Knowledge Management Will Maximize Upstream and New IT Architecture Value-Creation.

John Gibson

Landmark Graphics Corporation

Knowledge Management and New IT Architecture Will Maximize Upstream Value-Creation*

by John W. Gibson
President and CEO, Landmark Graphics Corporation

Long before the oil price collapse of 1998, the petroleum industry has been on a roller coaster ride that is not over yet. Despite the current high oil prices, slowly rebounding energy stocks and a general atmosphere of optimism, our industry faces a number of serious challenges in the coming years.

For one thing, our workforce is rapidly aging and enrollments in petroleum-related university programs are at record lows. So, we are facing an impending shortage of intellectual capital, which will impact our ability to make wise decisions. Knowledge management, therefore, must become a way of life, not just another buzzword.

Furthermore, energy companies are still not as consistently profitable as other investment alternatives in the marketplace. The oil and gas industry must leave no stone unturned in its quest for greater efficiency and productivity. New Internet-based IT architectures will be necessary to enable us to sustain and grow profitability, not just at $25 per barrel or $4 per Mcf, but at *any* price.

Part 1 of this paper explores the "people problem" and issues of knowledge management in more detail. Part 2 will describe an emerging IT infrastructure that promises to lower costs and maximize both efficiency and value industry-wide.

PART ONE: Knowledge Management

Anybody out there want a job in the energy industry? How many of you have recommended that your own children pursue a college degree in petroleum engineering, geology or geophysics? That is how I have opened several recent presentations to executives of multinational oil companies. Not surprisingly, people laughed. Most industry executives know that there is a looming crisis, and luckily we can still laugh about it. Unfortunately, it is no laughing matter. If we do not do something, we could lose almost two-thirds of our current knowledge workers in the next seven years.

E&P Demographics

According to a recent study, there are only about 2,000 petroleum engineering students in the United States today. The number of new hires entering the industry significantly lags the current attrition rate. For decades, overall headcount in the E&P business has been declining, and it has not hit bottom yet. During the 1980s, the size of the industry workforce reached an all-time high. Today it stands at less than half that number.

*First published in *World Energy*, Vol. 3, No. 2 – 2000.

I predict that we will reach a theoretical “base level” of perhaps 100,000 people within the next two decades *(Figure 1)*.

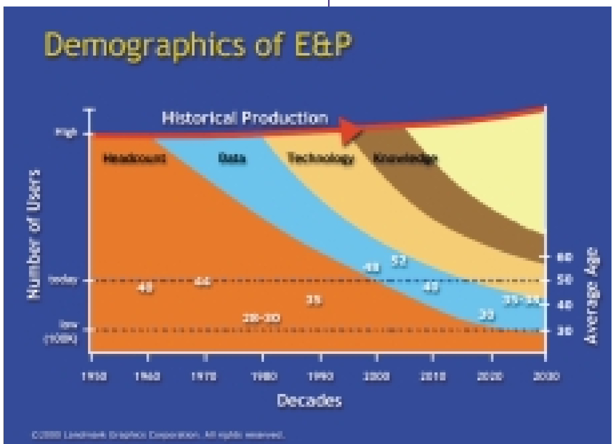

Figure 1

Remarkably, during these past four decades of boom-and-bust cycles and declining headcount, the E&P industry has managed not only to sustain, but *increase* hydrocarbon production to meet world demand. Most of us fully expect that trend to continue into the foreseeable future. How, then, have we successfully offset the continuous drain of intellectual capital?

Initially, starting in the 1960s, acquisition of new data, especially seismic, helped to improve productivity. Then, beginning in the early 1980s and continuing to the present, new *information technologies* — first, stand-alone systems, then integrated applications and databases, and continuously increasing compute power — began to compensate for repeated cutbacks in human resources. Today, we are witnessing the dawning of a new era in which the management of *knowledge* will improve productivity more than any amount of new data or technology. Once we have captured, stored and statistically analyzed our existing information, we can expect to see the rise of *intelligent “self-optimizing”* systems that — over the long term — will replace many of today’s human activities in E&P, enabling headcount to decline even further without sacrificing productivity.

