Building a Knowledge-Sharing Culture

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Knowledge capture and sharing in the E&P industry have taken on added importance as companies focus on productivity gains, improved financial performance and increased asset value. Success depends on creating a corporate culture structured around real-time knowledge management.

An anonymous author once wrote: "Strange how much you've got to know before you know how little you know." Knowledge-building is an ongoing process, a necessity to advance the state-of-the-art. In certain disciplines, such as quantum physics and global environmental control, this process can span generations. Centuries or even millennia can pass as we learn both from our successes and our failures, ascending the hierarchy from initial observations and data to information, knowledge and understanding—the basis for optimal decision-making. .

During the wildcatter days of the upstream oil and gas business, witnessing a gusher erupt through a derrick constituted knowledge, and the only certainty was that a reservoir of some undetermined size had been discovered. In the last half of the 20th century, as the industry matured and measurement technology came to the forefront, exploration and production (E&P) companies were inundated with increasing amounts of surface and subsurface data. The ability to sort these data and find nuggets, separating proverbial wheat from chaff, distinguished profitable

companies from poor financial performers. Reliable, validated data represented the key to efficient and cost-effective field development and hydrocarbon recovery (below).

Despite advances in high-speed, high-power computing and communications technologies, the nearly exponential growth in the volume of modern oilfield data has, at times, overwhelmed those charged with data handling, manipulation and interpretation.
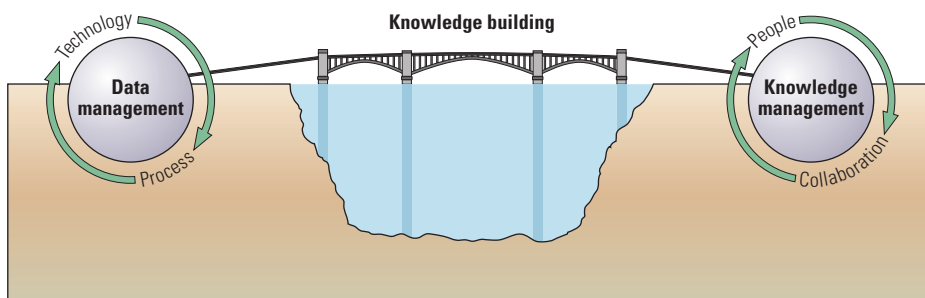
Without data management, knowledge management is impossible. Yet, until the mid to late 1990s, few oilfield companies had defined and implemented a data-management methodology that encompassed full verification and categorization; construction of comprehensive, easy-to-use databases; and utilization of these databases as a foundation for capturing knowledge. This deficiency has driven several companies to initiate comprehensive data-management programs that form the basis for a knowledge-driven infrastructure.[1]
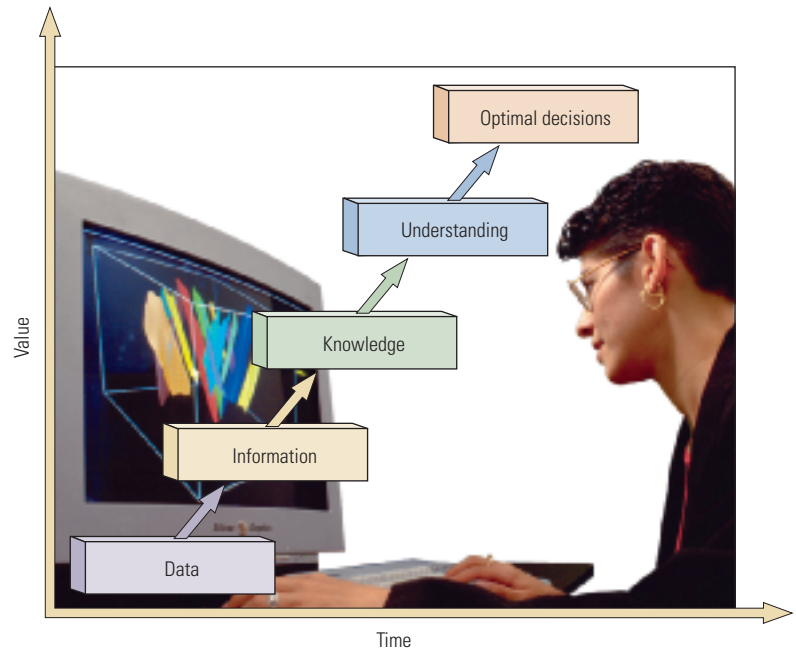
> ^ The knowledge hierarchy. Excellence in business and financial performance requires taking acquired data, converting them first into useful information, then into knowledge and finally into understanding as a basis for accurate, reliable decision-making.
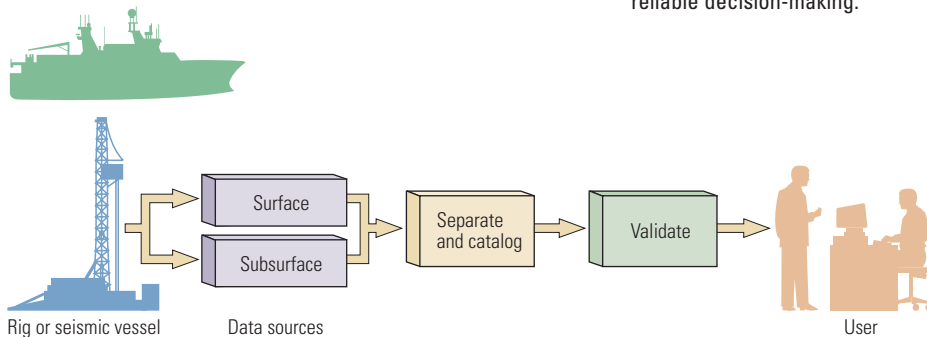
> ^ Taming the data deluge. The massive quantities of surface and subsurface data available from advanced oilfield measurements must be properly separated, cataloged and validated to be of real value to the end-user. This process is a necessary precursor to building a data-management system.

There is, however, a profound distinction between data management—principally devoted to technology and process—and knowledge management—focused primarily on people and their interaction and collaboration. The chasm between the two can be bridged only if companies invest in and commit to building a comprehensive knowledge-sharing culture (below left).[2]

Today, significant progress is being made toward building such cultures, but much remains to be done. Knowledge repositories, corporate memory banks and communities of practice are becoming commonplace in the oil field. The industry is finally beginning to harvest the tremendous value inherent in fully exploiting the data and information at its disposal.

1. Beham R, Brown A, Mottershead C, Whitgift J, Cross J, Desroches L, Espeland J, Greenberg M, Haines P, Landgren K, Layrisse I, Lugo J, Moreán O, Ochoa E, O'Neill D and Sledz J: "Changing the Shape of E&P Data Management," *Oilfield Review* 9, no. 2 (Summer 1997): 21-33.
2. Gould A: "Merging Knowledge and Technology to Improve Oilfield Efficiency," Middle East Oil Show, Bahrain, United Arab Emirates (February 1999).
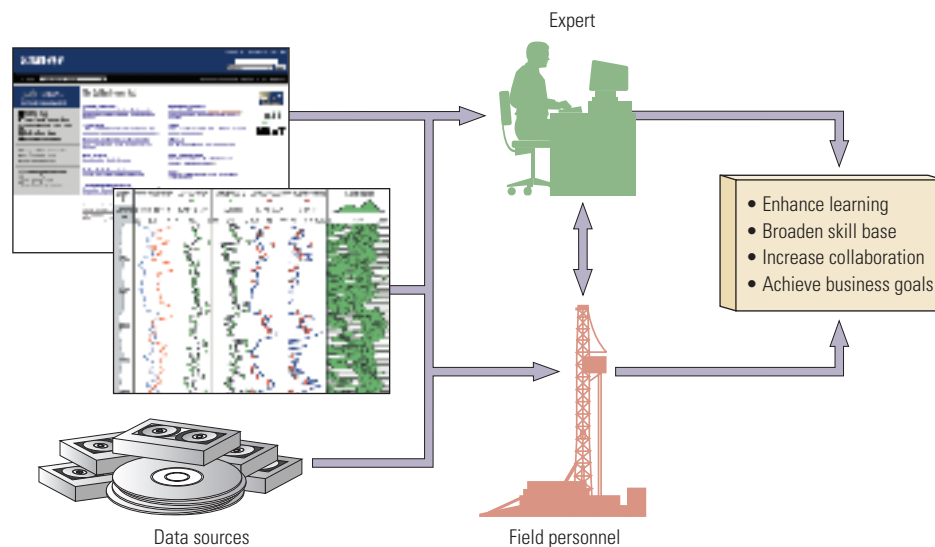
> ^ Bridging the chasm. Data management focuses on process and technology, while the pillars of knowledge management are people and their collective ability to collaborate rapidly and efficiently. Successfully bridging the gap between the two requires a commitment to a knowledge-sharing culture.

^ A new landscape for learning. Efficiency and flexibility in transferring, cataloging and retrieving information have created a business atmosphere conducive to evergreen learning, advanced skill development and collaboration—crucial elements in meeting oilfield technical and business objectives.

Knowledge: Information transformed into the capability for effective action
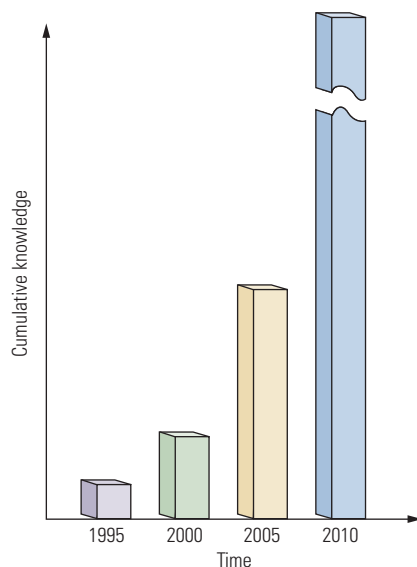
^ The growth in knowledge. Cumulative worldwide knowledge currently doubles every four years. After 2010, it is forecast to double every month. This poses a tremendous challenge to all enterprises. To gain a competitive advantage, a company must be equipped to develop and apply the tools necessary to effectively absorb and exploit this knowledge.

In this article, we discuss some of the knowledge-management initiatives that are elevating the industry's ability to find, develop and produce oil and gas reserves cost-effectively. In the next article, we offer the perspectives of experts from six oil and gas companies who comment on the lessons learned in establishing knowledge-management programs, the benefits that have accrued to date, and what they envision for the future (see "Managing Knowledge Management," *page 66*).

