

# The Development of Knowledge Management in the Oil and Gas Industry

El desarrollo de la Dirección del Conocimiento  
en la industria del petróleo y gas

92



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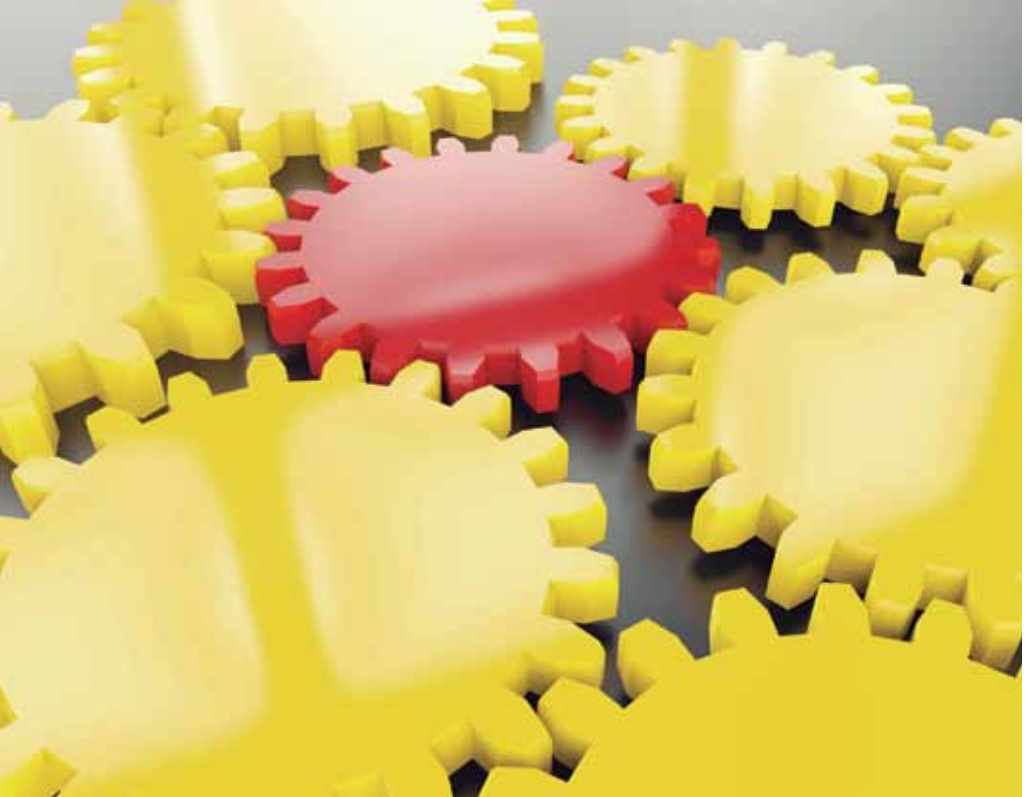
## I. INTRODUCTION

Since the early 1990s, interest in knowledge management has been spurred by accelerating rates of technological and market change that have resulted in innovation and learning becoming increasingly important for business success and by rapid advances in information and communications technology (ICT) offering greater opportunities for exploiting the knowledge available to organizations. The oil and gas industry has been at the forefront of both the development and deployment of knowledge management techniques as a result of several factors:

- Technological and market changes in the petroleum sector became increasingly intense during the 1990s and first decade of the 21<sup>st</sup> century. The pressures resulting from the depletion of established fields, the need to explore in frontier locations (especially in deep waters), and pressures for greater environmental responsibility provided massive impetus for technological advance. Upstream technologies have moved especially rapidly especially in relation to seismology, drilling technologies, and offshore E&P.

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### **EXECUTIVE SUMMARY**

A review of the knowledge management experiences of BP, Royal Dutch Shell, Chevron, ExxonMobil, ConocoPhillips, Halliburton, Schlumberger, Paragon Engineering Services, BHP, Marathon Oil, and Murphy Oil identified two major types of knowledge management practices: applications of information and communications technology to the management of explicit knowledge and the use of person-to-person knowledge management techniques to facilitate the transfer of tacit knowledge. The study pointed to the challenges of converting tacit into explicit knowledge and the importance of knowledge management initiatives that combined the enthusiasm of bottom-up initiatives with strong top-down support from senior management.

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### **RESUMEN DEL ARTÍCULO**

Una revisión de las experiencias en gestión del conocimiento de las compañías BP, Royal Dutch Shell, Chevron, ExxonMobil, ConocoPhillips, Halliburton, Schlumberger, Paragon Engineering Services, BHP, Marathon Oil, y Murphy Oil identifica dos tipos de prácticas principales de gestión del conocimiento: aplicación de las tecnologías de la información y las comunicaciones para la transferencia de conocimiento explícito y el uso de técnicas de gestión del conocimiento persona a persona para facilitar la transferencia de conocimiento tácito. El estudio señaló los desafíos para convertir conocimiento tácito en explícito, así como la importancia de las iniciativas de gestión del conocimiento que combinan el entusiasmo de las iniciativas de abajo hacia arriba conjuntamente con un fuerte apoyo arriba hacia debajo de la alta dirección.

- Rapid advances in information and communication technologies (ICT) have made it possible for the companies to gather and process unprecedented quantities of data while providing the means for globally dispersed employees to communicate and collaborate closely.
- Individual projects (developing a new oilfield, constructing a deep-sea drilling rig, building a LNG plant) typically involve multi-billion dollar investments. Such huge investments require exceptionally careful analysis of the risks involved necessitating a marshalling of the full range of available information and know-how relevant to the project.

- The companies have undergone a major change in their *dominant logic*. Twenty years ago management in the oil and gas sector was viewed in engineering terms: tangible inputs—finance, equipment, and people—were deployed to acquire physical assets—oil and gas reserves—which were then transformed into marketable end products through a vertically-integrated system. Since the early 1990s, the oil and gas companies have recognized that they are operating in a knowledge-based business where superior performance is achieved through the early identification and appraisal of opportunities and their speedy exploitation.

These factors were especially relevant to the international, shareholder-owned oil and gas companies. While the national oil companies could rely upon their ownership of low-cost reserves as the basis for their continued pre-eminence in oil and gas production, the majors had to rely upon their superior technology, management systems, innovation, and learning capabilities for their competitive advantage. By the early years of the 21<sup>st</sup> century, Schlumberger, BP, Royal Dutch Shell, and Chevron had become recognized leaders in the field of knowledge management.

Conditions specific to the oil and gas industry further suggest the potential of knowledge management to provide solutions to some of the most critical problems faced by the industry. Between 2000 and 2010, the Society for Petroleum Engineers (SPE) estimated that 231,000 years of cumulative experience and knowledge will be lost to the industry in the next 10 years due to retirement of petroleum engineers and other technical staff. Knowledge management offers a means of limited the

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potentially devastating effects of the continuous knowledge loss of due to retirement & downsizing (Drain, 2001).

For these reasons, we undertook a detailed study of the evolution of knowledge management practices among a sample of oil and gas companies (including not only petroleum producers but also oilfield service companies). Our goal was to use the learning from the experiences of these companies to provide guidance to companies' in their use of knowledge management (KM), primarily in the petroleum sector, but also for other companies. **Table 1** shows our sample of companies.

