Mobil Implements Global Computing Strategy.

Executive Summary

Customer: Mobil Oil Corporation.

Challenge: Lower operating costs on a global basis, increase computing efficiencies,

reduce project cycle times, improve risk management.

Solution: Retire legacy systems; implement full suite of Landmark integrated

geoscience applications; OpenWorks® project database; training,

on-site support and consulting services.

Phased implementation of integrated computing environment and

standardized workflows in 15 affiliates worldwide.

In 1995, Mobil Oil Corporation began developing a global strategy to optimize the value of its investment in E&P computing technology. The Technical Computing Strategy (TCS) took a serious

"Mobil has made us a member of its team. We have a clear understanding of its business objectives. And we're highly motivated to make Mobil's strategy a success."

Plans:

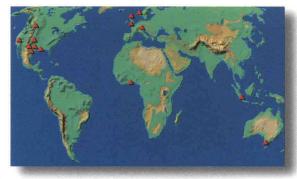
— Hank Holland,
Executive Vice
President, Integrated
Solutions Group,
Landmark

look at future directions. "One of our key findings was the need for integration," explains Mike Marzano, Project Manager for implementation of Mobil's TCS. "In the past, we focused on individual processes – say, petrophysics or mapping – and tried to find the best-in-class application. By not considering the entire workflow and how interdisciplinary teams work together as a whole, we weren't improving productivity as much as we could."

According to Marzano, many Mobil affiliates have used Landmark's

seismic interpretation software for years. They have also

used stand-alone applications developed internally and externally for other discrete tasks. The company developed its own integration toolkit. But ongoing software maintenance, ad-hoc data transfer systems and divergent local customization drove up costs, increased cycle times, and decreased efficiencies. As a result, Mobil decided to



Landmark will assist in a carefully phased implementation of the Technical Computing Strategy to 15 Mobil affiliates worldwide.

adopt commercial integration technology and to aggressively retire its legacy systems. In December 1996, Mobil signed a three-year contract with Landmark to assist in the implementation of its new global strategy.

"We found, by talking with Landmark, that we have common objectives," says Marzano. "We want our people to have integrated solutions.



(Continued on back)

And Landmark is delivering integrated solutions. Like other oil companies, we're trying to get away from building and supporting technology we can acquire from the market."

Under the agreement, Landmark will provide nearly 800 geoscientists in 15 Mobil affiliates worldwide, with access to its complete suite of

> integrated geological and geophysical applications. Landmark will also provide training, on-site support, workflow reengineering and other consulting services.

> To determine the budget and scale TCS implementation plans, a site assessment team including Landmark visited over a dozen Mobil E&P affiliates in Asia, Africa, Europe and North America. "People are usually good at calculating the costs involved in a project like this," Marzano observes. "But we wanted them to start thinking about the value of the strategy."

Based on staff interviews and workflow observations, Landmark

identified quantifiable benefits that Mobil's affiliates could derive from integrating geoscience data and applications. For example, Landmark estimates that streamlining the decisionmaking process associated with drilling deep, deviated gas wells by the German affiliate could save about \$2 million per year in drilling costs. Also, the Bakersfield affiliate drills 300 wells per year. Increasing production one percent by optimizing well placement and steamflood performance, by Landmark's calculations, would yield tens of millions of dollars in net present value.

Mobil's Nigerian affiliate completed a pilot project last year using integrated software and "fast-track" drilling. According to Kirk Van Sickle, who headed up the project, a multidisciplinary team (including a Landmark consultant) drilled and completed 18 development wells in the Asasa Field. In June, the first well came on-line at about 4000 bopd. By year end, the field was producing over 125,000 bopd.

The team believed the integrated approach significantly accelerated interpretation and remapping of the field. "By integrating all the tools, they were able to understand the reservoirs better and more quickly than before," says Marzano. "That was definitely one reason we went with Landmark."

Considering the magnitude of change involved, implementation of Mobil's Technical Computing Strategy will be carefully phased throughout 1997 and early 1998. During that time, Landmark consultants will assist Mobil in developing standardized geoscience workflows to support its vision of a common global solution.

"I think this project is noteworthy because we're rolling this out on such a large scale worldwide," Marzano concludes. "This may be the largest implementation of it's kind in the industry."

According to Hank Holland, Executive Vice President of Landmark's Integrated Solutions Group, this is the largest integrated solutions contract in Landmark's history. More importantly, it represents a whole new level of partnership. "The relationship we're building with Mobil is far more substantial than in the past," says



Mobil's new computing strategy is aimed at reducing cycle times, improving risk management, and lowering operating costs.

