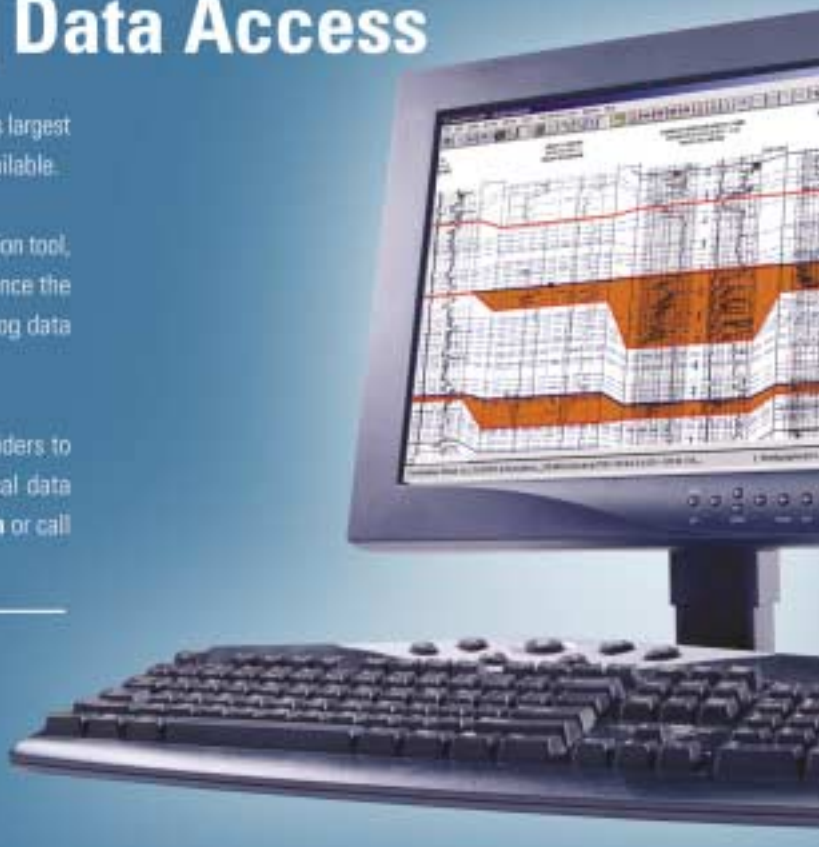
• BP earned $31 million more per year by optimizing its Harding platform and boosting production 5%, or 4,300 barrels per day.

As you can see, the real money is in the integration, and you can surely expect to see much more of it in the next few years. ■

Jeanne Perdue is senior producer for The Energy Forum LLC, a Houston-based energy conference company. She can be reached at jperdue@TheEnergyForum.com.

Viva E-Commerce

After the demise of several energy dot-coms like PetroCosm a few years ago, many thought that e-commerce was dead or not feasible in the oil industry. Au contraire, Pierre!

In May 2003, Unocal, Schlumberger Oilfield Services and Digital Oilfield successfully completed the first PIDX XML invoice transaction, complying with API's recommended practices. PIDX (Petroleum Industry Data EXchange) is the e-commerce committee of the American Petroleum Institute. XML is a data standard that enables seamless web-based transactions among trading partners.

Schlumberger created an invoice in the PIDX standard format from its ERP (Enterprise Resource Planning) system and transmitted it, along with the corresponding service delivery ticket, directly to Digital Oilfield's OpenInvoice hosted Web application. Unocal used OpenInvoice to route, code and approve the invoice prior to uploading it to Unocal's financial system for payment.

"This first PIDX XML invoice is a significant step forward for our industry," says Mike Comeau, e-procurement tools manager for Unocal. "The entire process complies with industry standards and will change the way we transact with our trading partners. This creates a win-win for both operators and suppliers as it reduces transaction costs on both sides of the equation."

Unocal is not alone in implementing new e-commerce solutions. Saudi Aramco, the world's largest oil producer, announced that beginning in June 2004, all of its refined products will be sold exclusively through the Internet. According to A. Al-Hadrami, marketing manager for product sales, the new Web application, which has been in development for more than a year, "will help get rid of thousands of pages of contracts and speed up the process."

Doing Financial Processes in Real Time

For a spending-intensive industry, conversion of the accounts-payable process to electronic invoicing helps make companies' financial data more current.

ARTICLE BY ROD MUNRO

E&P companies have a history of spending large amounts of money to acquire and process data quickly—in many cases in real time. Driven by the need to make operational decisions immediately, meet investment decision deadlines, and reduce very expensive equipment "waiting on orders" time, the industry has earned its reputation as the "real-time" industry.

The real-time label is appropriate except for one area: the financial processes that are needed to pay for all of that real-time exploration and production. In this area, the oil and gas industry has lagged behind other industries that operate in a "just-in-time" mode.