#### KEY WORDS

Knowledge management practices, person-to-person knowledge management, communications technology, case study

#### PALABRAS CLAVE

Prácticas de dirección del conocimiento, dirección del conocimiento persona a persona, tecnologías de la comunicación, estudio de casos

Table 1. **The Companies**

COMPANY	ADOPTION OF KM <sup>1</sup>	ORIGINS OF KM <sup>2</sup>
BP	1996	Organizational learning/best practices transfer in upstream
Royal Dutch Shell	1995	Organizational learning initiatives by corporate planning (e.g. scenario analysis, cognitive maps)
Chevron	1996 (in Chevron)	Best practices transfers & cost reduction in Chevron's downstream businesses
ExxonMobil	2003(?) <sup>3</sup>	In Exxon: application of IT to E&P In Mobil, best practice transfer in downstream
ConocoPhillips	1998	IT support for E&P
Schlumberger	1997	IT applications to drilling
Halliburton	1998	IT applications to drilling and seismic analysis
Marathon Oil	1999	IT applications to exploration
Murphy Oil	2000(?)	IT applications to exploration
BHP-Billiton	2000	KM uninitiated by IT dept. - but not adopted company-wide
Paragon Engineering Services Inc.	1999 (approx.)	KM practices based upon groupware, intranet, project files, & other IT tools

*Notes:*

<sup>1</sup> Establishment of KM as an explicit program at corporate level.

<sup>2</sup> Corporate or business activities most closely associated with subsequent KM program.

<sup>3</sup> ExxonMobil has not formally committed itself to KM at the corporate level, however, by early 2003, the term KM was used widely both on upstream and downstream businesses.

N.I.R. = Not Included in Report

A key observation from our study was the role of KM as a major force changing thinking and management practices among the oil and gas companies. Not only did all the companies we surveyed institute KM systems and processes, at most of these companies senior managers offered explicit recognition of the importance of all of these companies testified to the importance of knowledge management within corporate management systems as a whole and as a major contributor to performance enhancements. For example, Chevron's former CEO, Ken Derr observed: "We learned that we could use knowledge to drive learning and improvement in our company. We emphasize shopping for knowledge outside our organization rather than trying to invent everything ourselves. Every day that a better idea goes unused is a lost opportunity. We have to share more, and we have to share faster". BP's former chairman and CEO, John Browne, similarly identified the central role of KM: "All companies face a common challenge: using knowledge more effectively than their competitors do". Several national oil companies also adopted KM. At PDVSA, Rudulfo Prieto, commented: "We got into KM because we had so many projects going on that it was difficult to standardize without limiting creativity. ... Through KM, different leaders not only share experience and knowledge, but go forward to create what I call 'contamination centers' where people infect each other with ideas". At the oilfield services leader Schlumberger, D.E. Baird was emphatic that: "We must become experts in capturing knowledge, integrating and preserving it, and then making what has been learned quickly and easily available to anyone who will be involved in the next business decision".

## 2. MOTIVATION FOR KNOWLEDGE MANAGEMENT

While a common set of industry forces encouraged the oil and gas companies to adopt KM during the late 1990s, each company's circumstances was different. As we shall see, these different circumstances had an important influence on the KM strategy adopted by each company.

Table 2. Motives for the adoption of knowledge management

COMPANY	MOTIVES FOR ADOPTING KM
BP Amoco	Following radical organizational decentralization, KM viewed as mechanism for achieving lateral coordination
Royal Dutch/Shell	In Shell's highly-decentralized multinational structure, KM was a natural complement to strategic planning and career management as an integrating mechanism. With poor profitability during early 1990s, Shell came under strong pressure to make more effective use of its dispersed talent
ChevronTexaco	Chevron's adoption of KM driven by pressured for cost reduction during early 1990s. Resulted in strong interest in transfer of best practices
ExxonMobil	Mobil enthusiastic adoption of KM during the mid-1990s was driven primarily by its desire to improve efficiency in E&P and in refining through improved identification and transfer of best practices
ConocoPhillips	Expansion of exploration, especially in deepwater Gulf of Mexico, created need for data management systems to support huge amounts of data being generated and processed and link them to decision processes
Schlumberger	Impetus for KM came from need to link rapidly advancing data management with systems that linked human expertise in globally distributed operations
Halliburton	
Marathon Oil	Desire to improve upstream performance through more effective linking of people to people and people to information

### 3. WHAT KNOWLEDGE IS MANAGEMENT?

#### 3.1. Tacit and Explicit Knowledge

There are several ways of categorizing the knowledge that can be managed by a firm. The literature on knowledge management (Nonaka 1994; Kogut and Zander 1992; Grant 1996) distinguishes types of knowledge based upon the extent to which it can be transferred. A fundamental distinction is between *tacit* and *explicit* knowledge:

- *Tacit knowledge* is the stock of expertise and knowledge within an organization—primarily located within the brains of employees—that can not be easily expressed or identified, but may nevertheless be essential to its effective operation.

- *Explicit knowledge* is the more visible knowledge found in manuals, documentation, files and other accessible sources.

As Nonaka (1994) makes clear, although explicit knowledge may be easier to access and transfer (especially through information technology systems), managing both types of knowledge is important to achieving the objectives of knowledge management. Organizations need to be able to transfer the tacit knowledge found in its employees' diverse experiences in order to succeed and this is most often achieved through richer forms of knowledge transfer like interaction between groups and individuals.

Most of the organizations, we surveyed did not appear to differentiate specifically between types of knowledge to be managed—most organizations emphasized the broad challenges of knowledge management and did not link particular types of knowledge to particular KM instruments. Nevertheless, the different KM tools deployed by the companies did, implicitly, distinguish different types of knowledge. For example, explicit knowledge was managed primarily through people-to-information mechanisms which relied primarily on IT. Tacit knowledge was managed primarily through people-to-people mechanisms such as communities of practice. Some of the most interesting and fruitful areas of KM occur at the interface of tacit and explicit knowledge. For example:

- In order to utilize tacit knowledge more fully, companies have sought to convert tacit knowledge into explicit knowledge. Most companies have instituted project reviews where “lessons learned” are distilled and entered into a database.
- Most companies have used IT in order to increase the efficiency of person-to-person transfers of tacit knowledge. For example, most of the companies we studied have instituted some form of “expert locator” or “corporate yellow pages” that enables individuals with particular experiential knowledge to be identified and contacted.
- Most of the knowledge being managed by the companies comprises both tacit and explicit knowledge. For example, one of the most important areas of KM among the oil and gas companies is *best practices transfer*. Best practices tend to be recognized through explicit performance data, but their analysis and transfer requires substantial levels of tacit knowledge both at the level of individual expertise and in organizational routines.



### 3.2. KM in Different Businesses

Among most of the companies, the primary impetus for KM has come from upstream. This reflected several factors:

- For most of the companies, upstream was viewed as more important than downstream because it was the primary source of profitability of the companies.
- Upstream has been the most technologically dynamic area of business with rapid advances in drilling, seismic analysis, rig design, reservoir modeling, recovery techniques, and many other areas of technology. Most of these technologies have been accompanied by rapidly increasing in information and communications technology including telemetry, data warehousing, and real-time decision support.
- The increasing costs and technical challenges of deep-water exploration have called for faster, more informed decision making. The cost of errors and the cost of delays have increased substantially.

The result has been a surge in the development of highly sophisticated IT tools for managing and interpreting the massive amounts of data being generated during exploration. The oilfield service companies—Schlumberger and Halliburton—have been leaders in developing ICT solutions for the management of information to improve the efficiency and effectiveness of decision making in exploration activities.