Meanwhile, the average age of our present workforce is higher than ever before, and still rising. When oil prices dropped off in the early 1960s, hiring stopped and the average age of those who remained increased to the lower/middle 40s. Due to the oil embargoes of the 1970s, the industry experienced a hiring boom that attracted younger people, bringing average ages down to the upper 20s/lower 30s. As we all know, in retrospect, oil companies hired too many people. When the oil price collapsed during the 1980s, headcount plummeted again. A decade and a half of downsizing ensued. The average age began increasing as employers recruited few new hires and the energy business became less attractive to people just beginning their careers.

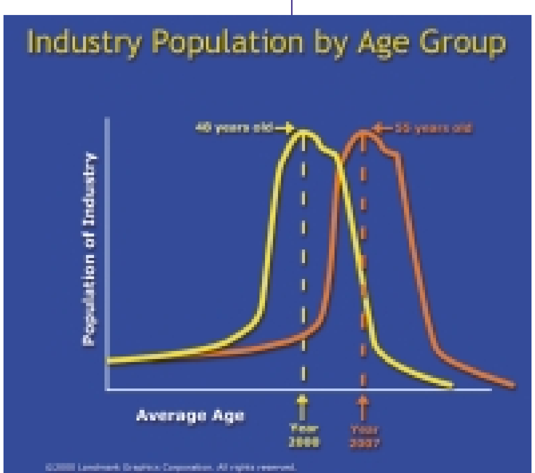

Figure 2

Today, the average age is about 48 years old *(Figure 2)*. A “young” worker is 43, and an “old” one is 55. Soon, therefore, many of our most experienced people will retire. Those who are 48 today will likely retire by age 55 in 2007.

Existing industry retirement practices still encourage early out at 55, even though that is clearly no longer appropriate. Furthermore, there is a cultural shift toward enjoying retirement, and stock market successes over the past ten years have provided people with sufficient nest eggs to do so. Finally, many people are leaving simply because they are tired of the boom-and-bust cycles. They are exhausted by the industry’s persistent inability to predict and accommodate changes in the marketplace. Everyone believes that today’s inflated oil prices will go down again. It is no wonder that few of today’s older E&P professionals are urging their children to follow in their footsteps.

Implications of An Aging Workforce

What are the implications of current E&P demographics? Think of our knowledge workers as the key to the entire industry's ability to make wise decisions. *By 2007, if we do nothing at all, approximately 60 percent of these people will leave the industry forever (Figure 3).* If that happens, our ability to make the decisions we make today will drop to 40 percent of current capacity — a dangerous situation indeed. Three steps, therefore are necessary to maintain, and hopefully, to increase productivity in the coming years.

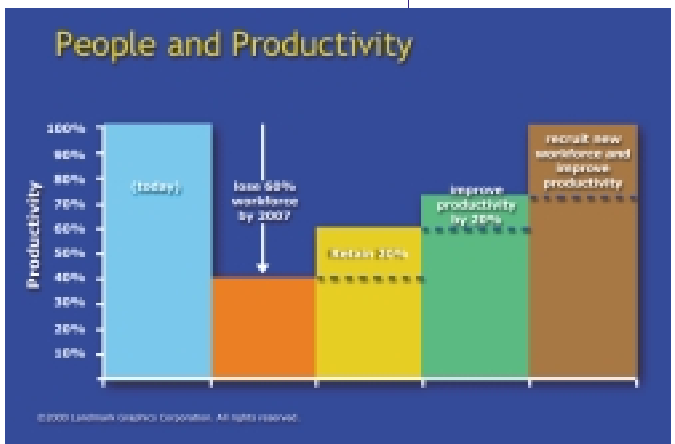

Figure 3

First, we need to design compensation packages and retirement programs that retain as many of our experienced knowledge workers as possible. Let us assume if we are lucky, we can retain 20 percent of those who would otherwise retire. That only brings us back to 60 percent of our current decision-making capability.

Second, we need to implement new ways that will increase the productivity of existing E&P professionals — both individuals and teams — through better workflow practices and integrated information systems. Fortunately, these types of solutions are available today, and have proven their ability to increase productivity at least 20 percent. Assuming, therefore, that today's users can improve by 20 percent, the industry could maintain 72 percent of its current productivity. What about the remaining 28 percent gap?