It's surprising that in an industry where real-time decisions are made every day, on multimillion-dollar projects, expenditure information is delayed an average of 60 days, destroying a lot of the "currency" value of other information acquired immediately.

But, that is changing as more E&P companies adopt a technology that brings key financial processes and data up to speed with the rest of the industry's real-time operating requirements. At a number of leading E&P companies, "e-invoicing" now captures more than 30% of all expenditures, and those companies plan to expand their use of the technology to manage virtually all of their spending.

Invoicing has been recognized as a problem in most industries for a long time. Companies inherently recognize paper-invoicing processes as cumbersome, expensive, prone to error, and ripe for automation. Invoicing represents the largest single category of transactions that companies engage in with business partners. Invoicing is painful for the sender and receiver, creating the ideal opportunity for a win-win solution.

Interestingly, the oil and gas industry has some unique business characteristics that create a bigger invoicing problem (and therefore a more compelling opportunity) than almost any other industry.

• Many companies in other industries deal with (at most) hundreds of suppliers located close to their facilities. Upstream E&P companies typically deal with thousands of suppliers located

HOW IS THE OIL & GAS INDUSTRY UNIQUE?

Compared to Other Industries

	Other Industries	Oil & Gas Industry
Production Infrastructure	Low Number of Fixed Manufacturing Sites	Many Mobile "Manufacturing" Sites
Spend Characteristics	Buyer Specifies Transaction	Supplier Records Transaction
	High Quantities of Standard Components	High Number of Complex Engineered Services
Buyer / Supply Chain Processes	Formal PO Usage	Informal PO Usage
	90% Point-Procurement	10% Strategic Contract and Negotiated Terms
	Price-Based Selection	Results-Based Selection
Corporate Performance	Days Inventory	F&D Costs / BOE
	Time to Market	Reserve Replacement Ratio
	EVA	

in multiple regions or countries.

• Manufacturing-based industries know exactly the quantities of material they need to order and purchase, resulting in very simple procurement and approval processes. Good luck! In our industry, we never know quantities until they are measured at the wellsite and recorded in the "field-ticket" process. This results in longer and more complex validation and approval processes.

E&P in particular is known for the complex nature of its expenditures, and procurement and engineering professionals have wished for years to have a better understanding of their spending.

All of this adds up to hundreds of thousands of complex invoices that need to be received, coded, checked, verified, routed, occasionally disputed, approved and analyzed—every year. And this has been the story for as long as the industry has been operating. So it's no wonder that E&P companies are responding positively to the improvements that e-invoicing offers.

But, given that the invoicing problem is not a new one, why is the oil and gas industry so focused on e-invoicing now?

First, e-invoicing is becoming less an option and more a requirement as companies comply with the Sarbanes-Oxley legislation. Sarbanes-Oxley demands more timely and accurate reporting, and the 60-day lag period that results from manual invoicing isn't acceptable any longer. And, with auditors now required to assess the adequacy of internal financial controls annually, manu-

B2B PROCESS AUTOMATION

Transactions, Cost and Spend by Segment

	Transactions	Process Cost	Associated Spend
Permitting	2000 – 3000	$1 – 3 Million	$5 Million
Invoicing	200,000	$10 – 20 Million	$600 Million
JIB	4000 – 5000	$2 – 4 Million	$200 Million

GROWTH IN SPEND CAPTURED

Annual Processing Rate in Billions of Dollars
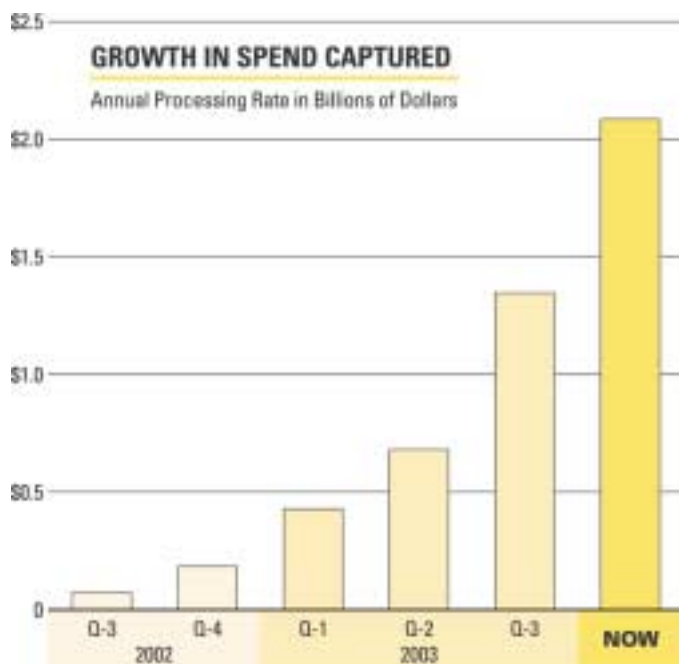
Capturing and analyzing spending trends leads to efficiencies.

al invoicing begins to show up as a very visible shortcoming in most companies' reporting processes.

