Since the mid-1980s, producers and service providers have struggled to remain profitable as unstable oil prices moved generally lower. In the 1990s, oil companies downsized and started relying on outside services for functions that are not considered core business activities. They turned to outsourcing, alliances, partnerships and, lately, to mergers. The oilfield supply sector also restructured, formed joint ventures, consolidated, and began providing integrated products and services to fulfill operator needs. Once again, market conditions and emerging trends are driving the industry to adopt fresh approaches, including better management of oil and gas fields.

To squeeze optimal value from petroleum assets, management of production operations begins at near-well regions of a reservoir, proceeds through completion equipment and surface facilities, and may even extend to sale or export points (next page). Ideally, production management begins before field startup to limit risk and financial exposure, reduce capital investment and minimize time to first commercial output, particularly since many new reservoir discoveries are in frontier areas where expenses are high. For mature reservoirs, this process involves reducing expenses, enhancing productivity and extending field life to improve profitability and maximize recovery. Effective production management may be the difference between saving an asset and divesting or abandoning a property.

This tactical process takes quality, health, safety and environmental (QHSE) as well as economic factors into consideration. Local experience and expertise in applying new or existing technology help reduce costs while optimizing field output and hydrocarbon-processing capacity. Use of innovative methodology is a key element. Because technical, managerial and operational aspects are combined to support optimization and asset development strategies, this renewed emphasis on production differs from traditional outsourcing of field operations, often referred to as contract lease, or pumping, services.

The past 15 years have been extremely dynamic in the upstream petroleum business. Companies continually reinvented and repositioned themselves in response to business pressures and challenges. This article reviews trends behind a production management renaissance and explains why new approaches are needed. In addition to what and why, we discuss how this process is being reengineered, improved and implemented.
Managing field operations. Production management efforts encompass activities from near-well regions of producing formations through subsurface well completion equipment to surface facility networks that initially process and move hydrocarbons to pipelines for transfer to a point of sale. For oil and gas developments—large or small—a focused process is needed to develop plans, establish budgets, oversee schedules, control capital investments and operating expenses, meet timetables, reduce artificial-lift costs, increase field output, improve hydrocarbon handling and administer joint-interest revenue.
Industry Trends
The upstream petroleum sector has not always performed as well as other industries. Under pressure to increase shareholder return, efficiency and costs were targeted for improvement. As a result, integrated oil and gas companies and large independents began breaking the historically linked, long-chain E&P business into smaller segments that are flexible, efficient and easier to handle. These specialized asset-based units are structured to be more responsive. After restructuring and reorganizing to improve performance, unit resources—properties, employees and suppliers—are consolidated so that a streamlined organization can concentrate on activities in areas where assets can best be exploited. Service companies, which are also focusing on key competencies and activities that deliver more value or offer the most competitive advantage for clients, are undergoing a similar rationalization.

Breakup of the traditional value chain is causing operators to look hard at organizational effectiveness, and many companies are finding that in-house functions can be improved by partnering with other producers and by forming strategic relationships with service providers through long-term contracts and alliances. Some operators continue to use a periodic low-bid approach that may fulfill immediate needs, but is often counter to finding the best applications for today’s technology and service solutions. Oil and gas companies that consistently emphasize overall production and asset management are setting standards and benchmarks for operations and performance in the next decade.

Long-term relationships have facilitated consolidation in the service sector, which has been a genesis for wider ranges of products and services that deliver customized as well as reliable, cost-effective solutions. Operators, however, now expect service companies to provide integrated processes for products, services and solutions within their areas of expertise (see “Processes Within a Process,” page 6). New product and service combinations applied through the appropriate integrated support process free up operator resources that were previously committed to individual projects, allowing them to be used for other core business functions. In this way, oil companies can add even more value and further
increase shareholder return by directing company energy and efforts toward managing risks, asset portfolios, competitive acreage positions, acquisitions, mergers and exploration programs that replace and add reserves.