The third step that we need to take is to begin aggressive and creative new global recruiting efforts (largely among Third World nations and developing economies since there simply are not enough students in the United States or Western Europe). Of course, the only people left to recruit will be younger. If we are successful, the average age of our workforce should begin declining again within the decade.

However, since we still have not reached the industry's theoretical "base" headcount, we cannot afford to hire as many people as are leaving. That means new hires will have to be *twice as productive* as present workers. Given the comfort level most young people have with computers and the Internet today, it is not hard to imagine they will be able to run circles around the rest of us — at least technologically. But what about their *lack of experience?*

As older people retire and younger people enter the industry, the workforce will become increasingly dominated by inexperienced E&P professionals. Inexperienced workers lack the knowledge to make many of the decisions for which they will be responsible. They will make more mistakes. And mistakes are not only costly, but in some cases, deadly. What types of mistakes can we anticipate? Dry holes, overlooked prospects, safety violations, increased "re-do" and lower performance overall — Not a pretty picture.

How, then, will the energy industry be able to succeed in the critical years ahead? First, by *capturing the knowledge* that is currently leaving our companies.

Second, by *"condensing" and transferring* that knowledge as efficiently as possible to the new hires. Let us consider each of these steps in more detail. But first, we need to define exactly what we mean by "knowledge."

Data, Information and Knowledge

Before we can attempt to "manage" knowledge or put it to work, we need to establish a common vocabulary. People often talk about "converting data into information and information into knowledge." Occasionally, they also confuse these three terms.

"Data," as I understand it, are *simply structured records of transactions.* For example, records related to drilling a deviated well might include true vertical depth, the top of the target interval, total drilling time and total cost compared with the AFE. Data, however, do not set context or meaning. They do not explain, for example, why the target reservoir was or was not encountered as predicted; whether the drilling schedule could have been shortened or why the project ran significantly over budget.

"Information" results from *adding meaning and context to data with the intent of influencing the perception of a receiver.* Thus, for data to become information they must be sent to someone and interpreted. How people — senders and receivers — interpret data depends very much on their accumulated knowledge.

"Knowledge," according to Davenport and Prusak, authors of the book, Working Capital, is "a fluid mix of framed experience, values, contextual information, and expert insight that *provides a framework for evaluating and incorporating new experience and information.*" We gain knowledge through formal classroom training; books, meetings and movies; relationships with friends, family and colleagues; from work and life experiences. We use knowledge to make decisions.

In the oil and gas industry, most of us share a fundamental belief that *it takes an average of seven years for new E&P workers to achieve a level of competence that permits them to make or recommend appropriate risk decisions* — not just any decisions, but decisions that comprehend all of the actual risks and costs involved. Anyone can recommend a decision on the first day of work, but they do not know enough to predict whether or not the results will be successful.

Our challenge today, given current demographic trends, is to find innovative ways of *condensing* seven years of knowledge into a much shorter interval of time.

Fortunately, knowledge or "experience" is not equal to "years of work" in any industry or field of endeavor. Some people who have "been in the business" for 25 years have gained one year of experience and just repeated it 25 times. We all know people like that. We also know people with much less time on the job who are capable of much better performance. Beethoven played the piano better at the age of seven than most musicians can after decades of practice.

Having "more experience" really means a person has acquired a greater number of *mental models* or "patterns," good and bad, against which he or she can evaluate new experiences. Pattern recognition is the essence of "intuition," which is the secret to rapid, complex responses.

When you are on a drilling rig and the well takes a kick, you do not have time to use a search engine on the Internet to figure out what to do (though the more distant future may hold that possibility). You may have mere minutes before you must take decisive action. It is critical that you already have a set of mental patterns to choose from so that you can make the "appropriate risk decision" in real time. Lives may depend on it.

Mental Models

Mental models, which form the basis of "knowledge," come in two basic categories: pain and pleasure. Painful experiences — like that auto accident last year or recommending that dry hole last month — generate patterns that are stored in the mind as "war stories." Pleasant experiences — that vacation in the Caribbean or drilling that big discovery — are stored as "fairy tales." When we instinctively (and often unconsciously) compare new experiences or information with our past successes and failures, we are doing pattern recognition, pure and simple. In the process, we may notice a perfect match, a partial match or no correlation at all.