Second, before e-invoicing could become a reality, a secure electronic platform was required that could support collaborative business processes between trading partners. The platform needed a technology solution, industry transactional standards, support from the supplier community, and a common network—the Internet.

So, even though most will agree that invoicing processes are painful, and that the Internet can drive adoption of better processes, the journey from idea to value delivery has not been simple. A number of key milestones needed to be achieved before the industry could add the "real-time" designation to its financial processes.

Strategic value verification

For oil and gas companies, one of the first steps in adopting a new technology is to determine if it delivers a strong return on investment and fits with the company's strategic direction. As most oil and gas company executives will attest, myriad opportunities for technology investments compete for attention every day.

Why invest in e-invoicing? The answer is that it cuts direct costs and delivers value in three strategic areas:

• It integrates the business processes between suppliers and operating companies,

• It saves money, automates manual processes and frees valuable technical resources and

• It provides the foundation for measuring and improving corporate performance.

Supplier integration

The oil and gas industry is one of the most outsourced industries in the world. In a typical E&P company, more than 60% of the expenditures are "outsourced" to suppliers. And yet, in most oper-

ating companies, there is very little technology associated with automating and optimizing processes conducted by the supply chain.

In other industries, such as the computer industry and automotive industry, which are not nearly as outsourced as the oil and gas industry, material savings and improvements have been realized by integrating the supply chain. These dramatic improvements are available to oil and gas companies as well, especially since so much of upstream expenditures are actually executed by the suppliers.

Strong ROI

As oil and gas companies carefully scrutinize and prioritize their investments, no project will be considered without a strong business case. E-invoicing passes this hurdle easily with measurable savings in four key areas.
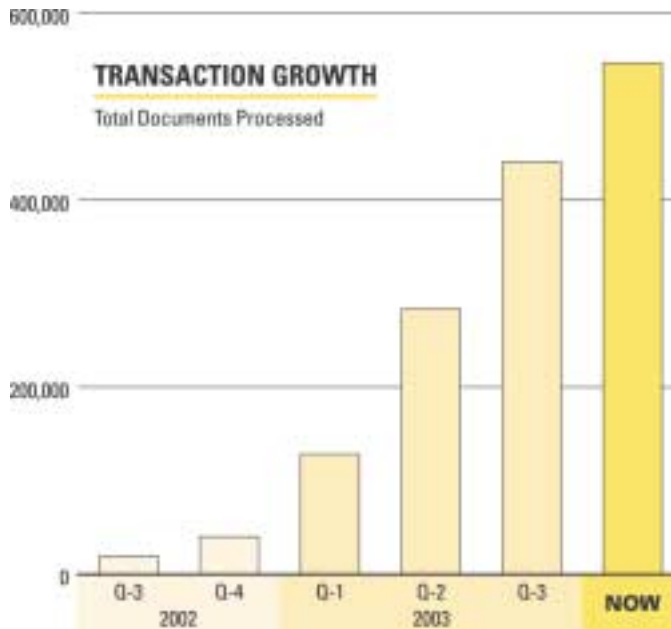
Process automation This entails the savings realized through automation of a process that today is almost entirely manual, very paper-bound, open to personal interpretation, and prone to errors in a number of areas. It also implies that valuable professional staff are freed for other more value-adding activities. Studies indicate that e-invoicing can eliminate 50% to 80% of the effort associated with the invoicing process when compared with a typical paper invoicing process.

Spend capture This references savings derived from the aggregation of detailed, line-item spending information captured and recoded during the e-invoicing process. Analysis of this data is used to drive strategic sourcing, identify detailed spending areas that can be reduced using modified buying practices and more efficient operational processes. Most studies show a cost saving of approximately 1% of corporate spending is realized through strategic sourcing initiatives.

Price reconciliation These benefits accrue through "invoice to contract" reconciliation ensuring compliance with contract pricing. From discussions with various oil and gas companies, it appears that incorrect pricing occurs on anywhere from 1% to

SUPPLIER GROWTH

Total Suppliers On-Ramped
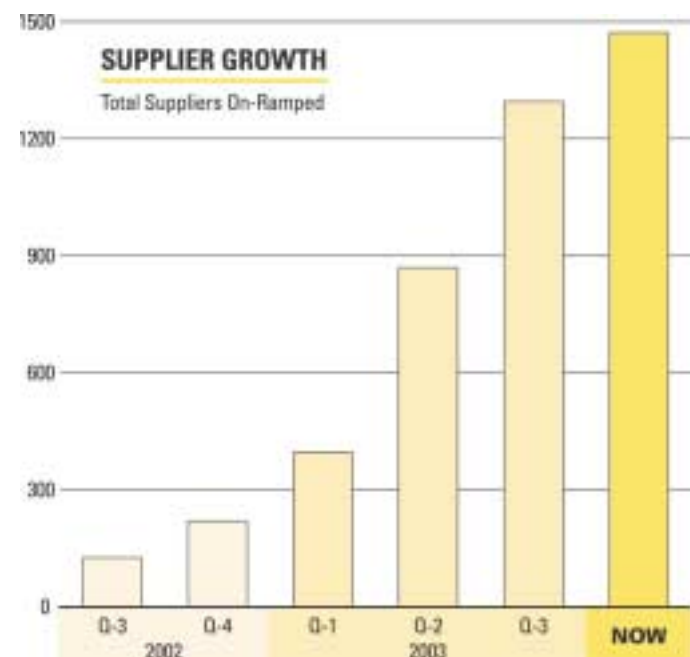
More suppliers are in the e-invoicing loop.