A New Landscape for Learning

The information age has ushered in an era of unsurpassed efficiency and flexibility in transferring, cataloging and retrieving information about people, process and technology. This ability has created an atmosphere conducive to higher productivity, greater cost-effectiveness and total quality awareness. Today—fueled by this new-found ease of accessing data— oilfield professionals are increasingly willing to learn, to broaden and deepen their basic repertoire of skills, and to mold and adapt new information to help achieve both personal and business goals (above).

The thirst for learning and understanding has led to a revolution in structured knowledge-sharing in which the collective experience of multiple experts can be pooled and then disseminated quickly to anyone located anywhere in the world. Desire for increased speed can often conflict with getting the right information of the utmost quality to the right individual at the right time—a prerequisite for accurate, real-time decision-making. However, as we will see, efficient information movement can be achieved with no trade-off in quality, content and delivery flexibility.

What is Knowledge Management?

Knowledge can be defined as "information transformed into the capability for effective action." Currently, it is estimated that cumulative worldwide knowledge doubles every four years, and that after 2010 it will double every month (left).[3] The business impact is staggering. The challenge of absorbing and productively exploiting this knowledge is monumental, but necessary if companies are to remain responsive and competitive in an expanding world of information. Traditional strategies have become obsolete; companies require a proactive, structured methodology not only for keeping up with the knowledge deluge, but keeping ahead of it. The foundation of a successful strategy is knowledge management.

Knowledge Management:	Processes and technologies for capturing, sharing and applying collective knowledge to make optimal decisions in real time.

People ☑
Technology ☑
Process ☑
Content ☑

"Apply everywhere what you learn anywhere."

^ Knowledge management. The transformation of a company into a knowledge-centric organization relies on merging people, technology, process and content as a basis for prompt and well-defined action.

So, just what is knowledge management? No single definition is universally agreed-upon. For this article, we adopt the following: "processes and technologies for capturing, sharing and applying collective knowledge to make optimal decisions in real time." In this context, real time means the time available to decide on an action that will materially affect the outcome (above).

Looking beyond the definition, what is the ultimate goal? Schlumberger sets the target as: "apply everywhere what you learn anywhere." Achieving this objective relies on merging technology, process and people's intellectual capacity, and then transforming the result into prompt and well-defined action.[4]

The focus of knowledge management is improving organizational capability. Success requires creating a new working environment where knowledge and experience can be shared easily. Processes and technologies to accomplish this objective must be put into place. Organizational behavior must be aligned so that information and knowledge merge and flow to the right people at the right time so they can act more productively. First, knowledge management must connect people to information across a broad spectrum of E&P disciplines. This connection includes the processes and encouragement needed for people to not only trust and use the information available, but to then contribute to the global repository of information. Second, people must be connected to people. They need to be able to find each other and be comfortable about asking for and giving help and publishing their experiences. This makes people feel that

they are contributing daily to achieve the company's strategic goals. Increased productivity, accelerated learning, and better and faster decision-making result, enhancing the ability to scale up, energize innovation and foster employee motivation (below).

Today, intellectual capital is rapidly replacing physical capital as the driving competitive force. Investment in knowledge-management solutions brings the power of intellectual assets to the forefront and translates them into real value. As a result, roughly 80% of the world's largest corporations have some type of knowledge-management effort under way—some basic, some highly sophisticated. Oil and gas companies have demonstrated substantial bottom-line savings by adopting and fostering knowledge capture and sharing. Chevron, for example, has reported $2 billion annually in reduced costs, while BP's initiatives saved the company $30 million in their first year.[5]

In building successful knowledge-management programs, four issues must be addressed: people, technology, process and content. The initial knowledge-management wave concentrated

on infrastructure for capturing data, building data storehouses, providing access to these storehouses, integrating and managing them, and then using this capability as a basis for improved decision-making. The current trend in knowledge management is centering on empowering people to use information for creating value through aligned business goals and user needs; the ability to extract, distill and customize knowledge; and, finally, to successfully apply this knowledge efficiently and routinely (bottom).[6]

3. Saputelli LA and Ungredda AD: "Knowledge Communities Help to Identify Best Operating Practices," *Journal of Petroleum Technology* 51 (December 1999): 42-47.
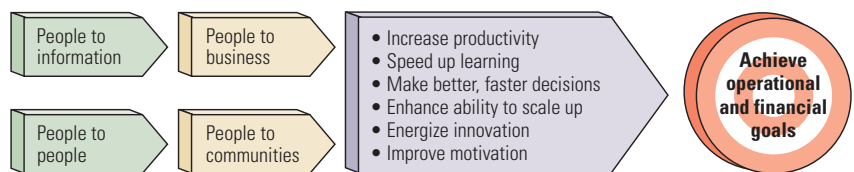4. Smith RG: "Knowledge-Management Solutions," GeoQuest Forum, Kuala Lumpur, Malaysia (March 2001).
5. O'Dell C, Elliott S and Hubert C: *Knowledge Management: A Guide for Your Journey to Best-Practice Processes.* Houston, Texas, USA: American Productivity & Quality Center, 2000.
   O'Dell C, Hasanali F, Huber C, Lopez K and Raybourn C: *Stages of Implementation: A Guide for Your Journey to Knowledge Management Best Practices.* Houston, Texas, USA: American Productivity & Quality Center, 2000.
6. Schafer PA: "Beyond Access—From IT to Managing Knowledge," *Knowledge Management in the E&P Marketplace* (February 2001): 3-4.

Connecting

People to information → People to business →
People to people → People to communities →

• Increase productivity
• Speed up learning
• Make better, faster decisions
• Enhance ability to scale up
• Energize innovation
• Improve motivation

→ **Achieve operational and financial goals**

Collaborating

^ Vital connections. For effective oilfield knowledge management, people must first be connected to information across a broad spectrum of E&P disciplines. Then, people must be connected to each other to improve productivity and decision-making.

First wave
Optimize decision-making
Integrate and manage data
Provide access to data
Capture data; build data stores

Current wave
Create new value
Apply knowledge
Extract, distill and customize knowledge
Align business goals and user needs
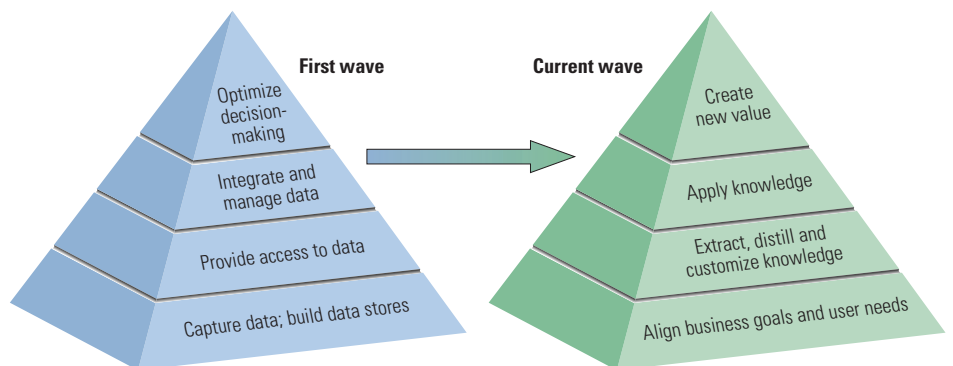
^ Knowledge-management waves. The first knowledge-management wave concentrated on capturing data and building data storehouses to improve decision-making. The current wave is focusing on extracting and customizing knowledge to create new, measurable value.

In 2000, estimates placed the yearly market for knowledge-management tools at between $3 billion and $4 billion, growing to a range of $8 billion to $12 billion by 2003. However, even making a broader spectrum of more sophisticated tools available does not overcome the knowledge deficit—a metric that captures costs and inefficiencies resulting from intellectual rework, substandard performance and the inability to find information in a timely fashion. Experts estimate that this deficit will increase by nearly $20 billion in the next three years, despite equipping 20% more of the workforce with knowledge-extracting technology.[7] Warning signs that a company is not capitalizing on modern knowledge-management practices include repetition of mistakes, duplication of work, failure to share good ideas, loss of competitive position in the marketplace, and inefficiencies in launching new technology (below).[8]

A company may profess that knowledge management is central to its strategies, when in actuality it relies solely on a loose assembly of nonvalidated data and information from which knowledge is difficult or impossible to extract. An ingrained knowledge-management culture improves organizational efficiency and productivity through the collective ability of people to capture, share and use experience effectively. This capability, for example, allows an oilfield service supplier like Schlumberger to deliver the sum of its global knowledge to oil and gas companies, rather than the expertise embodied within a few, local individuals. Active collaboration between oil company and service company technical experts leads to accurate problem-solving, improved productivity and reduced cost. This type of interchange is the basis for building close, long-term, team-based working relationships between the two sectors focused on capturing added value.

Building a Knowledge-Sharing Culture

There is no substitute for knowledge. Albert Einstein once stated, "Knowledge is experience; everything else is just information." It is becoming increasingly important to shorten the learning curve, or the time to achieve full competence; to rapidly assimilate sophisticated new technologies; and to efficiently fill the gaps in a company's knowledge base—particularly as field developments become more complex and operating environments, like the deep offshore, pose increasing demands on people and equipment. Moving forward to be a best-in-class company means transforming everyone in the company into an experienced practitioner in one of more technical or support disciplines (next page, top).

For service suppliers, there is a tremendous competitive advantage in being equipped and recognized as a company that can deliver knowledge-based solutions to oil and gas operators. These solutions are critically important for high-risk field developments. In these instances, knowledge-management principles, coupled with effective risk management, have helped establish record-setting performances—for example, in extended-reach drilling, as described later in this article. Knowledge-management solutions are essential elements in achieving higher production rates, increased reserve recovery and maximum asset value. Success depends on leveraging intellectual capital, sharing knowledge across borders, preventing the same mistake from happening twice and taking advantage of opportunities because the right information is available at the right place, at the right time.

The biggest impediment to transferring and applying knowledge is corporate culture, and the largest difficulty in managing knowledge is changing people's behavior. Many companies are rigorously adopting a knowledge-based philosophy, vowing to be best-in-class by having the best people produce and apply the best technology using the best process to provide the best products and services—in essence creating a knowledge-powered enterprise. For most, this requires a basic cultural shift. People must be equipped with the right tools, including a new

DANGER

- Repetition of mistakes
- Duplication of work
- Failure to share ideas
- Loss of market share
- Inefficiency in launching new technology

^ Warning signs. Inherent in a company without a firmly embedded knowledge-management culture are time- and cost-draining inefficiencies, such as repeated mistakes, duplication of work and failure to effectively share ideas, which can lead to loss of market share and inefficiencies in launching new-generation technologies.