Further supporting this trend in service integration is a willingness among operators to base service compensation, or rewards, on results that are achieved and the incremental value added by a service company in proportion to the degree of risk that is shared—value pricing (previous page, top). More than any other, this factor helps align objectives and set the stage for agreements between producing and service companies to jointly manage production operations.

A type of risk-reward structure is used in the Dacón oil fields of eastern Venezuela. This large-scale project involves redevelopment of a major asset. When the current production contract was awarded in 1998, these fields had 111 active wells and 136 inactive wells, and output was less than 10,000 BOPD [1590 m³/d]. The work scope for alliance partners LASMO and Schlumberger includes seismic data acquisition and evaluation, 300 new wells, 180 remedial well interventions, facility upgrades and artificial-lift optimization. Several teams responsible for design and management of this tactical development effort interact on a daily basis (previous page, bottom). The goal of this technology alliance is to improve output above 90,000 BOPD [14,300 m³/d] and achieve ultimate recovery of at least 35%.

Under this agreement, Schlumberger participates in production management and reservoir optimization by providing products and services on a preferred-supplier basis, but does not have an equity interest. Value pricing for this technology alliance is a gainshare system with incentives based on maximizing project net-present-value (NPV) over a 20-year production contract. Other companies participate through third-party contracts awarded by tender and bids. One year after the fields were handed over to LASMO in April 1998, production had been increased from 10,000 to over 30,000 BOPD [4770 m³/d].

### The Case for Change

Oil company asset portfolios encompass numerous properties, some of which include mature fields near the end of the development life cycle when production is declining. Many new fields are in high-cost heavy-oil, gas, deepwater, remote or environmentally sensitive provinces, requiring operators to redirect internal resources. More than ever, because of continually changing market conditions and corporate priorities, producers need the flexibility to access experienced personnel who can work exclusively on a project. Because of downsizing, consolidations, reorganizations, joint ventures and mergers, the older, smaller or nonstrategic fields are often sold, traded, or perhaps worse, ignored. For these types of assets, production management services may be best (above).

Some of these reservoirs will produce at economic rates for many years; others like the Dacón fields can yield more if companies have resources to operate and manage them effectively. Optimal use of critical internal and external resources, and relying on an alliance partner with expertise in a particular area can improve field performance. By using technology and integrated processes to fully exploit reservoirs through improved cost control and efficiency, companies can establish, sustain and, ultimately, increase asset value.

Use of outside providers for some business functions or operating activities, and alliances between clients and service companies that support them are not new to industry in general or the oil and gas sector in particular. Automobile manufacturers were among the first to form alliances with suppliers. These mutual arrangements leveled the playing field for supply companies by stabilizing demand and establishing a base income level that ensured a dependable revenue stream. In return, product and service prices were lower, and automobile companies reduced costs by participating in and helping direct supplier research and development.

Oil and gas producers and service companies benefit from alliances in the same ways as the automobile industry. By the end of the 1980s, cost-reduction efforts by operators resulted in (continued on page 8)
Increasing asset value through improved reservoir performance has been pursued for decades, but productivity and recovery results were often difficult, sometimes impossible, to attain because crucial tools and technologies were either unavailable or inadequate. Today, advanced technologies and rigorous process-driven approaches offer ways to reach production goals and take oilfield efficiency to new levels. The IRO Integrated Reservoir Optimization methodology is a well-defined, closed-loop process to help operators maximize reservoir performance (below).1

For new fields, this macro-process represents an approach to understanding reservoirs that encompasses activities from exploration and discovery through reservoir development and production management to abandonment. In existing fields, most, if not all, of these principles can be applied with emphasis on renewing, or rejuvenating, production, and remedial actions to enhance productivity, extend longevity, increase recovery and improve financial results.