TRANSACTION GROWTH
Total Documents Processed

If more invoices are e-processed, errors can be caught.

10% of all invoices. Yet, most companies do not have the resources to check every invoice for correct pricing. By performing this task as part of the invoicing process, the savings are material, even if the pricing is incorrect only 1% of the time.

Cash management In the electronic world, transactions can be settled more quickly. Enhanced visibility to future expenditure requirements leads to enhanced cash management. Suppliers and customers are finding new ways to benefit from faster settlement, and a clearer view of forecasted payments leads to more efficient use of corporate capital resources.

Fixing the industry-wide problem of late payment has also led to better business relationships between suppliers and their customers. Dealing with problems electronically is faster and easier than having to organize a meeting or a phone call. Resolving issues quickly leads to more productive ongoing business relationships. Time is money, and e-invoicing lets both sides of a transaction benefit from shorter settlement cycles.

Measuring performance

Companies are beginning to realize that capturing spending in real time can have benefits far more strategic than simply automating accounts-payable processes. Companies make multi-million-dollar decisions every day related to lease purchases, property acquisitions and drilling opportunities. To assist them, they use sophisticated electronic tools to perform economic and portfolio analyses. And they feed these tools with up-to-the-minute production and price-forecast information.

Yet, unbelievably, that analysis is based on actual expenditure data that lags the rest of the business by two months.

This is a serious deficiency during a period of time that the industry has experienced cost increases of up to 20% or more per year.

A solution

A number of other industries have demonstrated impressive results by integrating processes between buyers and suppliers. So, is there a solution that was developed for other industries that can

Anadarko Canada's E-Invoicing

In 2001, Calgary-based Anadarko Canada Corp. analyzed its existing invoice process and discovered that few invoices actually made it through to settlement without error. Approval cycles took weeks or even months. The process was manual, work-intensive and ultimately very costly.

In addition, the existing process provided little detail of Anadarko's spending with suppliers. Opportunities to improve operational efficiencies were being missed as a result, putting at risk significant strategic objectives that Anadarko had identified.

Once Anadarko's requirements had been defined, it undertook an exhaustive research campaign of available commercial solutions. Digital Oilfield's OpenInvoice application was selected.

The first task at hand was to determine a phased approach to the implementation of OpenInvoice. Anadarko analyzed the annual spending for the most recent calendar year—by supplier and by invoice volume. Based on the results, Anadarko began a roll-out in selected operation areas, and then increased take-up after absorbing lessons learned from the initial implementation phase.

The suppliers provided valuable feedback throughout the engagement process, and ensured the requirements of the suppliers, as well as Anadarko, were being met. In addition, Anadarko partnered with other operating companies who were also rolling out OpenInvoice to maximize supplier on-ramping benefit.

In September 2002, the system went live with its first e-invoice transaction processed through Digital's OpenInvoice tool. The e-invoice was automatically uploaded to Anadarko's ERP system.

Since implementation of OpenInvoice, Anadarko has seen a marked increase in the invoice growth rate that has reached an average of 30% per month. As of October, it had exceeded its 2003 goal of adding 750 suppliers.

The volume of spending capture has grown to approximately $20 million per month. Roughly 14,000 Anadarko invoices have been processed and approved using OpenInvoice since the project kicked off in the fall of 2002.

Total spending captured since inception is nearly $125 million. Average invoice approval time, including dispute (adjudicated electronically) time, decreased to nine days. Based on a recent user survey, overall supplier and operator satisfaction is very high.

— Rod Munro

be readily adopted within oil and gas? Unfortunately, our analysis revealed that the cross-industry technologies (most were developed for the manufacturing industry) do not fit a large portion of oil and gas requirements, particularly in the upstream energy industry.

There is one key difference that makes most manufacturing solutions inappropriate for oil and gas application. Technology solutions that model the "procure to payment" process for manufacturing invariably begin with a purchase order (PO). Procuring goods through a PO process is suitable when the item and quantity to be procured is known prior to the purchase. So, for example, if one is purchasing a certain number of widgets for a manufacturing process, it would make sense to use a PO to begin the purchasing process. But in oil and gas, especially in the area of complex services (drilling, completions, well servicing etc.) and ad hoc services (field-based "call out" services with no formal purchasing process), neither the quantity nor the exact line items is known in advance.