7. Perdue JM: "The KM Toolbox," *Knowledge Management in the E&P Marketplace* (February 2001): 11.

8. Perdue JM: "E-Collaboration," *Knowledge Management in the E&P Marketplace* (February 2001): 32.
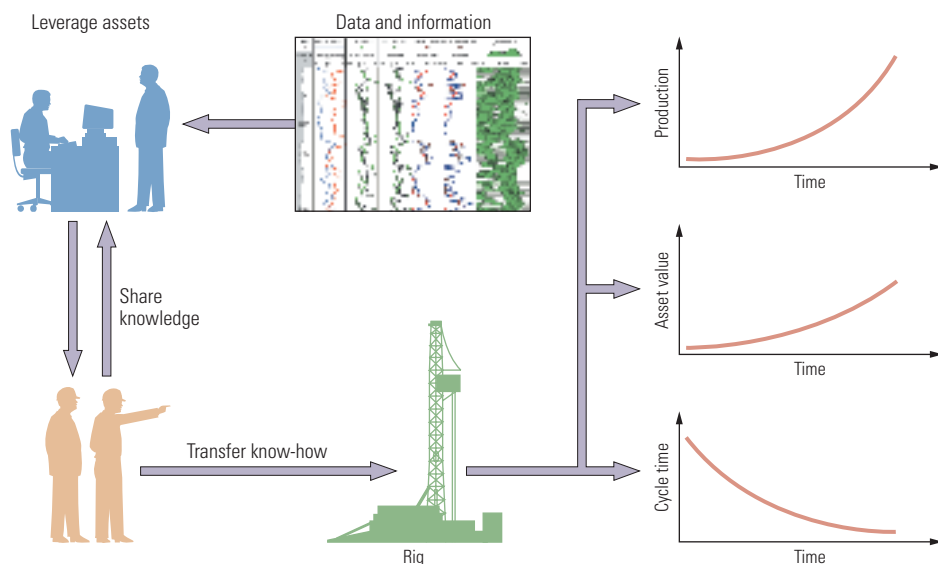
^ Achieving business goals. To generate higher oil and gas production rates and increased asset value, an E&P company must leverage its people and infrastructure through knowledge-sharing and efficient transfer of know-how, for example, from centers of excellence to the wellsite.

generation of business and technical applications that contain integrated decision-support and simulation capabilities, and be motivated to evolve from individual contributors to fully participating members of expert communities. Changing the culture rapidly and efficiently requires an intellectual atmosphere that embraces and rewards knowledge-sharing.

The potential benefits are enormous—organizationally, operationally and financially. The implementation of a knowledge-sharing culture within Schlumberger is creating a dramatically new working environment by tapping into the wealth of data and information already available within the organization. By fostering this culture and backing the commitment with management support at all levels, each individual—regardless of geographic location—is empowered to contribute to, assimilate and draw on a central collection of global experience. Field experts systematically share—as part of their daily job practices—their expertise,

and reuse the knowledge of their peers on an ongoing basis. This translates into reduced job preparation time, less stress, and better customer performance and service quality. At the same time, this compelling environment stimulates creativity and innovation. The bottom line is that people see knowledge-sharing as simply the right thing to do.
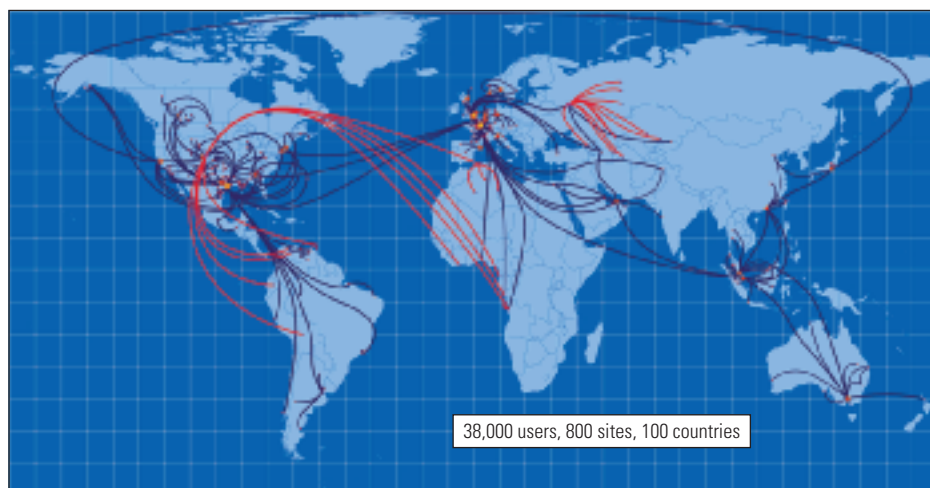
At the request of field engineers, knowledge-sharing has become one of the dimensions along which the company appraises the performance of

its staff. In addition, managers and engineers are responsible for achieving specific knowledge-sharing objectives during the course of the year.
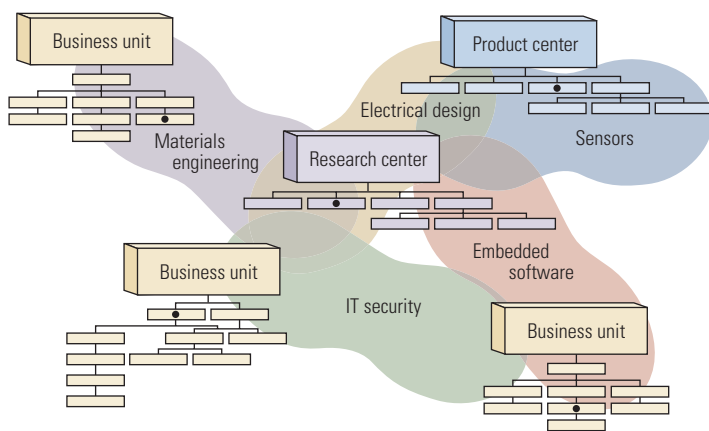
Connectivity and the Knowledge Hub

Connectivity is fundamental to empower and sustain a knowledge culture and its resulting initiatives. More than 15 years ago, Schlumberger recognized that the future of the upstream oil and gas industry would hinge on providing an infrastructure for diverse, globally distributed groups to interact electronically. In response, the company began building and deploying a world-class intranet for rapid and effective communications among all its worldwide locations. Today, it is one of the largest private communications networks in the world, connecting over 38,000 users at about 800 locations in more than 100 countries. This intranet serves as the primary building block for all the company's communication and knowledge-management programs (below).

The next step in building a knowledge-management structure and culture within Schlumberger was creation of a Knowledge Hub. A pilot project was undertaken in early 1999 in cooperation with the Drilling and Measurements business segment. This initial venture in knowledge management had two primary objectives. The first was to build a Web portal for drilling personnel that represented the corporate memory and facilitated the capture and reuse of expert information within the drilling community; the second, to develop a set of knowledge-management standards that other

38,000 users, 800 sites, 100 countries

^ The Schlumberger intranet. More than 15 years ago, Schlumberger began building a world-class intranet that currently connects more than 38,000 users, at 800 sites, in more than 100 countries—one of the largest private networks in the world.

^ Drilling Hub. The result of a knowledge-management pilot project, the Drilling Hub provides a portal into the corporate knowledge bank and best-practices repository for the global drilling community, and has acted as a prototype site for building similar hubs for a full spectrum of oilfield disciplines.

^ The Hub. Individual, single-discipline hubs rely on a central, user-friendly intranet site for finding and retrieving information as quickly and efficiently as possible. This site, The Hub, contains a hierarchical index of more than 10,000 Web pages, with direct access to several million additional pages.

business segments and support groups could apply and easily implement (left).[9]

Today, all business segments have adopted standards developed during that pilot program, following a simple architecture that promotes easy replication. A best-practices and lessons-learned methodology was rigorously followed from knowledge capture and validation to sharing and, finally, application. This provides a mode to quickly move ideas geographically, horizontally and vertically within the organization. Following the same standard, specialized hubs can be created at any time to organize and disseminate knowledge in a particular discipline or domain.

Globally within Schlumberger, individual hubs rely on a central Hub for finding and retrieving information as quickly and efficiently as possible (below left). It is basically a navigation tool, covering a wide spectrum of technical disciplines— utilizing the capabilities of the Internet, backed up by the company's intranet. The Hub leads users to where they need to go with a customized search engine similar to those found on the Internet. Information cataloging makes browsing, searching and retrieval fast and efficient, based on a hierarchical index of more than 10,000 Web pages, and additional access to several million pages on the corporate intranet. The Hub is intended to search into the Schlumberger intranet structure as deep as necessary to utilize the benefits of existing sites, and make use of home pages and links already present.

The Hub serves as a portal into a seamless information space—quite distinct from today's collection of independent Web sites, each with a different user interface and a different way of structuring its contents. Currently, browsing the Web is like visiting different counties. Each site has its own language and local customs, and the experience is anything but seamless. With a knowledge repository like The Hub, finding content on a complex intranet is easy and efficient, encouraging reuse and reducing user frustration that might result from interacting with a slow, cumbersome communications infrastructure.

Today, the Schlumberger intranet and knowledge-management portal support a full spectrum of communities of practice, composed of people in field operations, research and development, marketing, personnel, finance and other key disciplines. Connectivity and interlinked groups of technical experts accessible to the worldwide field organization at a moment's notice form the foundation for InTouch, an initiative targeted at rapid and effective problem-solving. InTouch is described in detail later in this article.

^ Communities of practice. A company's core competencies reside, thrive and grow in communities of practice, which connect experts from within individual business units, research centers and product centers. Communities can be tightly or loosely structured, depending on business needs. The overriding goal is for every member of the community to contribute to knowledge generation and capture, and to use knowledge to improve productivity and performance.

Communities of Practice

The human foundations for knowledge management are communities of practice—collections of experts equipped with the tools necessary to interact effectively (above). These may be technical in nature or encompass diverse disciplines, ranging from marketing and business development to finance, tax and recruiting. Such knowledge communities or professional networks have existed for centuries in both personal and commercial enterprises. Early examples are artisan and trade guilds. An organization's core competencies reside, thrive and grow within such communities as networks of experts share and utilize their knowledge assets. Shared community experience adds vitality and aids in the definition, capture, preservation and dissemination of company and industry best practices that, in turn, accelerate adoption of new technologies and help maintain and further develop core competencies. These communities can be tightly or loosely structured. In the former case, there may exist a need to bring together recognized, formal teams of experts to solve pressing problems. In the latter, there is no prerequisite to define specific teams, task forces or even authorized, identified groups. The communities exist to best serve themselves and each other, utilizing structures commensurate with those objectives. The common goal is for every member to become a full-fledged contributor.