At the same time it has become increasingly apparent that ICT cannot provide a total solution to KM in upstream activities. For all the advances in intelligent solutions, advanced modeling, satellite-based data communications, and raw computing power—decision making in E&P remains highly dependent upon intuition and experiential knowledge that cannot be reduced to data analysis. Given the global dispersion of upstream personnel, exploration has also provided leadership in the development of person-to-person modes of KM.

While the upstream sector has provided the cutting edge for the development of most KM systems and techniques, some of the biggest problem areas for the oil and gas majors have been their downstream businesses. Throughout the past 10 years, the majors have struggled to improve the profitability of their refining, marketing and chemicals businesses. As a result there has been considerable interest in analyzing performance differences between different operating units, identifying best practices, and transferring



best practices to other units. In Mobil and Chevron, programs for disseminating best practice have provided a major impetus for KM.

#### 4. SYSTEMS AND TOOLS FOR MANAGING KNOWLEDGE: (I) TECHNOLOGY-BASED

Not surprisingly information technology (IT) played an important role in knowledge management systems in the oil and gas industry. Some companies, such as Schlumberger, have relied heavily on information technology and the codification of information to reach their knowledge management objectives. Others, such as Shell, and BP, emphasize a less formal and more-people oriented approach to knowledge management. Regardless of which approach firms have taken, IT was an important facilitator for many of the technology and people-based activities important to knowledge management success.

**Databases:** Information technology has facilitated the assembly of databases that can serve as corporate memories for important information including best practices, technical and managerial performance data, company yellow pages, and supplier and customer information. For instance, Schlumberger relies heavily on the use of IT to create and use directories useful to the management of knowledge. Intranets serve as a common medium of access to information and a variety of tools and repositories, such as the Schlumberger Knowledge Hub (the company-wide directory and expertise finder), data dictionaries, supplier contracts, digital libraries, catalogs, general news, manuals and online training modules, and bibliographic databases. Companies have developed databases of best practices like Chevron Texaco's Lessons Learned Database and BP's database of After-Action-Reviews meant to capture positive and negative experiences. Other databases facilitate the meeting of experts including Yellow Pages of Engagements and BP Amoco's Connect – a voluntary intranet Yellow Pages directory that makes it easier to find expert help containing details of more than 12,000 employees. ExxonMobil is working towards a single database for safety which will hold the records for all incidents and near misses worldwide. They are also developing another database that collects and aggregates environmental performance indicators for corporate wide reports. Often firms provide support personnel or reference librarians who act as knowledge brokers and assist users in searching these databases. (E.g. Halliburton).

**Software Tools:** An important aspect of databases is the ability to link them and make them widely accessible. Software tools associated with databases help users navigate, find and apply useful information relatively quickly and at a low cost. ConocoPhillips uses several databases linked by Oracle's web-based ConText search engine to develop an integrated document management system. It consolidates Conoco's operational and legacy databases in a data warehouse. Schlumberger has InTouch—a real time tool that helps capturing, managing, and sharing operations-related knowledge with the intent of faster and more reliable services for customers, accelerated product development, and significant financial benefits. Using the Web-based system, field staff can access validated data, information, and knowledge 24 hours a day, 7 days a week. More than 17,000 users benefit from real-time knowledge interchange with technical experts at 20 technology centers worldwide. In addition to rapid problem-solving, this level of technical collaboration provides technology centers with a better understanding of customer needs, leading to more rapid development and deployment of products and services.

**Portals:** Another important aspect of IT-enabled KM is the ability to provide users a personalized, single point of access for the applications and content they need. For this purpose, Internet portals are especially useful. A portal is a single gateway through which employees, customers, or partners can retrieve and share knowledge. Portals can help reduce the inconvenience and inefficiency caused by using multiple applications by integrating a wide range of application programs so that information can be exchanged and shared irrespective of a type of application. ChevronTexaco's Plumtree portal is a good example. It serves as the doorway to the network. The first three pages of the portal display links, calendars, a place where users can upload and share documents, and tips for finding specific information. Further into it, each separate network has its own page that is more specific. For example, on the Reservoir Surveillance network, users will find information about that area, key contacts and items of particular interest to that network.

**Groupware:** Collaboration software and groupware make it possible for groups and teams to interactively share knowledge. Groupware helps create a shared space where users can exchange knowledge and manage common tasks and resources. Various types of



groupware have helped the creation of virtual communities to enable the management of knowledge. During the early 1990s, Lotus Notes and similar groupware revolutionized communication and collaboration among many of the majors by providing email, mailing lists, ad document sharing. Subsequent developments in groupware provide more sophisticated support for virtual communities. For instance, TechLink is a Conoco tool that links all 6,000 engineers and scientists worldwide. It originated in drilling and productions, but was effective enough to be used in other areas, and is now used company-wide. ConocoPhillips has continued to develop this tool to hook up employees with each other.

Off-the shelf collaboration tools have been very useful in enhancing the use of virtual teams even in companies that do not emphasize it in their knowledge management approaches. Initiated in 1995 as a visionary experiment, the Virtual Teamwork program at BP brought together desktop video conferencing and collaboration technologies with behavior change coaching. Almost 1,000 BP staff and over 30 of its key partners and suppliers regularly used this capability to transfer knowledge face-to-face.

**Table 3** shows the principal phases of KM and the IT tools relevant to each.

**Table 3. Information technologies for knowledge management**

PHASE OF KM	INFORMATION TECHNOLOGIES AND TOOLS	
Capture and Store	Electronic Document Management System (EDMS) Database Management System (DBMS)	Internet and Intranet
Search and Retrieve	Information Retrieval	
Send critical information to individuals or groups	Push/agent, e-mail	
Structure and Navigate	Classification, World Wide Web/HTML	
Share and Collaborate	Workflow, Groupware, e-learning, Virtual Communities	
Synthesize	Data mining, Business Intelligence	
Profile and Personalize	Agents, Portal	
Solve or Recommend	Case-based reasoning, Rule-based systems	

## 5. SYSTEMS AND TOOLS FOR MANAGING KNOWLEDGE: (2) PEOPLE-BASED

While the initial impetus for KM was advances in IT, during the past five years the major driver behind KM has been the desire to leverage employee-based tacit knowledge. For Shell and BP, facilitating knowledge exchange between people has provided the central thrust of their KM programs. Scott Beaty, knowledge-management officer in group learning and performance operations at Shell Oil Co says, “When you start talking about knowledge, it’s really about people”. The challenge for the companies has been to go beyond occasional bilateral knowledge exchanges, to form interactive groups that share knowledge in a rich, continuous and dynamic manner. Since 1998, all the oil and gas majors have established informal or semi-formal groupings of employees that share common technical or professional interests for the explicit purpose of sharing knowledge. These knowledge-sharing groups go under a range of different names. For example, community types within ExxonMobil include: Communities of Practice, Best Practice Communities, and Communities of Interest (ExxonMobil, 2003).

**Communities of Practice:** Of all the tools of KM used in the oil and gas sector, the most widely and enthusiastically adopted have been communities of practice (Wenger et al 2002). These have been described in different ways in the industry:

- Shell defined communities of practice as “Groups of people geographically separated who share information, insight and advice about a common interest or practice”.
- At Chevron Texaco communities of practice, also referred to as networks, were defined as: “Informal networks of people with common job functions who meet to share knowledge, leverage experiences, and improve individual and collective capacity to contribute to the success of the business”.
- Schlumberger defined them as “A group of people who share a common area of expertise and need similar solutions to common problems”.
- The APQC described communities of practice as: “Groups of people who come together to share and learn from one another face-to-face and virtually. They are held together by a common interest in a body of knowledge and are driven by the desire to share problems, experiences, insights, templates, tools, and best practices”.