Instead, the purchasing process for complex and ad hoc services usually begins with a contract. Once the job has been ordered (either through a formal contract or a more informal process including phone calls, e-mails etc.), the supplier performs the work, records the work (scope and quantity), and then generates a field ticket as the first record of the transaction—but only **after** the work has been performed. Thus, to model the work process from order to invoice for oil and gas operations, a field ticket-invoice-contract workflow and reconciliation process is required.

There have been a number of early adopters of electronic invoicing technology in the oil and gas industry. These companies have pioneered various systems, have worked with their suppliers to ensure that the solution would deliver value to supplier and operator alike, and have worked with technology providers to determine which components and features would deliver the most value the fastest.

Digital Oilfield went live with its first customer in December 2001. Since that time, adoption has increased exponentially. A number of operating companies and more than 1,400 suppliers throughout North America are transacting through Digital Oilfield's OpenInvoice system today.

Electronic invoicing is here to stay because the components of the whole solution have come together: the technology platform, industry transaction standards, supplier community buy-in, and operating company adoption. And one of the most onerous paper-driven processes in our industry has moved into the realm of real-time. ■

Rod Munro is founder, president and chief executive officer of Houston-based Digital Oilfield. He can be reached at rmunro@digitaloilfield.com.
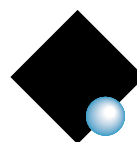
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How El Paso Production Went Digital

Take a look at how one independent uses a variety of digital tools as a catalyst to a new way of finding oil and gas.

ARTICLE BY REYNOLD DECOU

During the past year, El Paso Production Co. in Houston implemented the first Schlumberger-supported company iCenter in the U.S. The iCenter and its supporting technologies and experts have helped El Paso enhance collaborative workflows and promote cross-disciplinary communication. This has led to making more informed and timely decisions and reenergized the workforce.

Three Schlumberger innovations that have had a tremendous impact technically and economically on El Paso's operations have been dubbed within El Paso "the triumvirate of technologies." They are the dedicated client center (DCC), the InterACT Web-based data monitoring and delivery system, and the iCenter remote operational facility that brings everything together.

Nearly three years ago, El Paso purchased Coastal Oil & Gas, a company known for actively drilling new wells and quickly fracturing and stimulating them. To keep this record intact, we quickly needed processed log data to analyze and design frac treatments. Initiated four years ago, the DCC generated such efficiency and financial value to El Paso that it grew from just one person to four: three petrophysicists and one geologist, all provided by Schlumberger. They work as consultants to El Paso and handle the log processing for all newly drilled wells.

This is critical in light of the way we operate—statistics show that, for the last couple of years, El Paso has been the busiest operator in the U.S. Currently, we have roughly 14 rigs running simultaneously, but during the previous two years, our rig count averaged 35. (A few years ago when gas was $10 per thousand cubic feet, the company had 76 rigs running simultaneously throughout the world.)

Having the DCC streamlined and shortened the normally time-intensive log processing associated with all these wells. Now it takes just three to five hours to perform an electric log analysis (GeoFrame ELAN), which is a composite log for every new well.
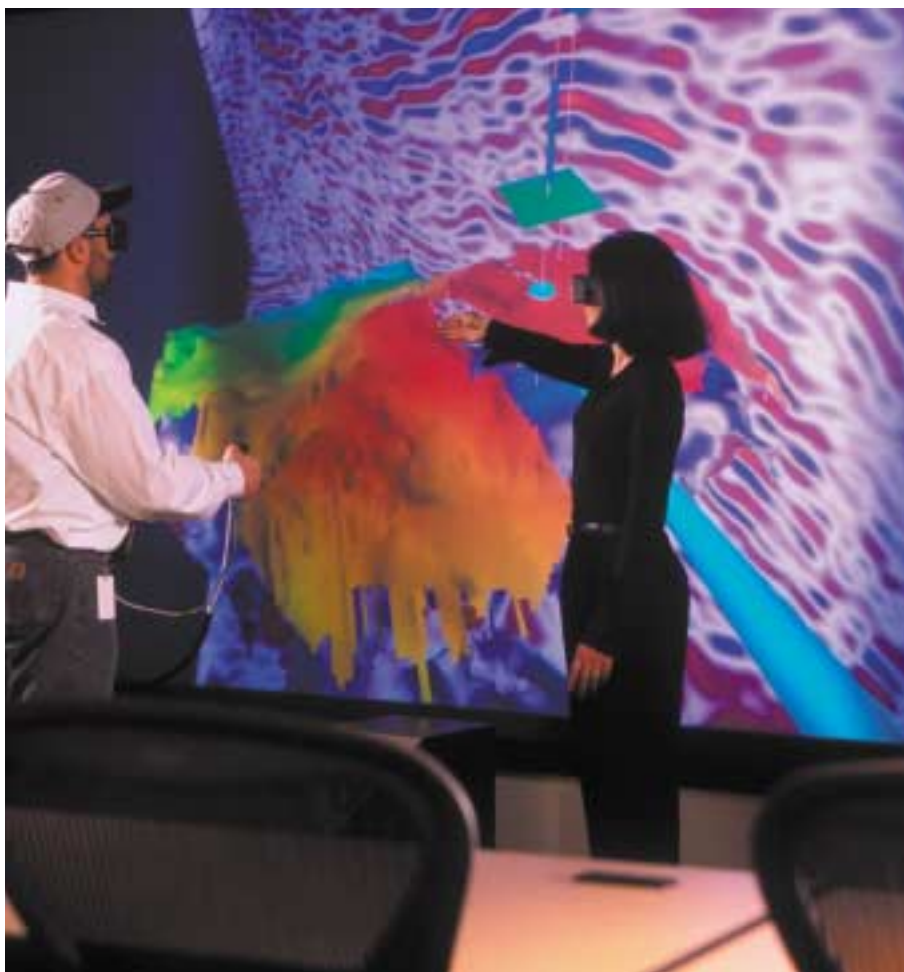