For either type of asset, this is a complex task, requiring innovative solutions and the latest fit-for-purpose technology. The IRO process hinges on closing a loop that consists of four principal elements: reservoir characterization through seismic and wireline formation evaluation, reservoir development through petroleum and facility engineering implemented using oilfield drilling and production services, and reservoir management through project, production and asset management, supported by consulting services and permanent downhole monitoring with well process control (see “Controlling Reservoirs from Afar,” page 18).

Time-lapse seismic surveys help pinpoint bypassed hydrocarbons, and comprehensive production logs confirm flow profiles and fluid segregation. As more data are collected and analyzed to refine reservoir and economic simulations, a clearer picture of reservoirs emerges to aid decision-making on capital-intensive projects such as infill drilling or horizontal wells to access bypassed formation intervals and intersect more producing intervals or natural fractures.

The motivation behind an integrated approach to reservoir optimization was to define step-wise procedures for optimal reservoir development and management as a way of identifying deficits in existing technology and new wellsite services that were needed to improve field production and reserve recovery. For example, areas that will benefit from further technological improvements include enhanced time-lapse seismic acquisition, downhole process control, a new generation of software for geological and reservoir modeling, and revolutionary formation evaluation tools, like the Platform Express well logging platform.2

1. See reference 2, main text.
3. See reference 1, main text.
The IRO approach represents an extended commitment, often requiring the life cycle of a field—20 years or more in some cases—to achieve full success. While always involving short-term decisions, the IRO process concentrates on major tasks to improve long-term reservoir performance. The production management process flow, which is used to reevaluate and address factors that determine day-to-day reservoir behavior and field performance, is a subset of this process.

^Integrated reservoir optimization and production management. The IRO approach incorporates major tasks associated with improving long-term reservoir performance, but also involves making near-term decisions. The production management process flow, which is used to reevaluate and address factors that determine day-to-day reservoir behavior and field performance, is a subset of this process.

The IRO approach represents an extended commitment, often requiring the life cycle of a field—20 years or more in some cases—to achieve full success. While always involving short-term decisions, the IRO process concentrates on major tasks to improve total reservoir performance (above). Production management is a micro-process, a subset of this integrated process, which is used on a daily basis to evaluate and reassess factors that control reservoir behavior and field performance. Development and operating plans are reviewed and updated, revised plans are implemented, and results are monitored against established benchmarks.

Applied within the framework of production management, production enhancement, getting the most production from existing wells, is an important subset of the IRO process and a key to reservoir optimization. Using proven NODAL analysis techniques, a multidisciplinary Production Enhancement Group (PEG) proactively identifies wells with a performance gap between actual and potential productivity—candidate recognition—so remedial action can be taken (below).³ Production enhancement is one of many functions that drive production management activities by increasing the overall effectiveness of integrated well services, which in turn, are pivotal in improving reserve recovery and maximizing value through reservoir optimization and portfolio-level asset management over longer time periods.

As a key reservoir or asset management tool when field output declines and a key to maintaining plateau oil and gas production for as long as possible, production management is of critical importance.

^Integrating reservoir optimization and production management. The IRO approach incorporates major tasks associated with improving long-term reservoir performance, but also involves making near-term decisions. The production management process flow, which is used to reevaluate and address factors that determine day-to-day reservoir behavior and field performance, is a subset of this process.

^Proactive production enhancement. Closing single-well performance gaps in wells when output is less than potential productivity is the objective of production enhancement. This goal is achieved by applying integrated services and custom solutions that move reservoir inflow performance relationship (IPR) curves up and to the right, and move flow-conduit performance curves down and to the right.

Reservoir and completion
Add pay
Reperforate
Acidize
Fracture
Drill lateral or horizontal wellbore
Control sand
Control water and gas

Flow conduit and facilities
Clean out fill
Remove scale
Optimize tubular designs
Redesign artificial lift
Coiled tubing completions
Early production facilities

^Proactive production enhancement. Closing single-well performance gaps in wells when output is less than potential productivity is the objective of production enhancement. This goal is achieved by applying integrated services and custom solutions that move reservoir inflow performance relationship (IPR) curves up and to the right, and move flow-conduit performance curves down and to the right.
formation of the first oil-industry alliances. These partnerships involved varying levels of participation and took different forms. Alliances have been formed between one or more producers, between producing and service companies, and between product and service suppliers.