Despite some differences in definition and nomenclature, the approach of the different companies to setting up and operating communities of practice were very similar. The starting point for most companies was Exploration and Production where all the companies established communication and consultation networks among engineers and technical personnel for the purpose of sharing know-how and expertise. However, the success of communities of practice has resulted in their tendency to extend throughout company-wide reaching both downstream businesses and corporate support functions—health and safety, energy efficiency, process engineering, web application development, retailing to mention a few. Communities of practice are seen as the most effective mechanism to facilitate knowledge transfer. They are an integral part of a learning environment, and a catalyst for the deployment of innovative ideas. Through their participation in communities, members seek others who are doing similar things or face similar problems, and who can quickly answer their questions, recommend products and procedures, or become mentors. Community involvement not only allows participants to make a contribution, but it allows them to strengthen and fine-tune their own skills, creating even greater potential value for the organization.

The main differences between the companies in their use of communities of practice relates to the degree of formalization, the processes through which they are formed, and the extent of company support given to them.

- Halliburton's approach to knowledge management was centred upon its communities of practice. Halliburton had a KM director and four assistants responsible for guiding development of new communities and staying involved with them after deployment through quarterly meetings. Each Community of Practice featured at least one full time Knowledge Broker who was responsible for monitoring and moderating a community portal, facilitating the personal networking by making sure the right people talk to each other. They watch every thread, make sure a Subject Matter Expert is found for every question, and double-check solutions posted by community members. They database and archive all threads, and remove a thread 30 days after a solution is found. The Knowledge Brokers also keep in touch with each other. There are roughly 350 Community of Practice members to each Knowledge Broker. The Knowledge Broker

usually reports to a global operations manager. In addition Halliburton has Knowledge Champions, who are individuals appointed by VPs. In addition to their regular full-time (non-KM) responsibilities, they act as touch points for the Knowledge Brokers functioning as the liaison / support for the community.

- At ChevronTexaco, over 100 communities of practice existed in 2004 linking professionals across refining, retail, drilling, energy management and information technology businesses, among others. Each network had a charter, an implementation plan, designated leaders and core members. CoPs crossed business units and tended to be global in scope. There were four major network groups: Reservoir Management, Drilling & Completion, Facilities and Operation; each comprised a number of smaller networks with more specific expertise. For instance, there were eight separate networks in the Facilities & Operation group.
- At Shell, communities of practice began as spontaneous associations, but tended to become increasingly formalized over time. The starting point was typically around 15 founder members, one of whom agreed to act as a coordinator, together with a facilitator who was experienced in initiating new networks. In E&P, this process had produced 107 communities by 2000. In order to achieve greater coherence and effectiveness, mergers between communities were encouraged. The end result was just three Global Networks: Surface, Sub-surface, and Wells. By 2003, Shell had 14 Global Networks covering the following areas: Benchmarking, Competitive intelligence, Commercial, eBusiness, Human resources, Health, safety, and environment, IT, Knowledge sharing, Opportunity evaluation consistency, Procurement, Subsurface, Surface, Special Interest Areas, Wells. In addition to its Global Networks, Shell also had a number of Local Networks. In E&P, these include: 4D Networks, Completions Network, Drilling Network, Geophysics Network, Petrophysics Network, Reservoir Engineering Network, and several others.

The formalization of these networks was indicated by the creation of governance systems—each network developed a “charter” and appointed a Network Steering Team.

- Schlumberger’s 17 communities of practice covered the main technical areas of E&P. Although participation in the communities was voluntary, Schlumberger’s communities had become



central to its operating strategy and were heavily supported with corporate IT resources. The communities of practice were integrated into Schlumberger's systems for the technical assistance, project documentation, and best practice transfer.

- SK Corporation of South Korea made communities of practices a core comp net of its attempt to build a knowledge sharing culture. Starting from simple groupware in 1995, SK introduced some 500 CoPs which in turn fed a knowledge database and "knowledge marketplace" where employees could buy and sell their knowledge using virtual points. This practice makes it possible to identify who needs what type of knowledge as well as the owners of current knowledge. SK Corp may be characterized as following a "personalization strategy", which focuses on people-to-people communication, as opposed to the "codification strategy", which relies on IT to automate knowledge sharing processes (Hansen et al, 1999).

**Best Practices Groups:** Several of the firms interviewed had groups or teams working on the recording and sharing of best practices:

- ChevronTexaco has application teams that travel to different sites identifying, collecting, and disseminating information on best practices. These teams work with local teams to implement Best Practices, taking into account the contextual differences of each situation.
- Shell Oil has established knowledge communities of employees with common interests. For example, a group of engineers from 11 refineries across the U.S. shares information on best practices via the company intranet and periodic face-to-face meetings. Participants found it difficult to adopt practices and suggestions from co-workers with whom they didn't have a personal connection. But working within a small, targeted group helped them create a pool of knowledge that they don't hesitate to dip into and use. Beginning with US refineries, Shell launched its "PEARL" (Practice Excellence through Accelerated Replication) methodology during 1998. The approach was adopted from Ford Motor Company, which introduced the system in the mid-1990s. It involves using communities of practice to identify successful practices (i.e. an activity that is successful at a particular location), to examine its relevance to other locations, and to document it and communicate it to other community members.

- At Schlumberger, the identification and validation of best practices is one of the central roles of the communities of practice. Each community member is encouraged to identify good practices that they then submit to the community as best practice proposals. Once the community validates the practice, it is stored in the Knowledge Hub. The “Knowledge Champion” within each community has the role of encouraging the submission of best practice proposals, validating the proposals, and integrating the new practice into the community’s knowledge repository.

**Virtual Teams:** The opportunities for communication and collaboration made available by IT and the new thinking about horizontal coordination ushered in by KM led to significant stages in operating practices among several of the companies. At BP, in particular, KM was concerned less with establishing a parallel structure for managing knowledge sharing as with making existing working teams operate more effectively. BP’s virtual teams began in drilling where it was noted that isolated drilling teams making critical decisions with very little time for analysis or consultation would benefit substantially from closer contact with colleagues in other locations. Through groupware and video links, BP established real time communication between BP’s drilling teams in different locations, with suppliers and contractors, and with business unit managers. By 2000, virtual teamworking had spread throughout the corporation.

**Peer Review Groups:** One of the most powerful KM tools for project-based organizations has been the “lessons learned” methodology pioneered by the US Army (Slabodkin, 2006). ConocoPhillips introduced group sessions in which staff from recently completed projects meet and record lessons learned from their experiences with the project. The sessions are facilitated by an individual and the discussion is captured in project reports then made available to other groups. Similar groups were formed around activities such as due diligence, risk management, and specific functional areas.

**KM and HRM (1) Training:** Most of the oil and gas companies linked training and career management to their KM systems. In IT-intensive companies such as Schlumberger, the web-based systems supporting knowledge capture and knowledge transfer were also used to support on-line training that was designed for focus, flexibility, and accessibility. Web-based training was organized around series of tutorials. Such training was especially important for new hires as a means of getting new organizational members familiar with Schlumberger’s



systems and procedures and formed a major mandatory component of their overall training program. Along with several other companies in our sample, Schlumberger had found training for experienced engineers to be a greater challenge. In particular, BP's Virtual Teamwork initiative required substantial investments of training and coaching for older and more senior personnel. Exxon Mobil's much-admired training curriculum was oriented not only towards technology training but also towards developing a culture of sharing knowledge through seminars, employee rotation and other activities.