A perfect match between a current situation and a fairy tale "says" go ahead and do this. For example, if you are recommending an exploratory well in the Yegua formation and I have already drilled a similar discovery in the Yegua, I may have little trouble approving your proposal. But a perfect match between your recommended well and a War Story — e.g., an embarrassingly dry hole I once drilled in the Yegua — "says," Stop! Do not do this! Perfect matches often look black and white, and they are usually the easiest to explain.

On the other hand, partial matches between our mental patterns and new situations often come in shades of gray, depending on how much a present pattern overlaps our past experience. In these cases, we say things like, "I do not feel good about this..." or, "I guess this might work..." Hesitant responses signal a partial match, an imperfect analogue.

For example, you recommend an exploratory well in the Wilcox, which is a similar depositional environment at roughly the same depth as the Yegua where I have drilled a discovery. Although the two reservoirs are not identical, they share enough characteristics that I suspect your proposal may succeed. But if you recommend an exploratory well in the Wilcox that uncomfortably reminds me of a *dry hole* I drilled in the Yegua, despite whatever differences that might exist between the two formations, I will probably frown, clear my throat and waffle. The magnitude of the potential loss appears greater than the chance of success.

Every once in a while, we encounter a situation for which we have no mental pattern. When that happens, it is critical that we find someone who has the appropriate experience to help us make the right decision. Normally, almost any new experience or piece of information will overlap one or more existing mental patterns of our colleagues, partners or team members. That is why it is critical to capture all the knowledge and all the mental models we can before our veteran workers leave the energy industry forever.

Capturing Knowledge

What is the best way to capture the knowledge of experienced E&P professionals? I have already suggested that most of our knowledge is mentally archived in the form of stories, not just abstract concepts or naked facts. Capturing knowledge, therefore, can be as simple as capturing, cataloguing and sharing our stories of success and failure.

Create a storybook. No new technology is necessary, although certain existing tools — such as Landmark's Web-based *OpenJournal* software and *Knowledge Reference System,* as well as various search engines — could be enhanced to better meet this particular need in companies. Text, photos, video clips, sound bites and other media could be brought to bear on the process. But at heart, it is a matter of good storytelling, an ancient art form still practiced by old hands in the field as well as presidents and chairmen of the board. All we need to do is get more intentional about it.

To do so, oil and gas companies need to reward knowledge workers who take the time and effort to capture their knowledge and convert their stories into permanent digital form. This, in fact, would be an extremely appropriate and timely activity for those professionals who have reached retirement age, but are willing to stay on a bit longer to "download" their experiences into the corporate knowledge management system, in whatever form it might take.

Where, exactly, should we start? As I noted above, we all have "war stories" that have come from monumental failures. War stories are great mental patterns we do not soon forget. Most people have a whole repertoire of these stories, and they have probably already told them time and time again. These embody urgent, critical learnings that when passed along to our younger counterparts, could save lives as well as large amounts of money. On a rig site, ask any seasoned driller if he has "ever seen one of those things catch fire," and you will get an earful of war stories.

We also need to tell our fairy tales and funny stories. These represent important learnings from situations that may not have been harrowing or life-threatening, but are vivid and valuable nonetheless. These, too, are great mental patterns worth passing along to new hires.

To fully capture knowledge, however, we should preserve the *subjective* as well as objective aspects of our stories — those "intangible" parts of success or failure. If a project succeeds, it is important to know why: "We all understood the business objectives," "Gina was tireless," "The metrics for success were actually too low," "Bill's experience on this type of project paid off," "Everyone worked well together," "We had the right technology, time and budget." If a project fails, we need to capture feelings as well as facts: "We were not sure what success really meant," "Gina was tired," "Bill's lack of experience cost us big," "We were missing critical data," "Everyone underestimated the risk."

Without this additional layer of interpretation, project data are just simply data. It never quite graduates to information or has much chance to influence the perceptions, mental patterns and decisions of a younger generation of workers. Hence, it cannot contribute to the growing repository of corporate knowledge.