Since experts have been sharing knowledge for centuries, why is the oilfield industry increasing emphasis on communities of practice today? First, electronic collaboration is rapidly replacing face-to-face interaction as companies diversify geographically. The traditional concept of having all technical communities housed only at one or a very limited number of sites, such as research and development centers, is changing, and the linking of experts globally has become paramount in day-to-day problem-solving. Second, optimal use of intellectual capital implies learning quickly and continuously to reap major benefits from the company's most competitive resource. Third, today's routine use of information technology and Web-based collaboration tools fully facilitates capture, sharing and leveraging of expertise and knowledge so that it can be applied more efficiently.

Within Schlumberger, the Eureka initiative has created a global, cross-disciplinary networking environment for technical excellence. Eureka brings together more than 4600 technical experts—3300 in the oil field—in 17 key communities, ranging from geophysics and mathematics to well engineering, information technology and quality, health, safety and environment (QHSE) (below). These communities represent the basic infrastructure supporting technical collaboration and information exchange. Eureka is self-governing and fosters continuous

9. Bargach S, Martin CA and Smith RG: "Managing Drilling Knowledge for Improved Efficiency and Reduced Operational Risk," paper SPE/IADC 67821, presented at the SPE/IADC Drilling Conference, Amsterdam, The Netherlands, February 27-March 1, 2001.
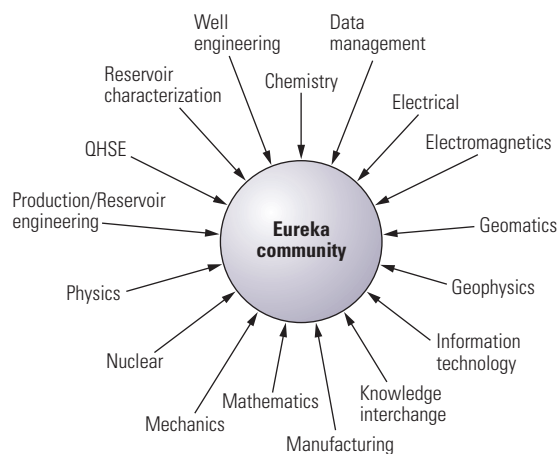
< The Eureka community. Within Schlumberger, the Eureka initiative has created a global, cross-disciplinary networking environment for technical excellence, composed of over 4600 experts—3300 within the oil field—in 17 communities, ranging from geophysics and mathematics to well engineering and information technology.

Field activities
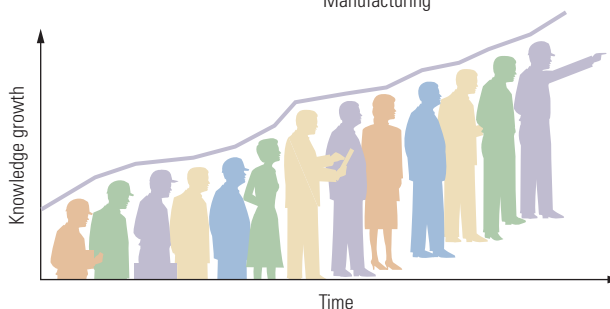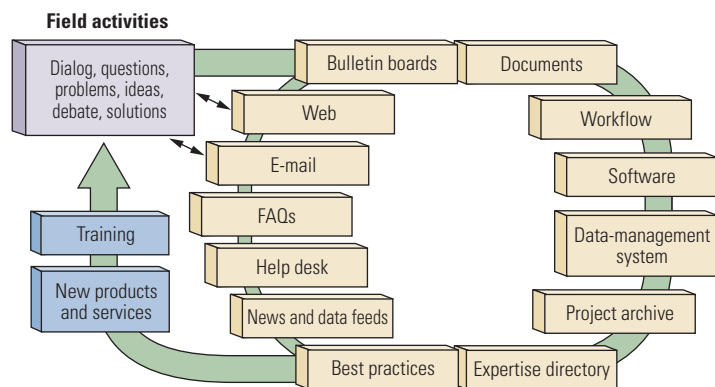
> ^ Closed-loop knowledge-building and application. Community members have access to a full range of Web-enabled data-management and information tools that support knowledge-sharing and expert interchange. These include project archives, expertise directories and best-practices repositories. Closing the loop is crucial to ensure that training aids are up-to-date and that best practices are being applied at the field level to improve decision-making and construct effective oilfield solutions.

have access to a substantial amount of information on the *Web*, with The Hub functioning as the portal. Dialog is facilitated by *Bulletin Boards*, of which there are several hundred in the company. These bulletin boards allow e-mail messages to be captured in Web-searchable archives. Via the Web, community members have access to *Documents*—for example, training materials, product information, technical manuals and policies for use in daily field activities. Community members can also refer to *Workflow*—the documented, authenticated steps necessary to perform a particular task—and *Software* tools, for job planning, simulation and diagnostics. Measured, hard data of all types are available from the *Data-Management System*, including economic and business information as well as discipline-specific data encompassing seismic, logging, production and a variety of other oilfield areas.

learning, professional development and employee motivation. Participation is voluntary. Community members continually set higher technical benchmarks for product and service delivery and performance.

Each community has its own specialized hub, integrated with the corporate Knowledge Hub, and uses threaded discussion facilities to exchange information. Specific knowledge-management representatives within each community are responsible for knowledge capture, validation and publication. The virtual infrastructure promotes knowledge development and sharing, and provides technical input on strategic business issues relevant to solving client problems. Integrating and broadening the reach of its technical staff better equips Schlumberger to deliver oilfield solutions that fully leverage global experience and expertise.
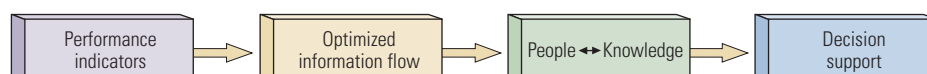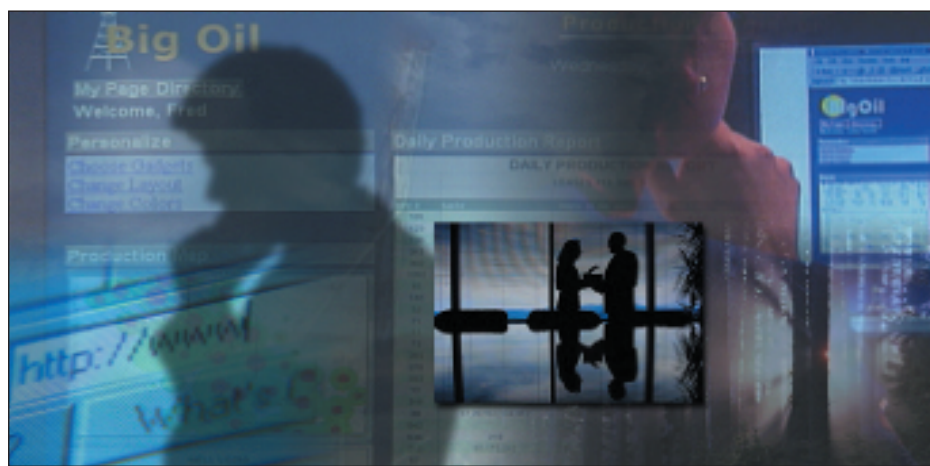
Closed-Loop Knowledge-Building and Application

In practice, how does Schlumberger combine a diverse collection of intranet, software, process and intellectual assets to create a Knowledge Hub?[10] Each day, community members perform their normal jobs, referred to as *Field Activities*, where they interact with their colleagues, capturing and sharing knowledge relevant to solving problems for customers (above). *E-mail*, over the Schlumberger intranet, is the tool of choice to support this interaction. Community members

> ^ The MindShare tool. A collaborative knowledge-based solution, the MindShare tool enables E&P teams to fully interact using different software and applications residing on different computer platforms. Decisions and workflows can be cataloged and preserved as a project progresses, serving as a central repository of project information, both current and legacy.

10. Smith RG and Farquhar A: "The Road Ahead for Knowledge Management," *AI Magazine* (Winter 2000): 17-40.

| Performance indicators | → | Optimized information flow | → | People ←→ Knowledge | → | Decision support |

∧ The DecisionPoint solution. A business-performance information-management technology, the DecisionPoint solution, allows oil and gas professionals at all levels within a company to obtain the information they need in the time frame required to make effective decisions. The process identifies key performance indicators and then optimizes the information flows necessary to feed those indicators, connecting people and knowledge at every point throughout the E&P workflow.

A *Project Archive* stores information on projects completed in the past, and acts as an electronic workspace for project teams. The archive is a clearinghouse for capturing and storing all aspects of a project, from planning and milestones to progress reports, experimental data and lessons learned. This feature is an outgrowth of an effort begun in 1997 at the Schlumberger Cambridge Research center in England. The archive fosters reuse of information and helps members avoid duplicating previous efforts.

This initiative has resulted in an innovative product offering called the MindShare tool— a collaborative, knowledge-based solution. MindShare technology enables E&P teams to fully interact—capturing knowledge, sharing information, creating reports and collaborating on-line (previous page, bottom). This capability has become increasingly important since diverse asset teams use different software and applications on different platforms. The MindShare tools supports this heterogeneous environment, customizes it to fit each user's needs and still allows information to be shared by everyone—the only knowledge-capture tool to offer multiuser access and full support for both PC and UNIX platforms.

With MindShare collaboration, workflows and decision processes for any project can be easily cataloged and preserved as the project evolves. It acts as a central repository for information on current and legacy projects, encouraging organizational learning. Cumulative corporate knowledge is readily accessible anywhere, anytime. The user can define customized security levels for any project so that information can be shared with confidence.

Community members can find people who may have the right skills, expertise and experience to help solve their problems using the *Expertise Directory*. Within Schlumberger, this is found on an LDAP (lightweight directory access protocol) directory that contains the basic coordinates for each employee—such as e-mail and physical addresses, telephone and fax contact numbers, and pointers to personal pages listing areas of expertise.