Knowledge management objectives are inevitably intertwined with regular functions of the human resource divisions of the petroleum firms. At ConocoPhillips, knowledge management considerations played a role in the selection of young talent. Further, career tracking by human resource departments accomplished two knowledge management objectives. It helped maintain a record of the tasks, roles, and experience on specific projects, so that when issues or problems arise in the future, individuals with relevant and pertinent experience can be consulted. Career tracking also helped to increase job satisfaction and professional development opportunities, which reduces turnover and keeps intellectual capital within the company.

KM and HRM (2) Knowledge Retention: A major problem for all the companies in our sample was knowledge loss resulting from employees retiring or leaving the company to join other companies. In Exxon Mobil the management was well aware of the impact of the aging of the oil & gas employee population and the turnover and institutional knowledge loss associated with retirement. Managing the risks of "brain drain" was a key element in career development. Though it starts with recruiting and training the right people, employee careers must be managed so that individuals choose to stay with the company and the benefit of their knowledge is not lost to a competitor. There are well-defined career requirements and competency milestones to guide employees along their career paths. Efforts are made to develop a career path that takes full advantage of an individual's capabilities, which improves job satisfaction. Younger employees and those entering senior management positions are mentored by more seasoned individuals, who pass on their expertise and therefore preserve their tacit knowledge. There is a formal succession plan to ensure that all skill positions are covered. Thus companies are attempting to take specific actions to deal with the 'people' dimension of knowledge management.



The problem of knowledge loss through human resource attrition was a source of concern not just for individual companies but also for the industry as a whole. As a result a number of inter-organizational and industry-wide knowledge-sharing networks have been established. These included the Global Benchmarking Group, an independent group is made up of representatives from the largest oil companies which establishes common set of definitions and standards as regards technology and processes in the oil and gas industry and collects information and performs studies on different practice areas, primarily in upstream activities. Also, industry and trade associations permitted networking and the exchange of information between other companies and agencies. Examples are the APQC KM conferences, and The Energy Knowledge Management Network, a group of 10-12 operating companies that meets periodically for a day of presentations.

## 6. IMPLEMENTING KNOWLEDGE MANAGEMENT

The case for knowledge management is inarguable. Competitive advantage is critically dependent upon a company's ability to increase the effectiveness with which it acquires shares and exploits information and know-how. The real challenges are organizational. How should KM initiatives be implemented? All of the companies we studied experienced difficulties and failures in their implementation of KM. Gaining information and insight into these difficulties and failures was problematic. Most of our interviewees were leaders of KM in their respective companies—many of them were evangelists for KM. As a result, it was difficult for us to gain a balanced view of the success of KM—most of our interviewees, we felt, downplayed the problems that they encountered in putting KM initiatives into practice. Nevertheless, by comparing the experiences of the different companies we were able to gain some insights into the problems that were encountered and the different approaches that were taken in overcoming these problems.

### 6.1. Top-down versus Bottom-up Initiatives

Since KM involves fundamental changes in how employees behave and interact with one another, one of the critical issues we addressed was: Where do KM initiatives originate, and whether the source of the initiative influences the success of KM? In our entire sample, KM initiatives originated among activists who were outside the top management team. For example:

- At BP, KM began with IT personnel within BP's exploration division.
- At Shell, KM was closely associated with training activities at Shell Oil, Shell's US subsidiary.
- At Chevron, KM had its origins in quality management and best practice activities in both upstream and downstream businesses.
- At Schlumberger, it was IT professionals and developments in data management that provided the impetus for KM.
- At Halliburton, KM had its origins among KM enthusiasts within the IT department.

However, for KM initiatives to take root and flourish within the companies, top management leadership was an essential ingredient. For example, at BP, John Browne, then head of exploration, was a key convert who championed KM in BP's upstream activities. Once Browne became CEO, then KM became one of the central themes of his corporate leadership. Similarly, at Chevron, it was Kenneth Derr's championing of KM that resulted in the widespread adoption of Chevron's system of best practices transfer.

For most of the companies, KM evolved rapidly from decentralized to centralized initiatives. KM activists lower in the organizations created initial interest and developed prototype programs, but building effective IT support and building an organization-wide impetus typically required corporate-level leadership. For KM to become effective typically involved two key developments: first, building a company-wide technological infrastructure for KM; second, achieving buy-in at the business level. For both of these tasks it was essential for the initiative to come from top management. There is some evidence that the continued evolution of KM may require a cycle of centralization and decentralization. While "grassroots" initiatives provide the initial flourishing of KM, and centralized leadership is required for establishing company-wide KM programs, embedding KM practices within the daily operational activities of a company may require a further phase of decentralization. Chris Mottershead of BP observed that, after centralizing BP's KM activities through establishing a corporate KM team, BP recognized the limits of what should a team could achieve:

"With a staff of 25,000 technical people, most of the value comes from the knowledge they apply daily. Believing that 12 or even 26 experts were going to reach the entire technical staff was

unrealistic, so we dispersed this team back into the business units in 1999. That strategy was successful because added up to that point were transfused back into the organization. A group with two or three members from the original knowledge management team was maintained to support knowledge exchange between different geographical regions and between the different business areas". (O'Brien & Rouse, 2001).

Companies did not employ a uniform organizational approach in setting up and controlling KM activities. Most companies have relatively few dedicated staff for developing knowledge management systems and supervising its implementation. Also in spite of the large cost savings associated with knowledge management, relatively few of the firms surveyed had distinct budgets for the KM. Rather than create separate offices or departments to handle KM initiatives, many companies have attempted to align and integrate their knowledge management initiatives, with the existing structures. In most companies KM activities were assigned primarily to the IT department—although in several, KM was located within cross-functional teams:

- In BP Amoco there is a team of 10 knowledge management officers linked closely to the senior management of the company that oversees knowledge initiatives. Yet, the emphasis in BP Amoco is on making knowledge management a decentralized process and allowing employees to feel a sense of ownership.
- In ConocoPhillips there is a "Leader of Knowledge Leveraging" but he has no department or staff as direct reports. He also does not have a budget but works with departments to get initiatives implemented using their own budgets.
- Halliburton has a core Knowledge Management group consisting of a KM Director and four staff members. The KM Director is a cross between a business analyst and a consultant. Outside consultants are also used, such as software developers, change management or quality experts.
- In Schlumberger KM is primarily a corporate-level initiative led by the Technology Group. In 1998 the company established a 6-person KM team headed by a Vice President for Knowledge Management.
- At Shell, KM programs and KM specialists are employed in each of the four major business sectors (E&P, oil products, chemicals, and gas and power). In addition, Shell's shared services organization provides technical support.