Through the 1980s and 1990s, these efforts reduced costs significantly, which improved the industry’s economic picture and financial structure (right). Now, the question is how can performance and efficiency be improved further?

One answer is long-term production management enhanced in four ways: by focusing on key business segments and strategic geographic areas; by optimal use of personnel and resources; by applying appropriate E&P technologies; and by leveraging the competencies of other companies—operators and service. Addressing these factors simultaneously ensures cost-effective operations, helps maintain high reserve-replacement ratios and improves return on investment. A common thread that runs through this process is selection and application of custom integrated solutions over the remaining life of a field. Generating customized solutions to get the most return from oil and gas assets is best achieved through cooperation and the combined strengths of all parties involved.

Managing production was always a service activity, even though traditionally handled by oil company in-house groups. A contract operator or production management team that hires local specialists can concentrate on a project, trim expenses and increase value for asset owners by boosting field output and extending the economic life of a reservoir. Using the best practices for managing production, well and facility interventions, field operations, reservoir performance or entire asset portfolios, an integrated service company can supply engineering design, well drilling and completion planning, artificial-lift optimization, production and injection analysis, joint-interest billing and other financial accounting, including petroleum export marketing for some projects. Production management services can also provide functions ranging from petroleum land, and E&P permit or contract work to exploration and geologic evaluations.

A production management alliance or partnership strengthens QHSE performance, reduces lifting costs, increases field output, improves profitability and adds long-term value. Through ongoing research programs, product development and service expansion, Schlumberger capabilities facilitate production management (see “Integrated Projects and Consulting: A Continuing Commitment,” page 12). Innovative and cost-effective approaches achieve success by combining global expertise and state-of-the-art technology with local experience, and are available when operators have limited infrastructure in a particular location or choose not to use internal resources exclusively, and for large, mature or complex fields.

\(^3\) 1998 Sterling Consulting report.

\(^\) Oilfield efficiency. Targeting expenses and performance throughout the 1980s and 1990s significantly impacted the economic picture and cost structure in the upstream petroleum business. Cost reduction efforts during the past 15 years resulted in a 48% decrease in finding and development costs, a 27% drop in lease-operating costs and a 20% reduction in general and administrative costs.

**A New Approach**

Day-to-day management of production is tactical, but in practice, it impacts strategic reservoir and asset management. In this way, it differs from contract operations of the past, which focused only on daily or monthly production targets for cost-plus or day-rate compensation. Also, these contract “lease-pumping” arrangements seldom included geoscience or petroleum engineering consulting support. The Schlumberger approach is to provide an alternative process that supports cost-reduction efforts,
delivering initial step-function improvements in lifting costs and further levels of production efficiency later in a project.

This fundamentally new way to manage production enhances asset value through leading-edge technologies, best-in-class products and services, custom solutions, engineering consulting and an integrated process carried out in conjunction with oil and gas company organizations. This comprehensive performance-based effort consists of three principal activities—engineering, intervention and operations. Linked in an integrated process, these activities deliver production management and associated services while overcoming the disadvantages of traditional producer and service-provider relationships (previous page, bottom).

Production management functions include personnel and human resources, information technology, financial issues and accounting, material or equipment procurement and logistics, oilfield services, QHSE compliance, commercial contracts, joint-interest relations and other relationships or communications outside of the alliance. Although targeted initially for onshore basins in North and South America, this model is applicable across geographic regions and offshore.

To achieve mutual objectives and optimal results, operator and Schlumberger organizations must work together to integrate services, processes and management. In a natural progression from multidisciplinary asset groups in an oil company, successful alliances with a service company include a cross section of personnel from each company in a project team that oversees daily operations. Executives from both companies steward long-term goals and performance as members of an oversight committee.