A distinguished group of community members has special responsibilities as knowledge champions. These recognized experts are responsible for validating, integrating and publishing the knowledge that is captured by the members. We refer to this ready-at-hand knowledge as *Best Practices*—recipes that detail the best way to

accomplish a task or solve a problem. Knowledge champions and other appointed experts are also responsible for reporting community *News and Data Feeds*—the topics, successes and failures, and lessons learned that most interest community members, for staffing the *Help Desk* to connect others with the right knowledge or people, and for capturing and refreshing frequently asked questions *(FAQs)* for the community.

Closing the loop is particularly important to ensure that technical training courses and manuals are up-to-date, and that best practices are indeed being implemented to improve decision-making and design customized solutions.

The convergence of these capabilities has led to creation of the DecisionPoint solution, a revolutionary business-performance information-management technology focused on the upstream oil and gas business (above).

The core philosophy behind this process is to identify bottlenecks in information availability and to build custom solutions that facilitate more effective decision-making. The DecisionPoint tool explicitly links a solution to decision processes that drive business performance by providing access to relevant information— exactly the information needed for professionals

to control their jobs at a glance. The process follows a top-down focus to identify key performance indicators for an enterprise, and then optimizes the information flows necessary to feed those indicators. It connects people and knowledge to support decision-makers at every point throughout the E&P workflow, including well planning, production optimization, drilling efficiency and asset management—all crucial elements for successful reservoir development and recovery optimization. A DecisionPoint engagement involves the implementation and long-term maintenance of an enterprise information-management solution with metrics tied explicitly to improved business performance.
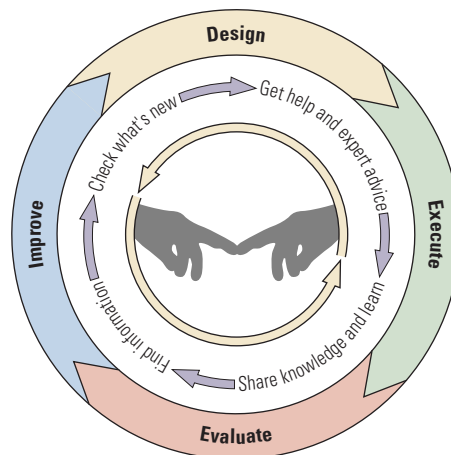
The DecisionPoint approach brings together, at any user's desktop, secure access to the information, applications and collaboration tools necessary to support new-generation work processes by leveraging the success of the Enterprise Information Portal, an e-Business productivity concept deployed by 80% of the Fortune 500 companies.[11]
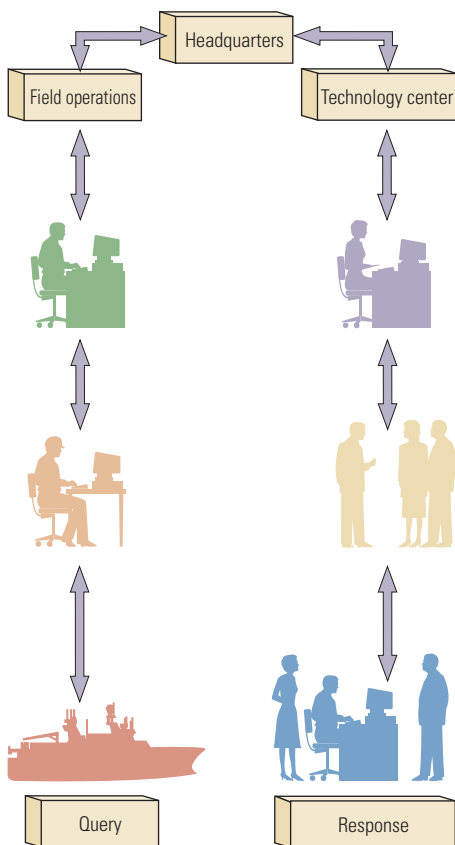
Getting InTouch

Knowledge management cannot succeed without a structured approach to technical collaboration. Successful companies will be those equipped with a streamlined infrastructure capable of instantaneously accessing a broad spectrum of data, information and knowledge. Increasingly, oil and gas companies look to service providers to deliver validated solutions for difficult operational problems quickly and dependably.

In response to this need, Schlumberger has focused considerable resources on an internal initiative called InTouch—initially launched in 1996—that has succeeded in providing timely, direct information exchange between experts at worldwide technology centers and field personnel. Through state-of-the-art information-technology and communication tools, field personnel have user-friendly interchange capabilities with technical experts and access to validated information, knowledge repositories and training aids. Direct communication allows engineering to identify customer needs and supply solutions at a pace never before possible.

Oilfield customers benefit because the Schlumberger global knowledge base and best-in-class practices are available to field personnel at any time. This leverages the vast knowledge base of the technology centers and the extensive operational experience of the field service locations, increases efficiency by streamlining communications, and speeds problem-solving. The latter has been a long-standing oilfield deficiency: the often inordinate time it takes to

^ Dealing with delays. Historically, it has typically taken an inordinate amount of time to obtain the information and solutions required to address operational problems, routine technical requests, engineering modifications and documentation needs due to transit delays in a complex business infrastructure.

Delays in:
- Solving complex operational problems
- Answering routine technical requests
- Resolving engineering modifications
- Updating documentation

^ Overcoming the deficiency. The InTouch initiative bridges the gap between technology centers and the field using communication and information-technology tools to facilitate interchange between technical experts and field engineers—leveraging the vast knowledge of the technology centers and the extensive operational expertise residing in the field—to deliver solutions rapidly and reliably. Through a closed-loop approach to design, execution, evaluation and continuous improvement, the InTouch initiative supplies the information and knowledge required to build an effective, integrated problem-solving organization.

obtain the optimal solution to a complex operational problem (left).[12]

Schlumberger is rapidly overcoming this deficiency through a closed-loop methodology of design, execution, evaluation and improvement (above). The following are key components:
- the Schlumberger global intranet
- a standard computer platform for facilitating communications
- a single portal, InTouchSupport.com, into the company's technical and operational expertise base, containing processes and workflows for knowledge capture, validation and dissemination
- on-line, interactive training and distance learning
- evergreen, on-line documentation, and
- knowledge interchange.

11. Shevlin R, Maney R, Sawyer J and Edward B: *Vision: Managing Knowledge, Forrester Leadership Strategies Research Overview*. Dallas, Texas, USA: Forrester Research, Inc., 1997.
12. Gould A: "A New Era in Oilfield Communication and Collaboration," India Oil and Gas Show, Mumbai, India (September 2000).

Standardized knowledge platform—A single-standard notebook computer functions as a fully supported knowledge platform (right). More than 15,000 users are equipped with this integrated, mobile office preloaded with special, standardized software, including advanced information tools and business applications. The platform offers secure, high-speed access via the Internet and the company's intranet to global help desks, and capabilities such as a robust search engine and remote troubleshooting.

InTouchSupport.com—The heart of the system, InTouchSupport.com, is the primary interface for information exchange on new and existing products and services between technology centers and the field (below). It enables technical support from centers of expertise, 7 days a week, 24 hours a day, and helps create an efficient knowledge-based organization where technical communities of practice interact, share and use what they know. Today, there are more than 75 such help desks and more than 165 full-time InTouch engineers. Never before has support been provided in such an efficient manner. With a global network of specialized professionals and multidisciplinary experts, Schlumberger is capturing, classifying and disseminating best practices, case studies, lessons learned and fit-for-purpose solutions vital to the worldwide field organization. InTouch provides a validation mechanism for best practices and lessons learned, thereby eliminating the worry of having unqualified technical suggestions circulating throughout the knowledge-sharing community.

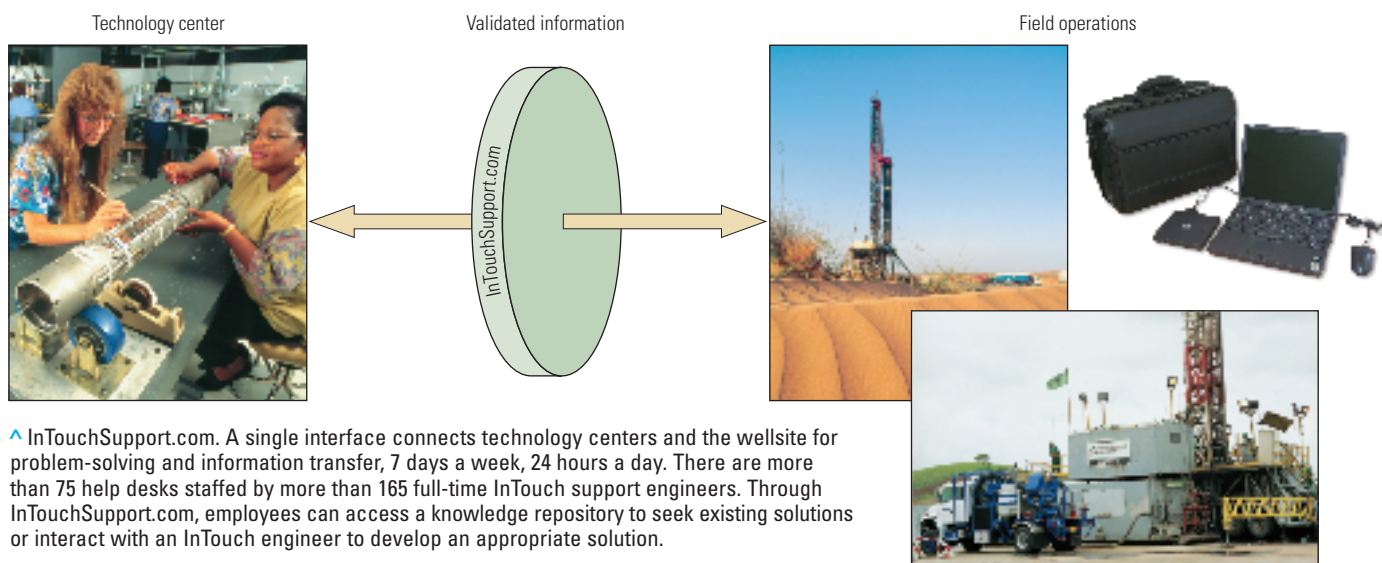It is estimated that over 40% of all wellsite service-quality issues are repeat occurrences.

^ The knowledge platform. A standardized, fully supported knowledge platform provides more than 15,000 users with an integrated, mobile office, preloaded with a suite of technical and business applications and high-speed access to the Internet and the company's intranet.

The only way to prevent them is to ensure rapid identification and thorough analysis of deficiencies on a global basis. InTouch provides a quantum leap in this process and captures every stage of workflow so that pertinent information can be shared with the communities that need it.