Rather than assign the responsibility of KM to a particular group, other energy companies have attempted to broaden the responsibility for implementing KM systems by integrating it with the broader organization. In Exxon Mobil, as one official puts it, “We do not have an official KM program with dedicated KM staff, because the concept of knowledge management has always been part of our value system – it’s just the way we do business”. Thus there is no official KM officer or department at ExxonMobil, and therefore no separate budget allocated to the practice. Knowledge management and transfer are integrated into many different management systems and processes, and so consist of several decentralized initiatives. Budgets to support these initiatives are allocated on a case-by-case basis by different departments. In Chevron Texaco, as well, the emphasis is on integrating and managing knowledge throughout the company. In this company knowledge management does not seem to be a distinct initiative, but rather an inherent part of the overall corporate strategy and leadership vision. Chevron Texaco has a corporate strategy called “4+1” where “4” stands for cost reduction, operational excellence, managing capital funds effectively, and profitable growth, and “1” stands for organizational capability. Knowledge management is seen as being inherently a part of this firm-wide effort to build “a world-class system combining people, processes and culture to achieve and sustain industry-leading performance in the four key areas”. (Chevron Texaco Corporation 2002). Thus Chevron’s knowledge management organization is not apparent – rather various managers have knowledge management as part of their responsibilities. There is, however, a knowledge management strategist that acts as a consultant to knowledge management projects throughout the company. In addition, each business unit has an employee that either has a knowledge management title or is at least responsible for knowledge management. Business units are responsible for funding and managing their own knowledge management projects. Hence, the budget for knowledge management projects varies and depends on the unit. The Upstream Exploration and Production unit, for instance, has sophisticated networks and spends billions of dollars. In contrast, the Energy Technology Company has a budget of only \$2.5 million for its technology deployment project. Shell Oil too has a decentralized approach to managing knowledge but tries to balance this with coordination. It allows business units construct their own Knowledge Management systems, but the 27 managers of

those programs in the US meet every six weeks to discuss shared interests and best practices.

## 6.2. Formalization of KM

There is a sharp contrast between the formalization of most IT-based approaches to KM and the informal approaches that are characterize the person-to-person KM techniques—communities of practice in particular. Many of the proponents of KM have emphasized the non-hierarchical and emergent characteristics of KM. This was supported by much of the early research on communities of practice that emphasized their spontaneity and absence of leadership or formal authority. For some companies, a reliance on local initiative and lack of formalization worked relatively well in the early stages of KM. For example, at BP Exploration, initial experiments in virtual teaming resulting in a clamoring to form teams on an ad hoc basis. Similarly with Shell's communities of practices were initially highly informal.

The trend over time has been for person-to-person knowledge sharing mechanisms to become increasingly formalized. In particular, communities of practices in several companies have moved from being loosely-linked, self-governing associations of like-minded professionals, to having clearly defined individual roles, reporting requirements, and governance structures.

For example, each of Shell's Global Networks includes:

- A Global Coordinator.
- Hub Coordinators for each of Shell's operating units.
- Individuals appointed as "Focal Points" for each Subject Area.

At Chevron, knowledge leader, Jeff Stemke emphasized the importance of formality in KM activities:

"The most successful communities have defined business goals, clear sponsorship form senior management, and a dedicated coordinator... At the other extreme are informal communities where there's no leader, just a group of people who get together. They may have teleconferences or meetings occasionally, but there's no formal process for sharing knowledge. These groups are only valuable if you happen to be in the community... We now recognize that networks need a coordinator. This position is funded or we recommend highly that it be funded to the extent of 10 or 20% of a person's job. We have not been totally successful in making the communities vital. There definitely needs to be some executive sponsorship and specific deliverables or



metrics that the community strives to achieve and that people can measure. In this way, communities know they're on track and others can see what they have achieved..." (O'Brien & Rounce, 2001).

### 6.3. Culture and incentives

Among the major challenges of knowledge management is getting buy-in from the employees. No knowledge management system can work unless the participants fully understand the benefits and unless employees have formal and informal incentives to participate. Even in organizations that have a technology intensive approach to knowledge management, the extent to which the technology is put to use and depends on the accompanying culture and incentives.

Only in a few of the organizations surveyed were employees directly incentivized to participate and perform in knowledge management systems. In most cases the incentives were either informal or indirect through the establishment of a culture supportive of knowledge management and through leadership support. In some business groups in Chevron Texaco, job responsibilities include participation in the networks or communities of practice. In the technology groups in this company, knowledge management participation is explicitly considered as a performance indicator when assessing promotions. However, there are no financial incentives for using knowledge management at Chevron Texaco, other than basic long term ones and growth in an employee's career. Direct and formal systems are more common, though, in project oriented companies like McKinsey and Accenture where employees can charge 'billable hours' for some activities associated with knowledge management.

In the oil and gas companies surveyed, most of the incentives to encourage participation in KM were informal or indirect. Knowledge sharing is often encouraged through peer and management recognition. For instance an informal incentive for employees to use BP's Connect is the "Fifteen Minutes of Fame" they get for adding content to their pages. The front screen of the Connect page shows a picture of the employee who last updated his details, so everyone in the company who accesses Connect will see this person's picture. This is meant to be a fun and creative way to generate participation in the program. In Chevron Texaco, participation in the networks can result in commendations that are sent to network leaders and senior management. Not only are employees who provide content

recognized but so are those that use knowledge management systems. In Conoco Phillips an effort is being made to stimulate sharing and knowledge reuse, by recognizing top users.

Early on in the process of implementing knowledge management systems, Schlumberger realized that a significant cultural change was necessary in order to weave knowledge sharing and reuse into the everyday workflow of field users. Specifically, the company needed to get field users to fill their knowledge gaps before starting a project, to continue the process during the project when conditions changed, and finally to share what they learned following the project. Once this became a natural part of the workflow for all employees, knowledge sharing and reuse would be truly institutionalized within the organization. As a management by objectives (MBO)–focused company, individual yearly objectives including knowledge sharing and reuse are a high priority for all field users. The standard appraisal form was modified to include a competency regarding knowledge sharing and reuse. The standard metric now included a knowledge activity report for each user, which, printed at the end of each quarter, demonstrates the state of fulfillment for that competency. Along with several training and communication measures, Schlumberger was able to create a culture supportive of knowledge management in the company.

Most of the organizations surveyed have attempted to develop a culture that is supportive of knowledge management. Of course, a positive culture is created by implementing a series of organizational systems and processes that enhance the perceived value and importance of knowledge management in the eyes of the employees. Recognizing this, one of the primary tasks of BP's knowledge management team is to visit each business unit around the world to create awareness and develop expectations across the company. An engagement typically consists of presentations and discussions with key staff, focusing on the importance of knowledge as a strategic asset and highlighting where knowledge management is already being successfully applied in the organization. Not only does this create an understanding of the KM process, challenges and opportunities but it also helps a culture that conducive to the management of knowledge and signals the leadership's interest in it. The BP Connect system fosters a sense of employee ownership by giving them the power to design their own web page and add their own content and creativity. The BP knowledge culture is intended



to be one of empowerment rather than mandate. Hence awareness campaigns use posters, competitions, learning fairs, and round-table lunches are utilized to generate curiosity and interest in the knowledge management programs.

#### **6.4. Integrating KM into everyday work practices**

KM only generates significant performance benefits when it has become embedded in the work practices of organizational members. If KM remains the preserve of IT professionals and a vanguard of lead adopters, then its impact will remain limited. The key is the way in which different tools and different programs integrate to support and transform the workflow within the businesses. For example, Schlumberger's Knowledge Hub draws simultaneously upon numerous technological tools and organizational systems and has changed the way in which project teams support units undertake their day-to-day work.