Condensing Knowledge

In defining knowledge, I mentioned a fundamental industry belief: that new E&P knowledge workers require about seven years of experience before they can make appropriate risk decisions. That means it typically takes seven years to build a sufficient number of mental patterns before an individual can really understand the impact of a particular business decision. How many patterns do E&P professionals develop in seven years?

Let us assume that most explorationists generate about 20 leads per year — 20 potential exploratory well locations. Now, assume that two of those leads actually get approved and drilled each year. In seven years, a typical explorationist would generate140 leads, and add 14 war stories or fairy tales to his or her knowledge base.

In production, a typical geoscientist or engineer would work up about 60 opportunities a year — sidetracks, workovers, infill wells, plug backs etc. About 24 of those would get approved each year and implemented in the field. In seven years, that is 420 opportunities and 168 success or failure stories.

What if we could provide roughly the same number of learning experiences, the same number of mental patterns, good and bad, in much less time? What if we could *condense* all this knowledge and give it to a new hire in, say, a matter of months? This is the hidden knowledge opportunity our industry faces over the next few years, the light at the end of our current demographic tunnel.

Here’s what I propose: with very little effort, using existing technology, we could design and build “decision simulation” systems that would allow new users to generate projects from actual field data, submit proposals for approval, drill wells or whatever, and immediately learn the technical and economic outcome of their decisions.

With such systems, new hires could *succeed or fail at very little actual cost* to the company or the industry, and rapidly build all those mental models under working conditions that closely approximate reality — without taking seven years to do so. Think of these as flight simulators for the oil patch.

Decision Simulation

How would decision simulation for petroleum exploration and production actually work? Let me be clear about one thing right up front: I am not talking about “training” in software application button pushing.

The best place for the next generation of E&P professionals to learn how to use the latest technology is while they are still in school. That means energy companies and technology suppliers must commit significant resources, both money and personnel, to aggressively support and enhance our top petroleum-related college and university programs. The next best way to learn basic, intermediate or even advanced software functionality is through self-paced, Internet-based distance learning programs.

Decision simulation experiences could also be delivered via distance learning, but the intent would be totally different. I am talking about *learning to make critical business decisions,* not learning to use technical applications, by leveraging those real-life war stories and fairy tales captured by our more experienced knowledge workers.

Let us say we decide to build a “decision simulator” for a particular “decision node” in the oilfield life cycle: “prospect generation”. Since this is exploration, our initial goal is to have new students develop 20 leads, make two drilling recommendations and learn from the results. But instead of taking a year, we do it all in weeks. How?

To simulate reality, we provide students with data from an area where we already know the answers. But we cheat — We go back in time and leave out all the data from all the dry holes and producers we actually drilled later on. To save time, we digitize, load and quality-control the data and point them to the relevant Web site. Maybe all they get to begin with are a few well logs, tops, paleo data and articles on the geology or depositional environment.

Their first assignment is to review the literature and understand the regional trends. Then they have to map an analogous field nearby, explain why certain wells produced and others did not. To further approximate reality, we could give them bad data and let them sort it out — or not. Next, they must identify 20 reasonable prospects, pick the best two and work them up for presentation to “management.”

At this point, we could reject or approve any of their well proposals. But, for their own learning, it might be best to accept whatever they propose and let them live with the consequences. Either way, we “drill” the first well immediately (no waiting for next year’s budget or better weather or oil prices to stabilize), and give them whatever information we have at or near that location.

They find out immediately if their decisions are good or bad, scientifically and financially. And, they begin building those hard-earned mental patterns of success or failure, developing the “intuition” of a seasoned professional. After they re-do and check their work, we ask them to write up a “war story or fairy tale” for the corporate knowledge management system.

Once a new hire has successfully completed a particular decision simulation module, they receive a certificate and move on to the next.

If we are smart, we will reward them in accordance with their proficiency in the simulator, and “graduate” them only when they demonstrate an ability to make appropriate risk decisions in complex, real-world situations. With decision simulation, they will be able to do that in far less time than ever before. And they will have to fail at a multimillion-dollar endeavor in the process.

The Time to Start is Now

Within seven years, unless we do something pretty innovative, the petroleum industry stands to lose about 60 percent of its present aging workforce. New, inexperienced workers, however energetic, will make costly mistakes.