A joint production management effort may involve a Joint Leadership Team (JLT) committee and Joint Project Management Team (JPMT). The JLT integrates the two companies on a management level to align strategic issues, measure performance and determine future goals, objectives and directions for the asset. The JPMT integrates alliance partners and third-party vendors on a tactical level (see “An Alliance to Manage Production,” page 15). Daci project management in Venezuela is organized using this approach.

The engineering phase includes asset-level and reservoir-level activities. On a technical, basin or regional level, geologic aspects of a project are typically handled by the operating company, or asset owners, as part of their portfolio management and financial responsibilities. This ensures a proper E&P perspective and diligent oversight. Reservoir-specific activities pertinent to production management and reservoir development are a JPMT responsibility. This includes formation evaluation, reservoir performance and economic analyses, and completion technology (above). Production planning, petroleum and facility engineering, data gathering and information processing are part of this phase, which, in addition to technical excellence and strong management skills, requires effective evaluation, planning, budgeting and accounting software.
The well and facility intervention phase involves new construction or remedial work that encompasses completion technology and design supported by formation evaluation, regulatory and client approval, contingency and risk management, purchasing and material logistics, and drilling or workover activities (left). These activities can be handled by the operator or service company separately, or by a JPMT, depending on contractual agreements or defined project scope. An understanding of field development objectives, planning and cost control, and exceptional QHSE performance are required in this phase.

Execution of the development plan. The well and facilities intervention phase of production management consists of well and surface facility upgrades or new construction, formation evaluation support for completion technology and designs, obtaining regulatory and client approvals, managing risks and contingencies, material purchasing and logistics, and well drilling or remedial interventions.

Artificial-lift optimization. A systems approach to gas-lift analysis, design and performance monitoring within the framework of a structured production management process increased individual well output rates and helped optimize production from the BP Amoco Forties field in the North Sea.
Managing production operations. Surface and subsurface surveillance, enhancement and maintenance are encompassed by the production operations phase of production management. This phase includes field operations, equipment lease or purchase, maintenance of wells and facilities, control of the production process, hydrocarbon volume reports, finance and revenue accounting, and, in some cases, marketing of produced oil and gas. These activities yield the results of plans formulated in the petroleum and facilities engineering phase.

In the production operations phase, efforts involving production surveillance, enhancement and maintenance can be divided into surface and subsurface processes that include field operations, equipment purchasing or leasing, well and facility maintenance, well-process control and optimization, production volume and revenue reporting, finances and accounting, and hydrocarbon delivery or export (right). This phase yields the results of plans set in motion during the first phase—petroleum and facilities engineering—and includes a feedback loop to provide analysis and evaluations for continually improving the next stage of reservoir development. Rigorous monitoring and control of expenses, production and OHSE performance are required as well as an understanding of field development and production plans, and portfolio-level or asset-level strategies.

Artificial-lift analysis is recommended as an activity during the production operations phase. These evaluations identify inefficiencies and deliver near-term production enhancement. An example of artificial-lift optimization is the BP Amoco Forties field in the North Sea where both gas lift and electric submersible pumps are used. This field has four main platforms produced primarily by gas lift and one lifted solely with electric submersible pumps. Production is declining, but substantial recoverable reserves remain.

Working closely with Camco Products and Services and later the enhanced oil recovery (EOR) group, the operator began submersible pump operations in the late 1980s, and gas-lift systems were installed in the early 1990s. Initially, gas-lift and submersible pump teams concentrated on their specific technology and performance, but over time, a total systems approach evolved that encompassed all aspects of artificial lift, reservoir surveillance and production engineering. Gas-lift optimization involving analysis, design and performance monitoring resulted in incremental rate gains on individual wells (previous page, bottom).

(continued on page 14)
The Schlumberger commitment to reservoir performance optimization and project management began in 1995. In that year, the Integrated Project Management (IPM) organization was formed to fulfill operator requirements through global expertise in combination with local experience. The Production Enhancement Group (PEG) initiative was started and Holditch & Associates was acquired in 1997. This was followed by launch of the IRO Integrated Reservoir Optimization service.