Two geoscientists are immersed within their prospect using Inside Reality, creating a new well drill plan using all the available geoscience data and offset well information. (Photo courtesy of Schlumberger)

The log provides information on critical parameters such as water saturation, density, porosity, permeability and rock mechanics so engineers have the information they need to design a fracture treatment.

The company's in-house processing capabilities offered by the DCC have saved tremendous money over the years in terms of rig and processing time. For example, saving 10 hours of processing time can potentially save the company about $60,000 in light of offshore daily spread rates.

Editor's Note: iCenter, InterACT, GeoFrame and Inside Reality are marks of Schlumberger.

Do You Need Capital?
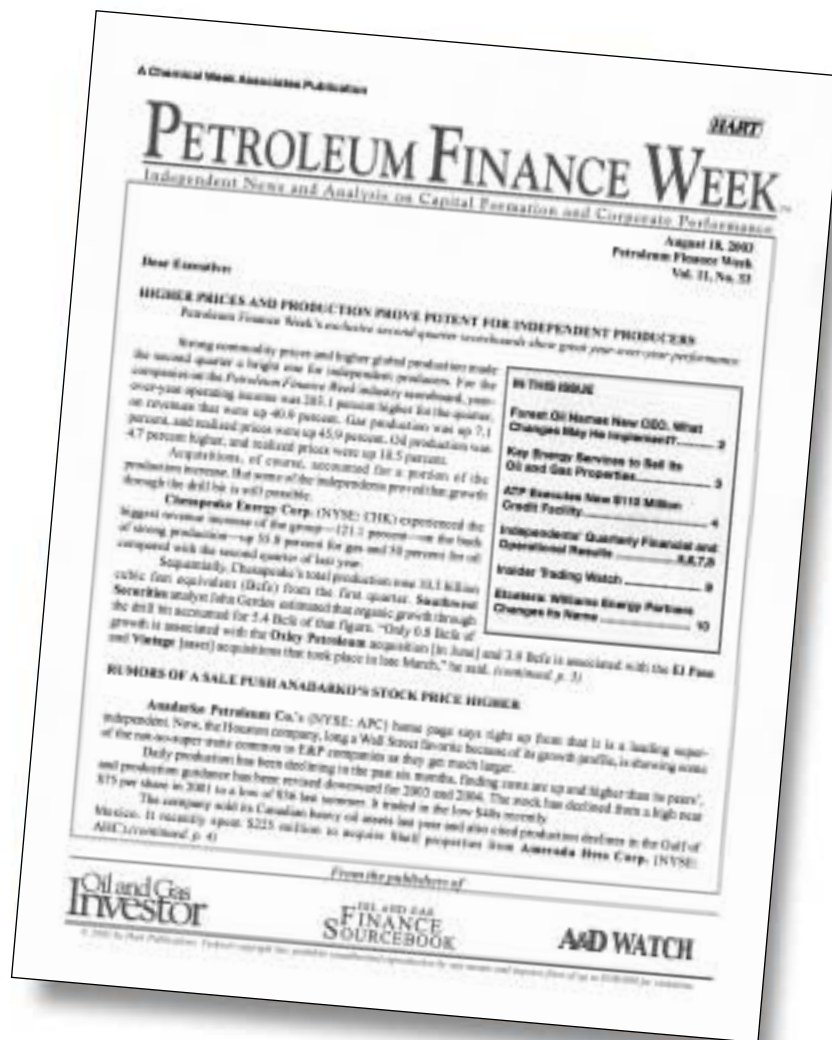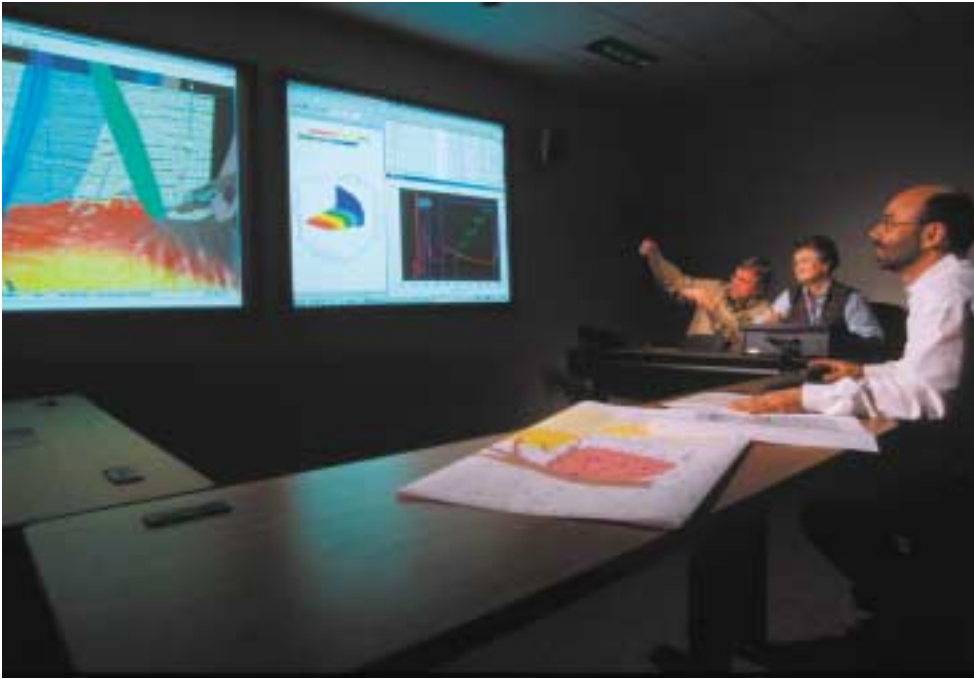
Technical team members are monitoring in real time via the InterACT system a formation's hydraulic fracturing, aided by the 3-D geological model enabling them to visualize the field. (Photo courtesy of Schlumberger)