We need to begin *now* to capture the intellectual capital that will soon be leaving, and to build decision simulators capable of condensing that knowledge and transferring it more efficiently to the next generation. Those visionary oil companies who do so should be able to weather whatever new storms that come their way.

PART TWO: Emerging IT Architecture

Megamergers, global expansion, continuous price pressure and renewed commitment to long-term value creation are motivating petroleum companies to alter the way they store, access and process technical and business information.

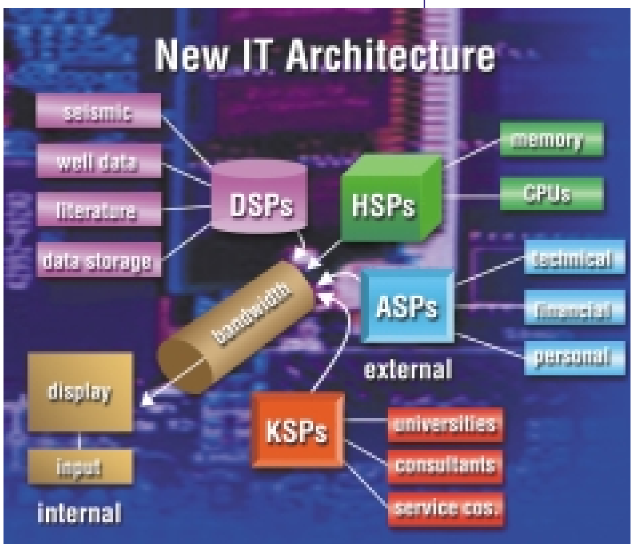

Figure 4

Today's business imperatives require that E&P knowledge workers access the same data from multiple locations worldwide; that asset teams inside the corporation collaborate more effectively with service companies, partners and suppliers "outside the firewall" and that more and more key decisions be made in "real time."

As a result, new, high-bandwidth IT architectures are emerging, and oil companies are experimenting with radically new business models in the age of the Internet. These new approaches to business promise greater economies of scale and scope, and unprecedented levels of productivity and profitability.

The Key: Bandwidth

According to recent studies, demand for Internet bandwidth currently doubles every 15 weeks. Last year, 24 million miles of new fiber optic networks were deployed worldwide, mostly in major metropolitan areas — enough to circle the earth more than 960 times. Total capacity of international fiber in 1999 was 100 gigabytes per second (gbps). Expected capacity by the end of 2002 is 12,000 gbps. That is exponential progress.

Fiber optics are becoming commonplace in our industry to link offshore platforms with onshore facilities in more mature areas such as the Gulf of Mexico, the North Sea and the Campos Basin. Today, we can also use geostationary satellite technology to deliver up to two megabytes per second of data on demand to remote areas of the globe.

Extrapolating recent trends, I believe we can make two quite reasonable inferences: 1) High bandwidths available today in our big cities and major producing areas will soon be available globally, 2) Capacity will continue to increase exponentially to a point where bandwidth will become, in effect, "infinite." As the world's telecommunications infrastructure becomes faster and better connected, the physical location of our information assets will rapidly become irrelevant.

This dramatic change will enable a whole new Internet-based business model and IT architecture *(Figure 4)* capable of replacing much of today's internal IT resources with secure, low-cost external resources through new e-businesses, which I call Remote Service Providers (RSPs).

We are all familiar with one early form of RSP — the Internet Service Provider or ISP. The new IT infrastructure will be built around four additional categories of Remote Service Providers: Data Service Providers (DSPs), Application Service Providers (ASPs), Hardware Service Providers (HSPs) and Knowledge Service Providers (KSPs). I believe this architecture, which is already emerging today, will evolve over the next three to five years into the dominant business model for global E&P. (Hopefully, we will sort out the appropriate vocabulary to describe this model without proliferating more "_SPs.")

In addition to "infinite" bandwidth, my rather bold assumptions *are that users will have no CPU, no memory and no disk storage at the desktop*. All they will have is a graphic display device (monitor, projection screen or goggles) and an input device (keyboard, joy stick or gloves). Why no CPU, memory or storage? To eliminate all the costly redundancies built into our current IT systems. How will this be accomplished? By disaggregating the major components of today's computers and distributing them across the Internet. The "computer" of the future will be the Internet itself.