Performance on major projects worldwide has provided extensive integrated service activity and project management experience. During the past four years, these organizations have worked successfully on projects ranging from integrated drilling and well servicing for the North Sea Andrew and Cyrus fields, and the Eastern Trough Area Project (Mungo, Marnock, Machar and Mirren fields) to the Hibernia, Wytch Farm and Machar field alliances. Projects in Africa and South America, like the Dación field redevelopment, are also included in this track record.

Within major or stand-alone projects, production management services have gained acceptance and are increasingly important in the upstream petroleum sector. Acquisition of Coastal Management Corporation (CMC) in 1998 further strengthened Schlumberger capabilities in this area. Formed in 1989, the CMC organization, which developed from a production operating company background, compiled a strong record of implementing projects from large-scale coalbed methane development drilling to production management of major waterflood operations (below). Schlumberger goals paralleled those of CMC, creating a natural fit that led first to formation of an integrated alliance and then, ultimately, to the acquisition.

In addition to an existing waterflood production management project in West Texas, CMC previously operated the Bryan-Woodbine field near Bryan, Texas, USA, which involved handling working-interest relations and accounting for 435 joint-interest and 15,000 royalty owners, and dealing with complex environmental issues. In the Alabama, USA, Black Warrior basin, CMC scheduled and managed a 14-rig coalbed-methane program for more than a year, drilling more than 400 wells and coordinating a $175 million budget.

Integrated Projects and Consulting: A Continuing Commitment

Production and project management in practice. The CMC organization, which was developed in 1989 from a background of operating company experience, has a strong project implementation track record from development drilling programs to large waterflood operations and major production management projects.
Each project had different parameters. The Bryan-Woodbine field involved solving revenue problems. In Alabama, the project included engineering design, accounting, control of capital expenditures and regulatory issues associated with tax credits for unconventional gas.

Recently, the Schlumberger Oilfield Services product lines were reorganized into three product groups—Reservoir Evaluation, Reservoir Development and Reservoir Management—encompassing 13 service segments. These groups develop and support the products and services offered in four existing geographic areas: Asia; Europe, Commonwealth of Independent States and Africa; the Middle East; and North and South America. The Reservoir Evaluation group includes land and marine seismic surveys, and openhole and cased-hole wireline well logging data acquisition, processing and evaluation activities. The Reservoir Development group includes Anadrill, Camco, Dowell and Testing products and services. The Reservoir Management group, which combines GeoQuest, Data and Consulting Services, Production Operators, Inc. from Camco and IPM, supports IRO Integrated Reservoir Optimization and production management processes (right).

Reservoir management embodies several elements, including a strong commitment to excellence in service delivery at the wellsite, integrated solutions and services, alliances, partnerships, value pricing and project management skills. The Reservoir Management group draws on Schlumberger technology and expertise for field development planning and implementation, but also relies on other best-in-class service providers and third parties to form a strong team.

Participation takes several forms, from simple coordination of oilfield services to full involvement in design and management of field operations. To facilitate effective communication and cooperation for life-of-reservoir projects, the importance of involvement during conceptual engineering and detailed design phases is stressed. In addition to a critical mass of operational expertise and a complete range of drilling, completion, development planning and production management services, Schlumberger has forged engineering and construction alliances with premier firms, including Coflexip Stena Offshore, Bechtel Offshore and Fluor Daniel. These arrangements are nonexclusive, with alliance partners representing preferred, first-choice suppliers in various areas.

Substantial improvement in submersible pump run times were also realized (above). Daily field operations may include operating surface equipment or valves to initiate and control production or increase gas-lift injection rates and pressures for artificial lift, but production enhancement through proactive candidate recognition addresses individual well performance to collectively increase total output from a field. These short-term rejuvenation efforts, which also may be part of the production management process, involve well servicing, modifying or installing artificial lift, pumping matrix acid or hydraulic fracturing stimulation treatments, and other remedial well interventions to improve or renew production.