Schlumberger has attempted to integrate knowledge management activities into the work processes of all employees. The central group involved in knowledge management is the community of practice – a group of people who share a common area of expertise and need similar solutions to common problems. Each day, community members are engaged in doing their regular jobs (Field Activities). While performing their jobs, they conduct a dialog with their community colleagues around the world, asking questions, discussing problems, proposing new ideas, and validating solutions—capturing and sharing knowledge. This worldwide dialog is carried out via Email, enabled by the Schlumberger Intranet. The community members also have access to substantial work related information on the Web. The dialog among community members is carried out on several hundred Bulletin Boards, operating via email. When a message is sent to one of the special addresses assigned to bulletin boards, those who have previously indicated an interest in the topic in their directory record receive the message. In addition, the messages are posted in special Web areas, accessible through the company's Intranet portal.

Community members have access to documentation and manuals for the products they use in their field activities. Community members follow the same workflow--the steps necessary to perform a particular task--and have access to software necessary for their jobs (e.g., job planning and simulation tools). The members also have access to

measured data necessary for the decision making process (reservoir data, semiconductor test data, economic & business performance data) via a Data Management System. Project Archive, a storehouse of information on the past projects, facilitates reuse of information and knowledge. The Expertise Directory available on the Web allows the community members to find colleagues who may have the right skills, expertise and experience to help them solve their problems. A distinguished group of community members, “knowledge champions,” are recognized experts responsible for validating, integrating, packaging and publishing the knowledge captured by the members.

Thus, casual knowledge is transformed into Best Practices—recipes that detail the best way known by the community to accomplish a task or solve a problem. Knowledge champions are responsible for reporting community News—successes and failures, lessons learned, or alerts that can be accessed or pushed to the community members. They staff the community Help Desks, connecting others with the right knowledge and/or people. The help desk can be seen as a first step towards an Advisory Service for customers as well as community members. Finally, the knowledge champions are responsible for capturing the FAQs (Frequently Asked Questions) for the community. This combination of Intranet, software, and organizational systems and processes forms a successful Knowledge Hub that lies at the heart of Schlumberger’s knowledge management initiatives.

## 7. PERFORMANCE OUTCOMES

### 7.1. Quantifying the performance benefits of KM

Every organization we interviewed attested to the importance of KM and the belief that it will play a role in the in the company in the years to come. Some companies provided estimates of the performance benefits of their KM programs. BP estimated that, in 1998, knowledge sharing cut its costs by \$700 million. Shell’s Lesley Chipperfield estimated that KM initiatives had saved the company over \$100 million a year in upstream alone. However, it is unclear that any acceptable methodology exists for identifying and quantifying the effects of KM. The central problem is that it is difficult to envisage a company that does not employ some form of KM system. Other companies have pointed to the overall contribution of KM programs t overall performance improvement. Kenneth Derr, Chevron’s CEO

noted that: “Of the initiatives we’ve undertaken at Chevron during the 1990s, few have been as important or as rewarding as our efforts to build a learning organization by sharing knowledge. In fact, I believe this priority was one of the keys to reducing our operating costs by more than \$2 billion per year—from about \$9.4 billion to \$7.4 billion—over the last seven years” (Derr, 1999).

Estimating the overall performance impact of KM is more feasible in relation to specific KM initiatives and particular projects:

- Schlumberger reckoned that its InTouch knowledge management system that permitted faster and more reliable decision making had generated significant financial benefits. In 2001, the program’s cost savings and revenue generation totalled more than \$200 million; the time required to solve difficult operational problems had been cut by 95%; the time needed to update engineering modifications reduced by 75%. In addition, reductions in technical support costs saved \$30 million. Finally, InTouch helped to shorten the 3-year Schlumberger research and engineering cycle by bringing the technology centers into direct contact with field operatives and technicians.
- BP Amoco reckoned that it saved \$50 million in drilling costs at the Schiehallion oil field off the coast of Scotland by leveraging knowledge it had gained from developing prior oil fields (Ambrosio, 2000). Shell’s global communities-of-practice produced \$200m per year costs savings, increased facility uptime, and reduced design & planning errors (Leavitt, 2000).

On the cost front, calculations of the costs of KM also pose problems. The key issue is whether KM is defined to comprise all knowledge-based activities—IT, R&D, and training—or whether KM identifies with specific KM programs, in which case the costs of KM are incremental to basic information and technological functions. A survey by the Cranfield School of Management calculated that European companies, on average, spend 3.3% of their revenues on knowledge management (that is, on technologies and activities aimed at finding, collecting and sharing knowledge). By 2005, this is expected to rise to 5.5%—greater than the amount spent on R&D.

## 7.2. What works? What doesn’t work?

The task of assessing best practices in KM was complicated by the heterogeneity of experiences between companies—and often between the perceptions of different interviewees within the same company.



Our strongest and most consistent finding was that the most troublesome and least successful area of KM was in the application of IT to knowledge storage and knowledge dissemination. If the greatest opportunity in KM is to reuse the knowledge generated in one place in many places, then this was the greatest source of frustration by KM pioneers.

The primary approach to capturing and reusing knowledge was systems where every project would require the knowledge generated in the project and “lessons learned” from the projects to be added to a corporate database that then became available to other project teams. Making such systems work posed massive problems for most of the companies:

- When BP was developing its KM strategy during the mid-1990s, it surveyed other companies KM experiences and found that: “KM seemed to be grounded in lessons-learned databases which consisted on information that no one really wanted and very few people knew how to access”. (Chris Mottershead).
- Shell’s Andy Boyd commented that his experience of communities of practice at Shell suggested that, in terms of the value gained, 85% was derived from interpersonal discussion and only 15% from the knowledge base—however, 80% of the costs were in the knowledge base. “We have spent millions building databases of detailed technical documents, but few people search them”.(Boyd, 2003).
- Halliburton offered similar observations to those of Shell. Halliburton’s initial efforts focused heavily IT-intensive approaches to KM. The result was an overabundance of sophisticated IT tools all of which were underutilized. Halliburton drastically reduced the number of IT-based KM tools it utilized and reallocated its KM budget such 10-20% was allocated to information technology and 80-90% to people and processes.

The clear implication is that linking people to people is a more effective KM strategy than linking people to information. While the potential gains from the know-how generated during projects being stored in databases then being reused are potentially huge. The practical problems associated with such archiving are massive. The problems reported to us included:

- Users reported being overwhelmed with information when they tapped into corporate databases. When numerous documents or alternatives are presented, users have difficulty in knowing

which is best. In Exxon Mobil a common problem was that of information overload. Employees complain that there are so many sources of information that they don't know which one to choose. Fewer tools and databases may actually help the knowledge management process. Further, in Exxon Mobil many tools are not used to their full potential. For example, people need to spend time every week on Best Nets but this is difficult when one is time-constrained and faced with other pressures and priorities.

- The information being inputted into corporate databases often fails to capture the real insights that were generated during the project.
- Much of the information in corporate databases is out of date. There is a credibility problem for the user. Information in a database that is not linked to a respected individual will not necessarily be trusted. Shell's Lesley Chipperfield commented, "On a particular topic, you can search our intranet and maybe get 500 hits, but if someone recommends one, it has more value and credibility. The people you connect with may direct you to a report, but that report now has a personal reference. We have a slogan, 'Knowing who is as good as knowing how'".

To deal with these problems of sophisticated KM tools that are relatively unused within companies, two key changes appear to be taking place.