With InTouchSupport.com, employees can find validated knowledge, capitalizing on existing solutions and experiences. If a field individual cannot find an answer to a problem within the system, he or she can immediately contact an InTouch help-desk engineer who is equipped to either solve the problem directly or assemble a team of experts within a technology center to

solve the problem. Fast, accurate answers are transmitted directly to the originator, and the solution is stored in the knowledge base for access by other field personnel with similar needs. The solution is "pushed" to all users who have subscribed to that particular area of interest, ensuring that the solution reaches the worldwide user base in a timely fashion independent of human intervention.

InTouch engineers then close the loop by identifying the root-causes of problems, why users required their support, and appropriate corrective actions, such as equipment and manufacturing improvements, software

Technology center   Validated information   Field operations

^ InTouchSupport.com. A single interface connects technology centers and the wellsite for problem-solving and information transfer, 7 days a week, 24 hours a day. There are more than 75 help desks staffed by more than 165 full-time InTouch support engineers. Through InTouchSupport.com, employees can access a knowledge repository to seek existing solutions or interact with an InTouch engineer to develop an appropriate solution.

^ On-line, interactive training and distance learning. The process of using the corporate intranet to deliver instructor-based training to the end-user's location can dramatically accelerate learning. An unparalleled on-line learning environment has been designed to support professional development and rapid deployment of new technology.
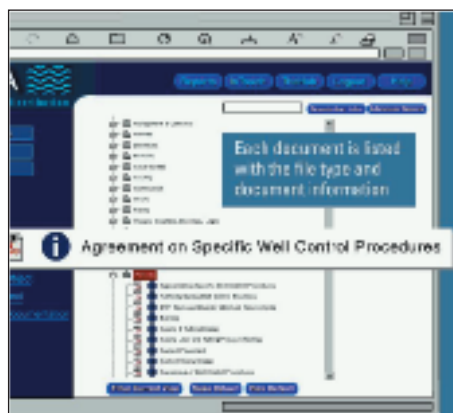
done as the opportunity presented itself. All employees understood that an important part of their jobs was to train and share their knowledge with others. The downside was the inability to practice and gain experience with products and services in a nonoperating environment. Expertise, teaching ability and interest in sharing varied between experienced personnel. The advent of formal training centers filled some of these gaps by bringing trainees together with experts in a structured learning environment, equipped with tools and software that could be applied under simulated field conditions. But, in an industry seeking accelerated learning and organizational efficiency, this is insufficient.

Today, an asynchronous, on-line process that complements and supplements formal classroom training allows users to learn in a more modular, efficient manner. Long classes at training centers are being reduced and shifted to practical application and less theory.

Through InTouch, distance learning and computer-based training deliver fundamental skills to field personnel nearly anywhere in the world in manageable sessions that promote retention. Individuals learn at their own pace after completing much of the course work remotely. Personalized training is available at the most appropriate time. This strengthens the process of professional development and enhances the company's ability to deploy new technology rapidly and effectively. Multiple locations can be connected simultaneously so that an expert anywhere in the world can deliver customized, just-in-time instructor-based training. Furthermore, several hundred hours of on-line, interactive training provide noninstructor-based, modular, self-paced learning covering multiple disciplines, from entry to advanced levels.

Evergreen, on-line documentation—A single source for evergreen, on-line documentation provides a vehicle for effective distribution of, and access to, materials in electronic and physical form (left).[13] This source is common to that used for on-line training, promoting consistency and reuse. All documents are modular and conform to a single standard. Users are automatically notified of updates and revisions. Easy-to-use search-and-browse functions increase productivity and efficiency.

Knowledge interchange—How does InTouch relate to the larger role of technical communities of practice? InTouch Knowledge Interchange, a focused part of the InTouch initiative, delivers operational and technical support to the field by

enhancements, documentation revisions and on-line training updates. This leads to rapid improvement of the technology and skills necessary to deliver world-class service to customers, while simultaneously building recognition and intellectual capital for employees.

On-line, interactive training and distance learning—A key component of the initiative is on-line, interactive training and distance learning—the process of using the Schlumberger intranet to deliver noninstructor-based and instructor-based training directly to the end-user's location (above).

Technological advances support knowledge-sharing, distance learning, and computer-based training and provide new opportunities to accelerate the training process. This significantly reduces the time it takes to train employees to develop full competence.

Historically, Schlumberger has considered best-in-class training as fundamental to its competitive advantage, with a significant investment both in terms of the number of customized programs and the number of training events held per

employee. From their first day on the job, people are immersed in an ongoing training effort with the goal of continual improvement throughout their careers. In the early days of Schlumberger, apprentice-type, on-the-job training—in which senior personnel schooled new hires—was the order. This had distinct advantages and major deficiencies. The upside was that training was

^ Evergreen, on-line documentation. A single documentation source provides modular documents that conform to a single standard, with automatic notification of updates and revisions.

establishing and harmonizing applicable oilfield knowledge-management efforts. There are three major goals:

- The first is to establish and recognize operational and subject-matter experts, named InTouch-applied community experts, or InTouch-ACEs, who provide operational support.
- The second goal is to implement within InTouchSupport.com, tools for the InTouch-ACE communities to collaborate and which support storage, validation and dissemination of knowledge.
- The third is to continue and accelerate the company's culture shift to one based on using and sharing knowledge by capturing, classifying and disseminating best practices and lessons learned.

Within InTouch communities, there are four groups: community champions—most of whom are the InTouch engineers and managers; subject-matter experts—based in the technology centers; applied community experts—of whom there are now more than 300 in the field; and members (field personnel, managers and other interested parties). The people within each community have a basic need to communicate and share information.

Since December 2000, when the current InTouch system went live, there has been a steady growth in the number of best practices,

^ The importance of being in touch. The popularity of the InTouch initiative has grown rapidly, resulting in a 95% reduction in the time needed to solve technical queries and a 75% reduction in the time required to implement engineering modifications. There has been a steady increase in the number of best practices, lessons learned, technical alerts and solutions that have been shared and published.

lessons learned, technical alerts and solutions that have been shared and published. These additions, however, represent a small fraction of the knowledge added to the system since its inception in 1996 (above). This knowledge enriches the information found in manuals and training materials and, when combined with other technical information residing within InTouchSupport.com, saves time and

improves the productivity of field and engineering personnel.

The benefits of InTouch to the organization are impressive. An annual cost savings of over $30 million, a 95% reduction in the time needed to resolve technical queries and a 75% reduction in the time necessary to update engineering modifications have been realized.[14] More importantly, InTouch motivates and encourages employees to "apply everywhere what you learn anywhere."

Real-time Knowledge Capture
Knowledge-management tools and techniques have had a major impact in research, development and operations. Examples include identification of design flaws in specific tools, upgraded measurements-while-drilling signal detection capabilities, customized software solutions to meet specific client needs and the transfer of annular-pressure-while-drilling interpretation techniques from the Gulf of Mexico to Brazil.

In one of many similar cases, an emergency call was made from a rig in Indonesia to the InTouch hotline at 17:00 local time (04:00 in Houston) (left). The field engineer had inadvertently programmed the wrong offset in a GVR GeoVision Resistivity logging-while-drilling tool.

17:00	Emergency call from rig
17:15	Workable solution defined
17:30	Request on how to apply solution
17:45	Information transmitted to rig
18:00	Solution implemented

Rig
(Indonesia)

Product Center
(Sugar Land)
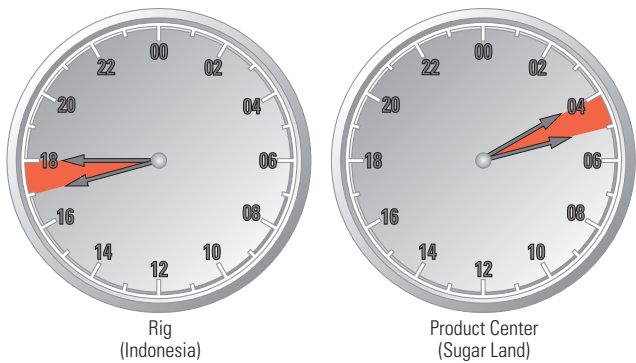
^ The InTouch process in action. It took only one hour to develop and implement an innovative solution to the problem of programming an incorrect offset in a downhole logging-while-drilling tool. The wellsite was in Indonesia, and the solution was developed in the USA.

13. In this context, evergreen means continually refreshed. Key documentation is updated frequently.

14. Smith, reference 4.
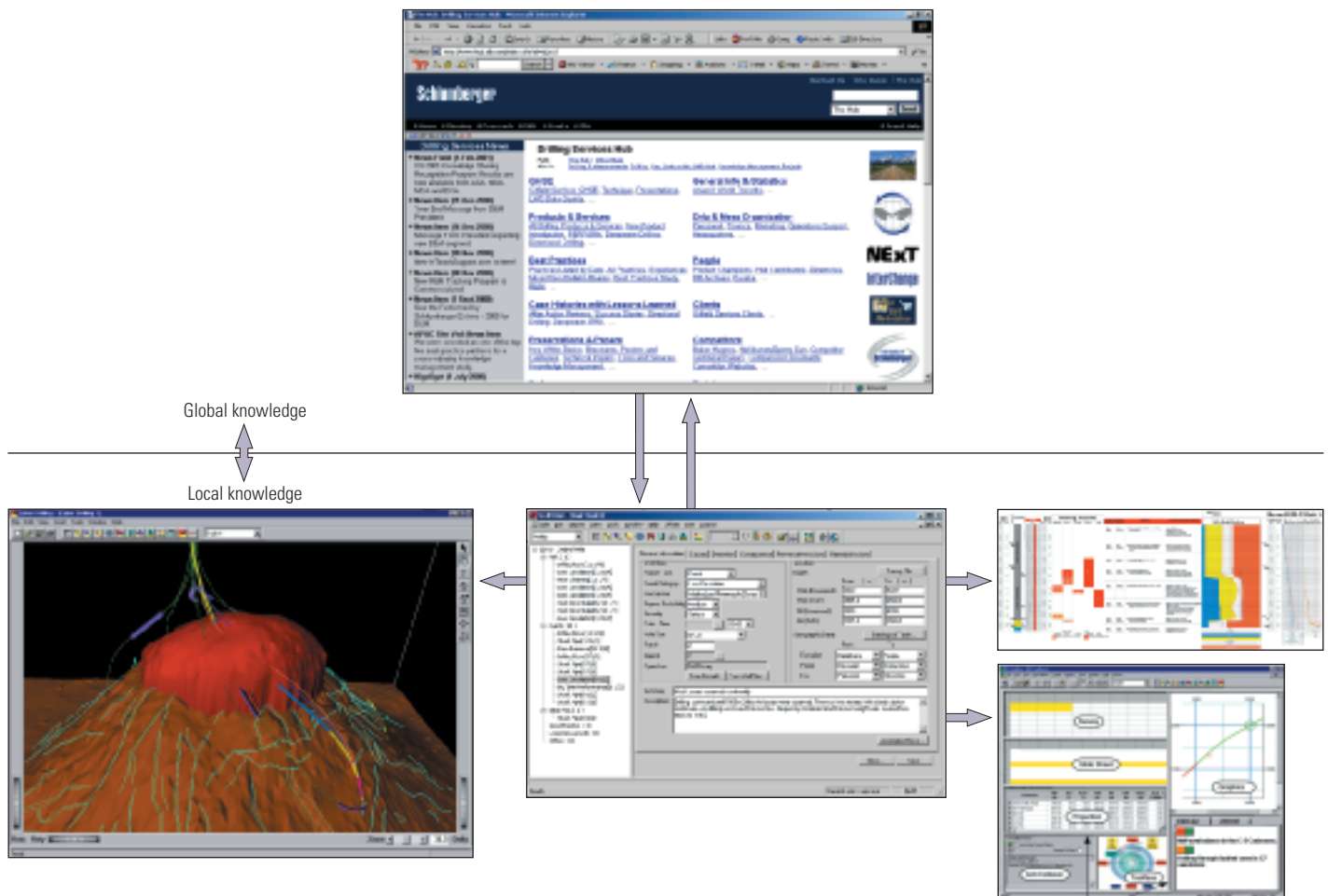
^ The PERFORM initiative. This initiative is designed to reduce costs by significantly improving drilling planning, execution and evaluation. Originally intended to leverage local knowledge, the PERFORM process has evolved to exploit global knowledge capture through a suite of applications. One such application, the RiskTRAK database, provides a front-end tool for knowledge capture and dissemination, delivering relevant information to the appropriate decision-makers in the proper time frame to enable corrective actions.