Developing aligned objectives is essential in any production management initiative. Commercial agreements combine near-term fixed compensation based on lifting-cost improvements with long-term rewards based on adding asset value (below). This model is applied on individual projects, but can be used as a template for future collaboration across an asset portfolio to optimize reservoir performance and maximize value for both the operator and the integrated service provider. A mutual relationship that balances risks and rewards can deliver immediate results and ensure continuous improvement.

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▲ Improved artificial-lift efficiency. A systems approach similar to the one used for gas-lifted wells in the North Sea Forties field significantly decreased electric submersible pump failures and increased the run life of these artificial-lift systems.

▲ Value-based production arrangements. Production management services require the support of value pricing through an alliance model that helps asset owners and the integrated service provider develop mutual goals and objectives. Most production management proposals involve near-term compensation based on reducing lifting cost, and a long-term risk-reward arrangement related to additional asset value based on project net-present-value or a combination of NPV and lifting cost.

An Alliance to Manage Production

In February 1991, Coastal Management Corporation (CMC) was selected from among six companies to provide project management for a group of oil and gas fields in the heart of the Permian Basin of West Texas, USA. CMC was given responsibility for normal operator functions, including general management, exploration and petroleum engineering, field production operations, revenue accounting, joint-interest billing, accounts payable and material procurement.

At the time, the asset operator’s staff was fully committed to other assets and projects. The company estimated that a substantial number of employees would be needed to operate the project, but did not want to expand their organization. Granted authority to manage and operate this project, CMC hired 85 people with local experience and assumed the production management role.

The project, which covers about 80,000 acres (324 km²) and includes more than 1350 active wells (2000 total wells) producing from multiple pay zones over 12 horizons in 47 fields, illustrates the impact of focused production management. Before CMC assumed operations in May 1991, little upside potential was believed to exist in the field, and previous operators had identified this as a noncore asset. A multidisciplinary team was assembled to carry out engineering and geologic evaluations, oversee operations and rejuvenate production output.

Study results led to several actions. Electric submersible pumps were installed in selected wells. With reinterpreted seismic maps, 16 wells were drilled. All but one of these wells were successful. Peripheral waterflood injection patterns were implemented along and between up-dip edges of overlapping formation sequences across the field (right). These boundaries were identified by two large-scale, Schlumberger-managed three-dimensional (3D) seismic surveys, which also resulted in new field discoveries for this 70-year-old asset.

Seismic survey and waterflood results. A multidisciplinary team carried out engineering and geologic evaluations, managed field operations and began rejuvenating production output. Peripheral waterflood injection patterns were initiated along and between up-dip edges of overlapping formation sequences identified by two large-scale, three-dimensional (3D) seismic surveys. Several new field discoveries were made as a result of these surveys.
Working closely with a petroleum and facilities engineering team, groups responsible for well and facility intervention, and production operations completed the initial stages of production rejuvenation. Total production rose from about 7000 to almost 12,000 BOPD [1120 to 1906 m³/d] in 1995 (right). Annual capital expenditures of less than $5 million in 1992 were increased each year to $35 million in 1998. Investment results were competitive and rates of return compared favorably with other spending opportunities of the working interest owners.

Control of lease-operating expenses is an important part of effective production management for the project. In addition to the large number of active production and injection wells, there are 37 surface equipment batteries for production separation, three electrical distribution grids and a number of other facility installations in the fields. Lease-operating expenses were reduced from historically high levels, but not to the point of ignoring prudent operating procedures and QHSE practices. With an estimated reserve life of more than 20 years, short-term spending limits are not allowed to override maintenance requirements that will ensure lease equipment and operational longevity.