Let us consider each component of the new architecture in more detail, remembering that they must all work in concert for this model to maximize efficiency.

Data Service Providers

If the desktop workstation of the future has no disk storage on, under or anywhere near the desktop, we will need external "Data Service Providers" to offer instant, secure access to every type of data we currently store — acquired data, derived data, published literature, personal, technical and business data.

External DSPs will come in two basic flavors: those that store raw data *acquired* in the field, and those that store proprietary data *derived* from raw data. No DSP would attempt to store every imaginable data type used or generated in E&P; instead, they would be "fit-for-purpose."

Acquired DSPs, for example, would be organized around major data types that share common characteristics: *seismic* surveys, wireline logs etc. Contractors such as Western Geophysical, PGS, CGG and Veritas would supply all of their raw geophysical data to an independently-managed *seismic* DSP. Oilfield service companies such as Schlumberger, Halliburton and Baker Atlas would provide downhole data to a common Wireline DSP. A *literature* DSP might be dedicated to petroleum-related online articles, abstracts and books from professional societies and business publications. Other DSPs would be formed as needed through joint ventures.

Data models and industry standards would evolve for each type of DSP, not for individual data vendors or the entire oilfield life cycle.

One big difference between today's internal or external data storage systems and *acquired* DSPs of the future is that there will be *only one commercial copy of any piece of raw data.* Under a service-level agreement with a *seismic DSP,* any number of customers will be able to access a single, quality-controlled seismic survey stored in a single location (either regional or global, depending on available bandwidth). When users request a particular 2-D line or 3-D survey from, say, Western Geophysical's library, what they will receive is an "image" of the data, not a "copy." They will be able to interpret, process and otherwise manipulate that image without ever downloading or storing a digital version. When they are finished, the seismic image will simply "go away." They will, however, store any proprietary data they derive from the original, acquired data.

Derived DSPs of the future would be organized along two lines: type of derived data and customer. While many companies could share the costs of archiving and accessing one copy of raw data, there would be no economies of scale or scope for derived or interpreted data. Five companies, using the same seismic survey, would generate five maps. They might also reprocess the survey in five different ways. Unique variations among derived data form the basis of healthy competition and value creation. Therefore, all five interpretations would need to be stored securely in one or more remote DSPs.

While multiple copies of interpreted data would still exist, no monolithic "corporate" data store would need to be designed, built and supported for every individual oil company. Think of the impact on current IT budgets.

Real-time access to data, not *storage of data,* will be the key driver in this new Internet-based data management scheme. Like data will be managed in a like manner. There will be only one copy of the raw data, no "local" copies. We would not need thousands of systems administrators to manage millions of gigabytes of redundant data, bogging down our networks, archiving the same information in hundreds of different companies around the world.

DSPs will significantly lower overall industry costs, funneling that money into more worthy investments. Competition among data acquisition companies in this environment will be fueled by innovation in availability, quantity and quality of data. Everyone will benefit.

Other Remote Service Providers

If we whittle down our current desktop systems to display and input devices only, users will need access to processing power, memory and applications, as well as data. With a continually declining workforce and an influx of younger, inexperienced professionals, energy companies will also need access to knowledge experts in various technical and business domains. Therefore, they will enter into service level agreements with Application Service Providers, Hardware Service Providers and Knowledge Service Providers, as well as Data Service Providers.

Application Service Providers. To date, every user has had numerous software applications loaded onto one or more desktop platforms or internal servers. Technical applications include seismic interpretation, well log analysis and directional well planning. Personal productivity tools includes word processing, spreadsheets and project management. Business software includes human resources, finance, accounting and so on. Every company has acquired multiple — i.e., redundant — copies of every application.

Like external DSPs, ASPs will be fit-for-purpose: some will specialize in technical applications such as Landmark and Paradigm; some will provide personal desktop tools such as Microsoft and Lotus; and others will supply business and financial software such as SAP and PeopleSoft. ASPs will also provide application and user support.