The problem was not detected until the drillstring was on bottom and drilling had begun. By 17:15, the GVR section head at the Sugar Land Product Center, Sugar Land, Texas, USA, had not only been contacted, but had calculated a workable solution based on a scaling factor. At 17:30, Asia operations requested additional assistance on how to apply the scaling factor in the surface software. An acquisition systems InTouch engineer was consulted, and the solution was transmitted at 17:45. By 18:00, the solution was implemented on the rig and drilling proceeded without the need to trip the drillstring.

Dramatic results based on knowledge sharing and application have been documented, particularly in performance and extended-reach drilling.[15] In the Gulf of Mexico, a high-risk, deepwater exploration drilling project was successfully completed by applying experience from previous wells and integrating it efficiently into the drilling process. Drilling time was cut by 39%, surpassing the operator's goal of 30%, and overall cost savings exceeded $14 million.

In Nigeria, lessons learned on prior wells aided the successful drilling of a high-risk well and helped avoid two potential stuck-pipe incidents through appropriate and timely preventive actions. Offset wells had experienced continual problems with stuck pipe, hole-cleaning deficiencies and annular overloading, lost circulation, depleted formations and overpressured shales. None of these problems impeded successful completion of the new well. In Colombia,

knowledge-sharing and application of best practices contributed substantially to success in drilling high-risk wells in a field prone to wellbore-stability problems.

The Schlumberger PERFORM Performance through Risk Management initiative is designed to reduce costs by significantly improving drilling planning, execution and evaluation (above).[16] The scope of PERFORM solutions, originally intended to leverage local knowledge and experience, has evolved to take advantage of the benefits of global knowledge capture through a suite of applications. One such application, the RiskTRAK database, provides a front-end tool for

15. Bargach et al, reference 9: 4.

16. Aldred W, Plumb D, Bradford I, Cook C, Gholkar V, Cousins L, Minton R, Fuller J, Goraya S and Tucker D: "Managing Drilling Risk," *Oilfield Review* 11, no. 2 (Summer 1999): 2-19.

knowledge capture and dissemination, and delivers relevant information to the appropriate decision-makers in the right time frame to facilitate corrective actions.

Use of RiskTRAK attributes begins in the planning stage. Local knowledge, events and hazards from offset wells are placed in the database to provide a picture of potential drilling hazards for the proposed well. A specific, searchable Knowledge Hub contains best practices and lessons learned for avoiding these hazards, incorporating knowledge and expertise from the global experience base.

Information in the RiskTRAK database can be presented in a variety of ways during the planning phase. A DrillMAP projection shows the risks and hazards in the context of the drilling operation. The same information can also be viewed in a 3D geological and geophysical context. When drilling starts, and at any time during drilling, a DrillCAST short-range forecast can be produced that presents information relevant to the drilling process over the next few hours, including potential hazards, best avoidance practices and contingency plans.

During drilling, the user can input observations and data to update the plans. Near misses are particularly important, and the ability to capture these experiences vastly accelerates the learning process. At any time, the information captured by the RiskTRAK database can be uploaded to the Knowledge Hub as lessons learned or best practices, ensuring that the information is immediately available to other operations around the world.

The Banzala field offshore Angola, West Africa, encompasses a shallow oil reservoir containing over 1.2 billion barrels [190 million m^3] of 32° API gravity crude. The productive horizons are between 1600 and 2000 ft [490 and 610 m] true vertical depth subsea. Water depths range from 120 to 170 ft [37 to 52 m] (below).

This field was discovered in 1982, but development was delayed until 1999 due to a number of drilling hazards created by a blowout while drilling one of the initial exploration wells. This blowout resulted in the loss of the jackup rig, and also charged a shallow sand body to almost formation fracture pressure. This created a shallow-gas layer overlying the entire reservoir, prohibiting

conventional drilling of wells directly over the center of the reservoir. Because of these risks, the only viable option was development with extended-reach wells having horizontal sections or multilateral geometries.

Neither the operator nor Schlumberger had local experience in extended-reach drilling. The potential hazards and the project's high visibility made impeccable execution mandatory. Local extended-reach expertise would be built through extensive information and solutions transfer from the Knowledge Hub and InTouch services.

A multidisciplinary team of engineers was assigned to the project from the start, responsible for detailed risk evaluation, planning optimization and real-time decision support. To manage the potential risks, the team tapped into Schlumberger experience in extended-reach drilling, working closely with the client asset-management team and other wellsite service providers to design an optimal solution. The local team also collaborated with Schlumberger teams working on other extended-reach projects around the world to learn from their experiences, and with experts at the Sugar Land Product Center.

The first couple of wells showed low reservoir permeability, which threatened to curtail further development of the field due to insufficient production. Production from later wells was significantly enhanced by successfully undulating the long horizontal sections or utilizing multi-lateral geometries. An experienced team of Schlumberger directional drillers on the rig, combined with support from operational base personnel and the lessons learned while drilling similar types of drainholes elsewhere, contributed to the project's success.

A major potential problem in well construction is pressure management during cementing operations. Initially, the team also lacked expertise in cementing practices and cementing computer simulations. With the resources of the Knowledge Hub, the team was able to access and transfer the information and knowledge on cementing practices. Simulation software was downloaded from The Hub. Additional training was obtained from a cementing domain expert in Pakistan who instructed the team on use of the software through the NetMeeting interchange tool. After two interactive sessions, the team was fully capable of running all required cementing simulations.
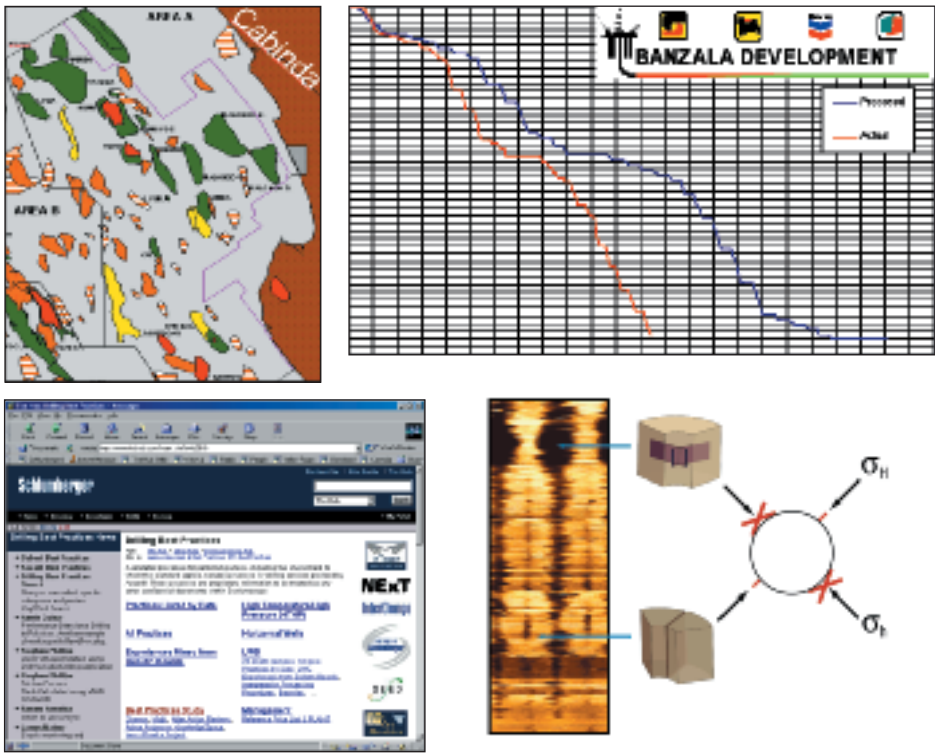
^ Banzala drilling program. Through the use of global knowledge, communicated to local expert teams, difficult drilling conditions were overcome in the Banzala field offshore Angola. Collaboration tools enabled field personnel inexperienced in extended-reach drilling and cementing design software to gain necessary expertise to complete the arduous drilling campaign 51 days ahead of schedule.

Detailed planning and real-time monitoring by the team helped the operator manage operational risks, with a resulting step change in drilling and safety performance. One important dividend was the accelerated learning curve, achieved through a process approach utilizing the Schlumberger worldwide knowledge base. After just the first two wells, the team was already pushing the limits of available technology. Lessons learned during the execution and evaluation phases were captured, reported and applied to the drilling program for the next section. A case history, detailing the experiences of this team, was placed on the Knowledge Hub.