An integral part of managing lease-operating expenses and overall economic success on the project is the enhanced relationships with vendors who participate directly in repairing wells. The objective was to promote cooperation between operational groups and companies that provide well servicing rigs, pumps and specialty chemicals. Well failure rates, at more than two failures per well per year, exceeded a benchmark of one failure per well per year for similar operations. The dilemma was how to reduce rod, tubing and pump failures. A strong culture of teamwork in the CMC organization pointed to a new model for integrating best-in-class service providers who could add value to the existing production process.

The field organization was restructured around well maintenance activities by organizing field production foremen into a Business Focus Team with management and supervisory personnel from well servicing rig, chemical treatment and subsurface pump companies as members. This team concentrated on improving well maintenance activities. In addition, the task of implementing improvements in the field was assigned to a new Well Reliability Team, again consisting of alliance representatives and specialists from each of the third-party service providers charged with initiating well maintenance improvements. Failures in rods, tubing and subsurface pumps were decreased from 175 per month in 1991 to 40 per month in 1998 (left).
Well failure rates were reduced significantly below the benchmark of one per year to less than one-half failure per well per year. As a result, lifting costs were decreased by 34%, and well failures were reduced 75%. These reductions saved working-interest owners more than $1 million over six years. At the same time, efficiency improvements through more direct involvement of the service partners allowed some alliance personnel to move to production management tasks that add more value to the project. Well maintenance cost reductions were achieved while reducing the staff allocated to this activity.

By 1998, these teams had reduced well failures to a point where further improvement was not cost-effective. The focus then shifted from failure reduction to production enhancement. Well servicing specialists have further improved revenue through artificial-lift analysis, optimization and modification. Developing a broader integrated services model than was used in the past—one that provides continuity and concentrates on process activities rather than individual disciplines or narrowly defined tasks—helped achieve these results.

Why is this approach successful? One key is the ability of production management teams to focus energy, creativity, expertise, technology and local experience on a single project and to have the flexibility to analyze problems and develop innovative solutions. Unique because it is a service organization that evolved from a producing company operational background, CMC maintains a life-cycle perspective on the assets it manages. This approach provides a model for coordinating and administering production management activities that is flexible and also delivers maximum field performance.

Project administrative structure is transparent to clients and differs little from any other oil company operation. Through mutually agreeable goals and objectives, both parties share a long-range vision and the corresponding rewards of this value-adding production management process. Developed over ten years of well maintenance and field operating experience, CMC internal systems and methods for managing day-to-day project activities by monitoring and tracking field data allow operations personnel to make cost-effective decisions (below).

An Ongoing Management Process
Market conditions and emerging business trends offer compelling tactical, strategic and financial incentives to adopt a new production management approach. The challenges of declining production and a mature asset base can be met by altering the way reservoirs are developed and managed from discovery to ultimate depletion and abandonment. By relying on alliances or partnerships for production management, functions and processes developed by an integrated service organization like Schlumberger significantly reduce demands on operator resources—financial and personnel—to acquire, integrate and manage the technologies, products and services involved in field operations. Oil company staffs are able to pursue business opportunities that improve asset value and financial return by redirecting internal resources to activities of greater strategic importance.

Additional advantages come through cost reductions from better application of technology and expertise, more efficient purchasing, pricing and material sources, and expanded R&D capabilities. New approaches to reservoir development and management are not just a repackaged collection of products and services that were offered piecemeal previously in response to client requests; they are customized solutions representing the best technologies and methodologies.

Project management services gained acceptance in the early 1990s. More recently, these arrangements became established as viable methods for meeting near-term tactical objectives and achieving long-range strategic goals. This trend is likely to continue over the next decade as producing companies pursue further production optimization and cost reductions. Controlling current expenses is important, but over the long-term, many mature properties around the world need engineering and operational attention. These petroleum assets contain resources that the world economy needs and producing countries can’t afford to lose as a result of operational oversights or resource limitations.

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[^Production management methodologies. Internal CMC systems and methods developed during a decade of well maintenance, field operating and production management outsourcing experience allow alliance operations personnel to make cost-effective decisions.]