Holland. "Mobil has made us a member of its team, and we have a clear understanding of its business objectives. As a result, we're highly motivated to do whatever it takes to make Mobil's strategy a success."

Reprinted from Solutions, Vol. 2, No. 1, Spring 1997



Mike Marzano, Project Manager, TCS, Mobil

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PanCanadian and Landmark Form Strategic Alliance for Integrated Solution.

Executive Summary

Customer: PanCanadian Petroleum Ltd., Calgary.

Challenge: Decrease cycle time and finding costs in mature basin, Western Canada.

Solution: Three-year alliance, including full suite of integrated applications for

geophysics, geology, petrophysics, mapping, reservoir modeling and

geostatistics; consulting services, customized training, on-site support.

Integrated field study reduced cycle time, increased confidence, lowered

risk, improved workflow practices.

PanCanadian Petroleum Ltd. of Calgary is one of the largest, most active energy companies in the nation. For three years in a row, the company has drilled over 1,100 wells in the Western Canada basin, a mature oil

"This alliance is a model for a new kind of value-based relationship we want to have with customers."

Results:

— Bob Peebler President and CEO, Landmark and gas province with nearly 300,000 wells. Despite the odds, PanCanadian's success rate last year was 84 percent. To support that level of activity, the company shoots close to \$60 million worth of seismic data — mostly 3D — every year. Improving cycle time, efficiency and, ultimately, finding costs are vital to ongoing success. Applying technology more effectively is a key corporate strategy.

"When I came to PanCanadian four years ago, we only had six or seven Landmark systems, so interpreters had to

wait in line," says Gerry Macey, Senior Vice President of Canadian Exploration. "Since then, we've put one on almost every geophysicist's desk. That has driven our ability to generate a very large inventory of drilling locations. Now I'm looking for the next quantum leap: I'd like even higher quality prospects to choose from. We need to find more reserves per well, for fewer dollars. Our alliance with Landmark should help us do that."



A multidisciplinary team completed a pilot integrated workflow study in just two months, substantially improving the team members' understanding of producing reservoirs.

A Halliburton Company

PanCanadian recently signed a \$10 million, three-year contract with Landmark for an integrated solution that includes software, professional services, customized training, and on-site support. The agreement provides nearly 150 geoscientists with access to a whole range of integrated PC and UNIX® applications — from seismic processing and interpretation to geological and petrophysical analysis, mapping, 3D reservoir modeling and geostatistics.

Scott Lowry, Landmark's account manager for PanCanadian, says, "To quantify the value of this agreement for PanCanadian's senior executives, we applied a well-known industry model for calculating risk. We found that if they recover *one*

"We need to find more reserves per well, for fewer dollars.
Our alliance with Landmark should help us do that."

— Geny Macey, Senior Vice President of Canadian
- Exploration, PanCanadian.

percent more reserves per well, PanCanadian will recover their investment. At three, five or ten percent, they'll make a substantial profit."

Bob Peebler, Landmark President and CEO, says, "This alliance is a model for a new kind of

value-based relationship we want to have with customers. We started with a clear definition of the higher level business issues, and brought in consulting services to determine the best solution."

"Strategic alliances are definitely the right approach for aspects of our business that are really critical, where we need true teamwork," says PanCanadian's Gerry Macey. "In the past, we had a straight vendor-purchaser relationship with Landmark. Almost nothing was customized. Now, training is done with small groups using our own data. And we've got three dedicated on-site support specialists. In effect, we're getting Landmark people who think like PanCanadian employees."

Over a dozen Landmark professionals are working with PanCanadian to integrate data, systems and applications for enhanced efficiency. Almost 35 separate initiatives have been identified in four areas: workflow processes, application integration, data management and computing infrastructure. "Our growth has been so fast and hectic that it created some real "rats' nests" in our computing processes. So consulting is a major component of our relationship with Landmark," says Macey. "Also, I'd like to see our people make much greater use of the high-end capabilities of Landmark's software. That's why we're making a substantial investment in training. Why have a garage full of Ferraris if no one has a driver's license?"

"The bottom line," says Lowry, "is that we're enabling PanCanadian's asset teams to work in a more integrated manner."

One of the most significant milestones achieved to date has been an integrated workflow study using a full suite of Landmark technology. Working closely with Landmark consultant Kandy Lukats, a multidisciplinary team of PanCanadian geoscientists,



Landmark consultants worked with PanCanadian to streamline workflows, improve reservoir characterization and cut finding costs.

engineers and technologists spent two months building an integrated project database and detailed 3D earth model of the Wayne Nisku Field in Southern Alberta. The final 3D model incorporated all available geological, geophysical and production data and interpretations — a technical feat never before achieved at PanCanadian.