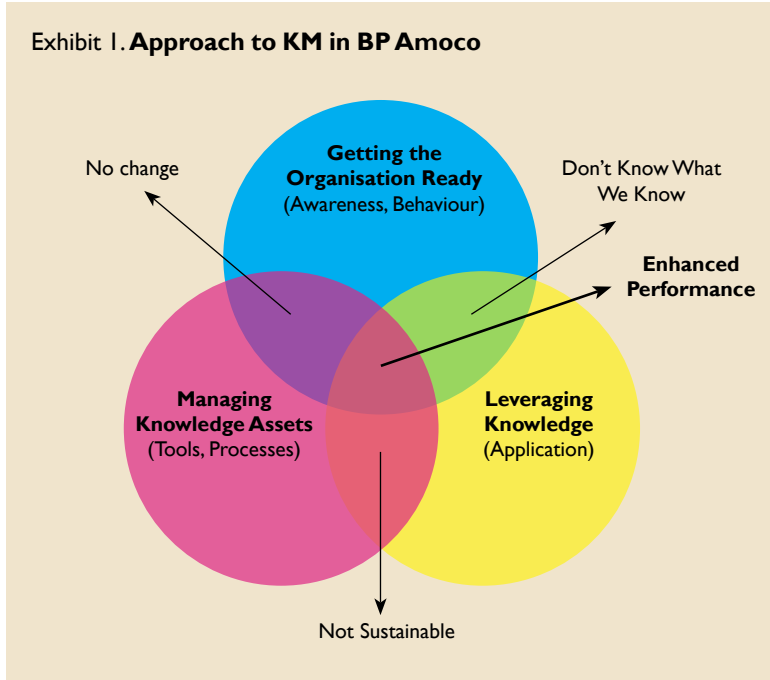
1. There is less emphasis being placed attempting to document all available knowledge and more emphasis on establishing "people locators"—directories where organizational members can identify colleagues with specific expertise. All the companies have established some kind of employee directory—typically personal web pages—where employees list their experience and skills. These corporate "yellow pages" were looked on favorably by most companies. However, their usefulness was not universally acclaimed. For example, Shell's Andy Boyd claimed that Shell's yellow pages had become increasingly problematic—they are "easy to build but hard to maintain", in particular it is very difficult to check the quality of the information and, as a result, have lost credibility. To avoid the quality problem, some companies have developed directories of acknowledged experts. Shell has an Experts Directory and Texaco instituted a Texaco Fellows Program prior to its merger with Chevron.

2. The major thrust with web-based information repositories has been speed and ease of use. Shell has placed a major emphasis on increasing the ease with which information can be accessed. Its *LiveLink* enabled web technology ensures offers a “simple attribute models combined with a consistent folder structure”. It has emphasized ease of use through its “Three clicks and I are there” slogan. In general, improvements in browser sophistication have done much to facilitate knowledge accessing.

Though every firm recognizes the importance of people in knowledge management initiatives, fully motivating and incentivizing employees to participate still remains a challenge. At Exxon Mobil, although the need for intrinsic and extrinsic rewards is recognized, currently there are no formal incentives for participating in or contributing to KM practices. Another lesson learned by firms like Exxon Mobil was that the benefits of knowledge management are not necessarily evident and salient to most employees. There is a need to make people understand and value the practices and to fully communicate their benefits. Several small firms felt the absence of adequate support for knowledge management initiatives. Another challenge is to get employees to use the technology available to manage knowledge. It is often considered too time-consuming and complicated to go to the electronic networks, so when someone needs knowledge, they just ask around and go to a person who worked on the same problem.

Instead of developing direct incentives for participation in KM initiatives, many firms like BP and Shell have relied on the development of a corporate culture to support KM. However developing an appropriate culture is not always easy. Schlumberger has found it difficult to build a knowledge sharing culture in the older and more senior employees. Employees recognize that knowledge is power and that they may change jobs, and are reluctant to share their expertise with new employees. An interesting lesson learned from Shell is that a cautious low-approach to initiating knowledge management systems is not best. “To get the greatest leverage in the organization, start with a high-value business problem”, suggests Scott Beaty, a knowledge manager at Shell Oil Co. in Houston.

The following figure (**Figure 1**) shows how the KM team at BP Amoco approaches the administration of knowledge management programs in the company.



## 8. CONCLUSION: MAKING KNOWLEDGE MANAGEMENT WORK

The speed and enthusiasm with which oil and gas companies have adopted the tools of KM during the 10-year period 1995-2004 points to the substantial potential for KM to boost efficiency, facilitate learning, build organizational capabilities and accelerate innovation in among global, technology-intensive firms facing constantly changing business and operating conditions. There is little doubt that KM has constituted substantially to the companies' success in dealing with the massive challenges of the past decade and a half—not only the technical challenges of frontier exploration and performance but also the organizational challenges of immense corporate size, environmental challenges of protecting the natural environment, and competitive challenges of limited access to many of the world's most attractive hydrocarbon deposits.

At the same time, the design and implementation of knowledge management tools and systems has been difficult. Most striking has been the difficulties experienced in the use of technological solutions. Despite the enthusiasm with which companies embraced IT-based knowledge management systems to increase the efficiency and the

effectiveness of employees in their work, implementing such systems has proven difficult. While the function of knowledge management systems is to deliver timely knowledge to appropriate individuals, the exponentially growing amount of knowledge in the knowledge repository thwarts such delivery through hindering knowledge retrieval and sharing. Moreover, as enterprises motivate system users with rewards or incentives, a large amount of knowledge will be stockpiled into such systems. A survey of 161 companies inquiring into the problems of using a knowledge management program found that the most frequently mentioned problems by respondents were:

Information overloads	65%
No time to share knowledge	62%
Not using technology to share knowledge effectively	57%
Difficulty capturing tacit knowledge	50%
Reinventing the wheel	45% (KPMG 2000)

Among all the companies in our survey we found that IT-based knowledge management systems facilitated knowledge storage and sharing, yet the ability of an organization to learn, develop, and share knowledge was largely dependent on how organizational members behaved. Accordingly, successful knowledge management requires linking the technology for knowledge management with an enterprise-knowledge sharing culture. Such sharing required managing the behavior of employees such that knowledge transfer becomes part of the organization's operating norm. This required: first, refining roles and responsibilities including the roles of knowledge owners, individual knowledge users, support members; second, incentives (including recognition programs) that motivate sharing, collaboration and innovation; and third, allowing those involved in knowledge sharing activities the time and space to capture knowledge and to collaborate with one another. Ultimately, the engagement of employees within a company's knowledge management processes requires the reformulation of perceptions and expectations about job responsibilities and performance such that knowledge-related activities are accepted as a normal part of the job.



In aligning knowledge management to a company's business strategy, our study pointed to several key questions: What types of knowledge are necessary for company's viability? What information is used and is useful? To provide such alignment, the knowledge management supervisory group has to prioritize and filter their knowledge depending on how much the knowledge would contribute to realizing their goals. Moreover, knowledge helping users to do their jobs should be updated dynamically. Ultimately, the knowledge and value chains should be incorporated to contribute to enhance profitability. Otherwise, knowledge management systems can easily turn into a garbage pool, which can exacerbate the problems of knowledge overload.

While top management leadership and support is essential to the effectiveness of enterprise-wide KM initiatives, it is also important to recognize that knowledge accumulation and sharing occur voluntarily and cannot be conscripted. KM systems are only utilized when knowledge sharing activities are supported by trust and appropriate motivation. The dependence of knowledge management upon the active engagement and participation of rank-and-file organizational managers is revealed most clearly by the central role that communities of practice have played in the KM initiatives of all the oil and gas companies we surveyed.

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## NOTES

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