El Paso not only needed to have data processed quickly, it required that the data be presented in a manner such that technical people could come together simultaneously to analyze them for decision-making purposes. Schlumberger's InterACT real-time monitoring and data delivery system helped us accomplish this by providing Web-based data delivery with secure, two-way real-time communications. Individual users, from technical team members to senior management, have access via a user name and password to the company's data in real time.

The iCenter

While the DCC and InterACT were instrumental to El Paso's business operations, we needed a venue to host collaborative sessions. This was accomplished by adding the iCenter, which adds a time-critical dimension to the typical visualization center with the utilization of immersive and collaborative 3-D tools. It is tied directly to the DCC and the InterACT system and provides a secure, networked, collaborative environment.

The iCenter integrates hardware and software. Along with sophisticated information technology integration, it brings together the work of multiple technical disciplines. It enables our multidisciplinary teams to collaborate—locally and remotely—to better understand complex data and solve challenging problems.

Energy companies involved in global operations are diverse and require different solutions and services to conduct their core business operations. As such, two distinct iCenter rooms were developed: Geoscience vision rooms and InterACT communication rooms. El Paso's iCenter consists of one large and one small vision room and two InterACT rooms. El Paso's two vision rooms enable two simultaneous Inside Reality sessions to be run because of the company's high ongoing rig count.

Inside Reality supports a fully immersive environment that enables the technical team to visualize and interact with all relevant data types and images simultaneously for increased understanding of complex data sets. The vision rooms have large screens with bright edge-blended projectors to provide immersive images that can be viewed in stereographic projection. Head-tracking devices connect the team to the virtual world, making it possible to walk into 3-D datasets and models.

A handheld, cordless 3-D mouse operates the system and supports natural hand interaction with the data using gestures like pointing, grabbing and drawing. The resulting 3-D visualization facilitates geologic interpretation and analyses. By analyzing the reservoir in a 3-D manner, our staff can be completely immersed in a project, thus providing a better visual perspective of what the structure looks like.

El Paso has 3-D seismic coverage on almost every block of the Gulf of Mexico shelf and in many onshore areas such as South Texas and Louisiana. The company's approximately 32 terabytes of data reside in Houston. The iCenter's specialized software allows the company to scan tremendous volumes of this 3-D seismic much quicker than with conventional methods, permitting incredible time savings.

Having 3-D visualization capabilities also permits more thorough analysis by creating the ability to slice data in arbitrary directions. With Inside Reality, we can look at a seismic profile and pick on a particular event, perform amplitude analyses and then do a volumetric calculation—instantaneously.