The drilling campaign was concluded 51 days ahead of schedule without a single safety incident. Not only were wells drilled safely and efficiently, but the use of complex well geometries improved reservoir access and drainage, thereby substantially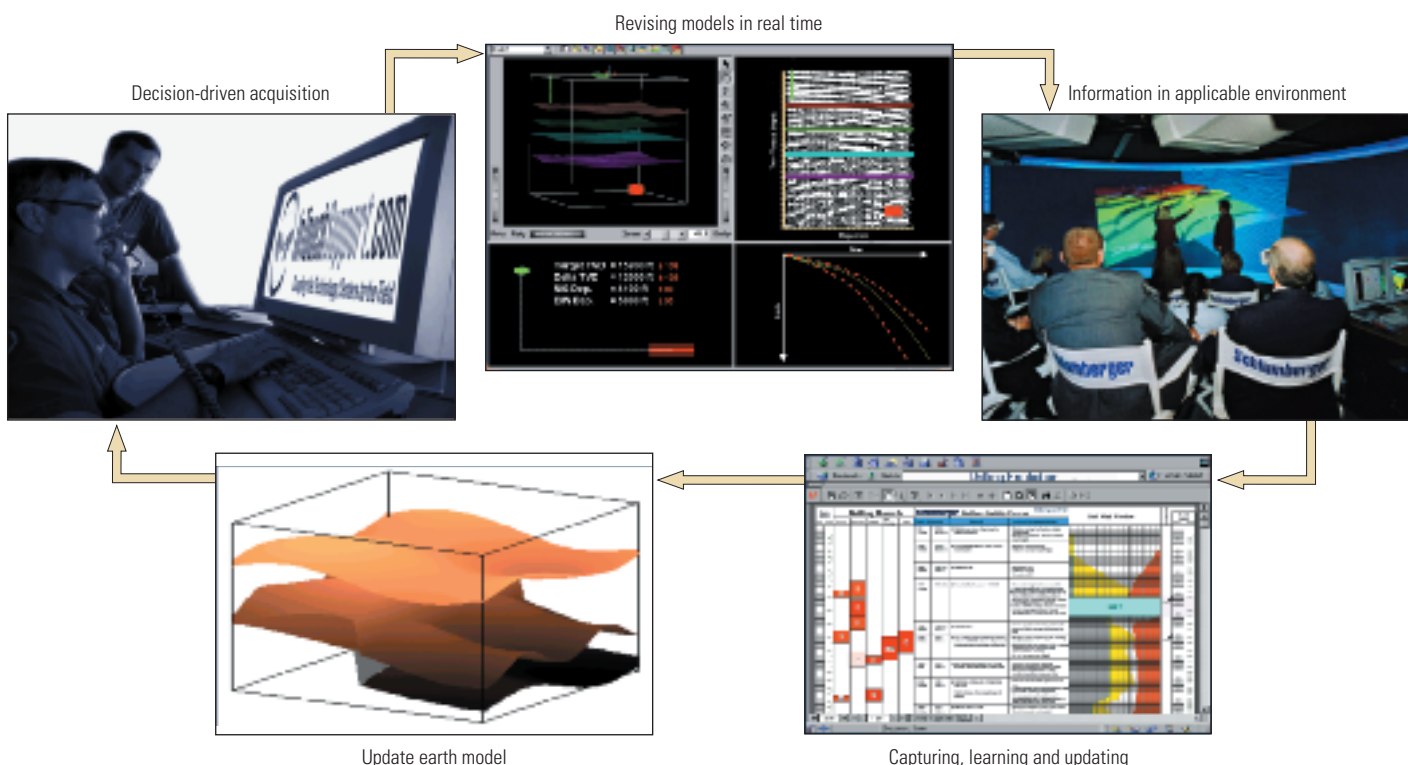 increasing well productivity. The client saved an estimated $5 million during drilling, and gained $10 million in additional production revenue.

Knowledge management is fundamental in constructing drilling solutions that integrate surface and downhole equipment, sensor, software, and data-communication technologies. Individual measurements require process and workflow optimization to maximize their value. Data must be provided in the form of usable information. This information must also be scalable and sharable with all disciplines, allowing experts to interpret information in real time and provide reliable remote decision support to the rig.

This is the basis for a joint BP-Schlumberger well-construction initiative called NDS No Drilling Surprises (below). The NDS solution encompasses predrilling, updating while drilling, decision-making while drilling and postdrilling follow-up. All pertinent disciplines—from pre-spud seismic data, drill bits and while-drilling measurements to modeling and interpretation software—come into play at appropriate points in the process. The fuel for NDS decisions is real-time data, the parameters and measurements required for optimizing drilling performance. Access to real-time data allows correlation of drilling with seismic information and provides input to interpretation packages for pore-pressure and wellbore-stability prediction and updating. The NDS approach will be described in detail in an upcoming article in *Oilfield Review*.

Knowledge management is an essential foundation for e-Business initiatives. Why? First, because the benefits that a company captures from its knowledge-management programs are also beneficial to customers, suppliers and partners. Second, because the portals constructed for internal access by employees also provide a natural communication interface with these groups. Third, much of the knowledge that companies are

Decision-driven acquisition

Revising models in real time

Information in applicable environment

Update earth model

Capturing, learning and updating

^ NDS No Drilling Surprises initiative. A joint development with BP, the NDS initiative optimizes well construction by bringing all applicable disciplines together at appropriate points in the drilling process, including predrilling, updating while drilling, decision-making while drilling, and postdrilling follow-up.
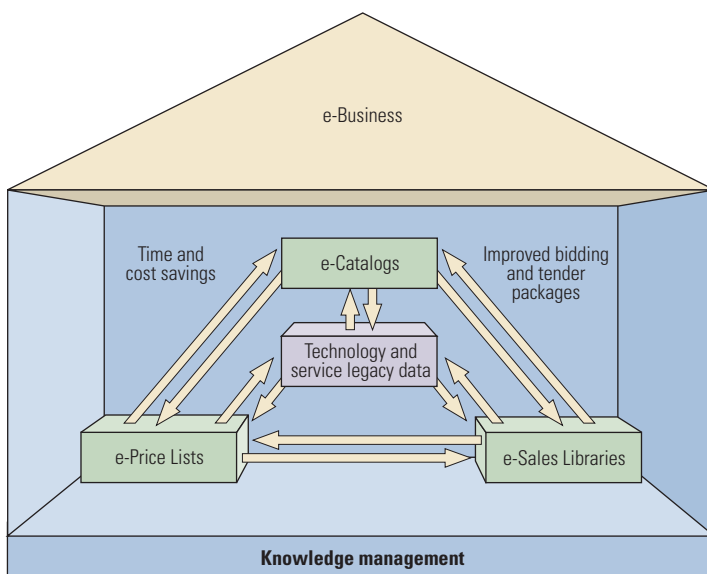
^ E-Business and knowledge management. Knowledge management has been a key enabling factor in the growth of e-Business initiatives for the oil field through a methodology that encompasses comprehensive electronic catalogs, price lists and legacy libraries that improve the quality and speed of response to tenders and procurement requests.

trying to reuse is actually generated beyond the single enterprise, or within an extended enterprise that includes these groups and others.

Today, oil and gas companies expect suppliers to deliver electronic inventories of their products and services as a basis for improving the cost-effectiveness of procurement. The construction of comprehensive e-Catalogs and their linkage to e-Price Lists has resulted in time and cost savings to both sectors, and improved decision-making about product and service offerings to meet the needs of local asset managers (above). This linkage includes access to legacy data on technology and service applications. Within Schlumberger, champions are assigned to manage, and supply updated content for, specific e-Catalog products.

17. Chevallier J: "The Energy Industry in the Internet Age," *Energy Economy* 2000, Houston, Texas, USA (September 2000).
18. Arango G, Colley N, Connelly C, Greenes K, Pearse K, Denis J, Highnam P, Drubec, C, Gutman L, Sims D, Jardine S, Jervis T, Smith R and Miles R: "What's in IT for Us?," *Oilfield Review* 9, no. 3 (Autumn 1997): 2-19.
19. Arango et al, reference 18.

E-Sales Libraries that include bidding and pricing guidelines provide critical data to support more rapid development of higher quality tender packages and greater consistency in the specification of fit-for-purpose solutions that reduce cost and improve wellsite performance.

Today's wide variety of oilfield electronic initiatives, some simple and others highly sophisticated, span activities from procurement, as just described, to the acquisition and divestiture of oil and gas assets through portals such as the IndigoPool.com Web site. The expansion of the electronic world brings with it major challenges—such as computer and information security—the Achilles' heels of the electronic age. Security, confidentiality and protection of proprietary information are crucial in the relatively open environment of the Internet. These principles must be honored because of the immense value of upstream exploration and exploitation information. Transactions between individual buyers and sellers must be confidential. Unauthorized extraction and use of aggregated information by third parties is not acceptable, and could pose a major threat to the long-term viability of the enterprise.

Special attention must be paid to security. There are five main issues: authentication, authorization, confidentiality, integrity and nonrepudiation. Solutions to fit the specialized needs of individual users can be designed by integrating encryption, public key infrastructure, policy servers and digital signatures. Their application is necessary to realize the full potential of the Internet, and will dictate the confidence with which companies interact in the electronic world.[17,18]

Today and Tomorrow

Today, the value that knowledge-management technology and a knowledge-sharing culture can reap is being consistently demonstrated throughout the oil field. Collaboration tools have opened a new era for rapid and easy access to, and interchange with, technical experts regardless of where they reside. Knowledge-sharing is rapidly becoming an integral part of everyday oilfield operations.

In the future, one-stop search capabilities, aided by case-based reasoning applications for indexing, information classification and extraction, will aid speed, precision and recall of information and knowledge, with multilingual and multiple media capabilities.[19] Ultimately, just-in-time knowledge delivery—exactly the knowledge required when it is needed and in the context in which it will be used—will lead to a fully functional knowledge-powered enterprise. This enterprise will be fueled by real-time knowledge management, a culture in which everyone contributes and knowledge management is firmly embedded in the workflow, with a seamless information space providing knowledge discovery, integrated simulation and decision-support capabilities.

The knowledge-powered enterprise fosters knowledge creation and innovative thinking, both in tangible and intangible ways, by continuous learning. The enterprise replenishes and renews its stocks of knowledge, leading to substantial improvements in efficiency, productivity and service quality. By leveraging the collective knowledge of people, oilfield companies can reinvent themselves, whether they are producers of oil and gas or suppliers of products and services. This vision promises to transform the business landscape and build the foundation for future growth and profitability initiatives within the E&P industry. —DEO