With remote ASPs, once again, there will be only *one copy of each software tool* to load, support and upgrade. Every authorized user will have access to the same copy via the Internet. It is all a matter of innovative licensing. While applications are in use, they will be held in memory. When a particular work session is finished and derived data have been stored in a remote DSP, applications will simply "go away" just like images of acquired data.

Hardware Service Providers. Of course, to hold data and applications in memory and to perform any kind of operations, users will require instant access to appropriate amounts of memory and CPU power from external Hardware Service Providers.

Remote memory must range from megabytes for personal work to gigabytes or terabytes for technical. Users will need scalable processing capabilities, also depending on the task at hand — from a single CPU for word processing or presentation graphics all the way up to high-performance parallel multiprocessors for reservoir simulation or seismic depth migration. Contributors to common industry HSPs would include companies such as Intel and Sun Microsystems.

To maximize performance until sufficient bandwidth enables them to be completely separate, DSPs, ASPs and HSPs may have to be more tightly integrated at first. But I believe every core application used in petroleum exploration and production should be written or rearchitected with this totally virtual IT business model in mind.

Despite increasing bandwidth, most of us still assume that certain applications or data volumes require a massive piece of hardware sitting inside the corporate firewall. As a result, even our latest information technologies are designed to run more efficiently in the IT architectures of the past. If we redesign our software to work in this ultra-distributed computing environment of the future, performance will only get better if we co-locate certain data, applications and platforms in the interim.

Knowledge Service Providers. A Knowledge Service Provider is a network of specialized knowledge workers, almost like an agency. With specially designed user interfaces and search engines, oil and gas companies will be able to locate, consult and contract with experts anywhere in the world.

Through industry-sponsored KSPs, oil field service companies and technology developers will provide access to their cementing specialists, drilling experts and application support professionals. Independent consultants will include everyone from basin modeling specialists to experts in international tax laws and regulations. Universities will offer access to professors, graduate students and research consortia.

KSPs could even help oil companies "catalog" the unique areas of specialization of in-house E&P professionals all across the globe. Then when their expertise is needed, they could be located quickly and efficiently.

Any authorized member of a KSP could be granted access to any multidiscipline, multicompany project. In the IT architecture of the future, all they would need to start working would be a “dumb terminal” and high-bandwidth connection to the Internet.

Conclusion

“Infinite” bandwidth, global access, no local CPU, no memory, no software, no data storage — The implications of this emerging business model are truly astounding:

- unheard-of economies of scale and scope,
- incredibly effective real-time global collaboration, and
- dramatically lower IT costs industry-wide.

At last, petroleum companies will be able to organize around their “core” business — the analysis and interpretation of E&P data — and outsource all of their “context” activities, including the management and storage of data. The much-touted “virtual energy company” will become a reality.

Even the “decision simulation” systems described in Part 1 would be implemented most efficiently through this new IT architecture. Students and new hires would simply register with the relevant KSP, and tap into the entire network of Remote Service Providers from a simple laptop or home computer.

Through innovations in knowledge management and new business models in the age of the Internet, the energy company of the future will reap greater profits. Ultimately, it is not about technology at all — It is about making better decisions.

About the Author

John W. Gibson is president and CEO of Landmark Graphics Corporation. Since joining Landmark in 1994, he has held numerous senior management positions, including vice president of Landmark's Zycor Division, executive vice president of the Integrated Products Group and, most recently, chief operating officer. Gibson began his career in oil and gas as an exploration geophysicist with Gulf Oil Company. Following Gulf's acquisition by Chevron, he became manager of geophysical and geological subsurface imaging for Chevron's Oil Field Research Company. He holds a bachelor of science degree in geology from Auburn University, and a master's in geology from the University of Houston. He is a member of the American Association of Petroleum Geologists, the Society of Exploration Geophysicists and the Geological Society of America.

Landmark

A Halliburton Company

www.lgc.com • moreinfo@lgc.com

Houston (281) 560-1000 • Kuala Lumpur +60 (3) 2164-1121 • London +44 (0) 1932 829999 • Calgary (403) 263-0070 • Caracas +58 (2) 953-0774

Moscow +70 (95) 755-8300 • Dubai +971 (4) 3313142

100399-1100