Redirecting a Louisiana well

We also use Inside Reality for interactive well placement. We can draw new well paths directly in 3-D space, optimally positioned relative to surface seismic, geological models and other

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Having 3-D visualization capabilities also permits more thorough analysis by creating the ability to slice data in arbitrary directions.
With Inside Reality, we can look at a seismic profile and pick on a particular event, perform amplitude analyses and then do a volumetric calculation—instantaneously.

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data, including various targets or drilling hazards. Recently, we modified the trajectory of a Louisiana well while it was being drilled, via Inside Reality, to optimize production.

We reviewed the well path at about 5,000 feet in a well targeted to 21,500 feet total depth. The technical and managerial teams agreed that a slight adjustment of the original target location would result in a more productive well.

However, there were restrictions to changing its surface location, which was in the environmentally sensitive transition zone in Vermilion Parish. The location was marshland in water about four feet deep. Therefore, the drilling engineers changed the subsurface direction, performing essentially a sidetrack and making the required modifications to the casing program. Results were excellent.

The primary mechanism that El Paso uses to move data between Landmark and other software such as Schlumberger Inside Reality is OpenSpirit, which is a software middleware to access multiple databases. The OpenSpirit platform-independent framework allows rapid data access and transfer from one project to another.

The ability to modify, in real time, frac design in collaboration with a multidisciplinary team of experts allows us to optimize treatments and subsequent production, and save time and money.

The Australian well

The InterACT rooms have front- and rear-projected projectors and are used for anything that does not require visualization, such as real-time well monitoring of logging, testing and fracture stimulation surveillance. We saw the benefits generated with InterACT during logging and testing of an El Paso well in Australia.

The tests used the Schlumberger modular dynamics formation tester (MDT) tool. MDT testing is a sophisticated technique for obtaining multiple fluid samples and reservoir pressures in the same descent. For the previous well, the company sent a two-person team to Australia for 10 days, which was a costly exercise. There was also a significant phone bill associated with an engineer's overseeing one lengthy MDT testing operation.

But for the next well, after installing the InterACT system, no overseas travel was needed and we did not incur expensive phones bills. Rather, team members could be in their living rooms or conference rooms and obtain the real-time information as if they were sitting in the logging truck. Moreover, instead of just two people, although very capable and talented, the entire technical team was making decisions on the well.

The InterACT rooms of the iCenter have a live feed that provides real-time logging and testing data on a large screen, allowing the technical team to make better and quicker decisions.

Frac design

Perhaps even more important to us is the real-time monitoring of fracture stimulations. Fracturing for El Paso is about as important as drilling because we hydraulically fracture virtually every well we drill. Decisions have to be made from the beginning of the frac design and throughout its operations.

Frac design and monitoring now takes place in the iCenter while the actual frac takes place in the field. The ability to modify, in real time, fracture design in collaboration with a multidisciplinary team of experts allows us to optimize treatments and subsequent production, and save time and money.

Previously, our team of engineers would go to the well site to observe and make decisions. Now, El Paso's crucial frac operations are supported remotely from the iCenter complex, where often, multiple frac operations are monitored and evaluated on a daily basis.

The DCC provides the data for fracture design. The secured connectivity to the well site via the InterACT system provides a team of fracture specialists with the means to physically observe and alter the fracture treatment right in the iCenter facility. Also, El Paso's partners can access data via the web-based InterACT system with a name and password clearance provided on a well-specific basis.

In general, this collaborative environment created by the iCenter is conducive to conducting successful meetings. In the past, there was a somewhat "keeping close to the desk" working environment from department to department. Now multidisciplinary teams want to meet, share ideas and exchange information, even at the early stages of the exploration and production cycle.

Improved collaboration and communication among team members is transforming conventional workflows and critical decision-making. The environment promotes collaboration across disciplines, but also within a particular discipline. For example, the collaboration crosses project boundaries so that, say, geoscientists on different projects might discuss why a technique worked on one project and not on another. It does not matter whether the technology is 3-D visualization or a PowerPoint presentation, the iCenter brings people together to exchange ideas and share information to develop a better product for El Paso.

El Paso delivers gas very quickly to its pipeline system, the largest in the United States, and optimal hydraulic fracturing is essential to the company's production. Timing is critical and the company takes, in the appropriate circumstances, a certain amount of risk in conducting its business. Therefore, one can imagine the importance of having processed data and frac designs as soon as possible.

The DCC's expedited processing and real-time transmission of data via InterACT is paramount to this company's business of exploiting its assets and improving its bottom line, and the iCenter brings everything together in a collaborative, high-tech environment.

If one well's target location can be adjusted to a better quality sand, or its trajectory optimized to increase pay and therefore producibility through amplitude studies performed with Schlumberger's Inside Reality and other sophisticated software, then the improved economics can essentially pay for an iCenter facility.

Now imagine the potential if these profits are multiplied by the number of wells that El Paso drills on an annual basis.

Reynold Decou is director, geological operations, technical services group, El Paso Production Co. in Houston.

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