At the end of the study, the team members assessed the business value of working in an integrated environment. They concluded that it reduced cycle times, increased accuracy, raised confidence levels and lowered risk. They substantially improved their understanding of Wayne

"Landmark is like the Microsoft" of the oil and gas industry—a sort of one-stop shop with a strong philosophy of integration"

Monte Montemurro,
 Chief Technology
 Officer,
 PanCanadian

reservoirs, and qualified a number of proposed drilling locations. The project also acted as a valuable educational experience, documenting team workflow practices that will be disseminated throughout the company.

By the end of the three-year alliance, Macey expects PanCanadian to be doing business in dramatically different ways. "We're facing a declining resource in a mature basin," he notes. "If we think we can take it easy, we're kidding ourselves. We've got to be continuously improving our processes. If our finding costs keep going down, I'll assume that Landmark technology and services are at least partly responsible."

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Landmark workflow consultant, Kandy Lukats, worked on-site with the PanCanadian team to redesign work processes, conduct training and document best practices.



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3DX Technologies Cuts Cycle Time 50 Percent.

Executive Summary

Customer: 3DX Technologies, Inc., Houston.

Challenge: Process, interpret and image a 19 square mile onshore 3D seismic survey

concurrent with field acquisition.

Solution: ProMAX® 3D software on an SGI Power Challenge™; full suite of integrated

Landmark seismic and geological interpretation applications; 24 hour

operation; multidisciplinary team.

Results: Processed entire data set 17 times during acquisition; made two significant

real-time survey design improvements; began drilling within three months

of starting field operations; completed several wells to date.

Years ago, before the advent of digital computers, a junior geophysicist—known literally as a "computer"—helped "process" seismic shot records on film and pick the data right in the field. In the early 1960s, however, mainframe technology moved seismic processing out of the field, severing the link between data gathering and interpretation. With advanced E&P software and hardware, 3DX Technologies of Houston is trying to bring the geophysical disciplines back together.

Early this year, a multidisciplinary team headed by 3DX fully processed; interpreted and imaged a land 3D seismic survey *during* data acquisition, cutting its typical cycle time by nearly 50 percent. The 19 square

mile survey took 11 days to shoot. A day after the last shot was recorded, processing was finished. Within a week, the subsurface interpretation (in depth), reservoir volumetrics and economic analysis were complete. The first well was

selected at a partners' meeting a week later.
Drilling began less than three months from commencement of field operations.

A number of wells have been completed in this field to date, and the "real-time" seismic imaging process developed during this pilot project has been applied to three other

3DX recently completed a successful experiment in "real-time seismic imaging" during acquisition of a land 3D survey.

3D surveys along the Gulf Coast.

"From a cost

standpoint, it

makes more sense

now to process the data all the way

through migration as

you acquire it, rather than waiting until

every last trace has

been recorded.

Instead of getting a box of tapes

at the end of

the survey, you <u>get a</u> completely

processed data set.'

Peter Duncan,

VP of Technology

According to Peter Duncan, VP of Technology for 3DX, several factors contributed to this success, including

(Continued on back)



integrated interpretation and 3D visualization using nine Landmark applications. Another factor was very fast, extremely cost-effective 3D seismic processing using ProMAX 3D on an SGI Power Challenge with two CPUs. "From a cost standpoint, it makes more sense now to process the data all the

way through migration as you acquire it, rather than waiting till every last trace has been recorded," says Duncan. "Instead of getting a box of tapes at the end of the survey, you get a completely processed data set." In fact, by the time this job was done, 3DX had processed the entire data set 17 times.

Each day about noon, a truck left the survey site in South Texas and drove three hours to Houston with the field tapes. Shot records

were loaded into ProMAX for geometry verification, decon testing, velocity analysis, stacking and time migration. By 7 a.m. the following morning, the complete migrated data set was loaded as a 3D volume in SeisCube.™ The data was time sliced, interpreted and tied to the wells. Key horizons were mapped. Before noon, the geophysicist would call the field to tell them whether or not to pick up the geophones.

Two significant real-time survey design changes took place as a result. Once, a structural anomaly appeared close to the edge of the data set and 3DX decided to extend the survey. The 1.5 square mile extension was permitted and shot immediately following the original grid, without any stand-by time. On another occasion, while the crew was shooting in a swampy area, the frequency content of the data dropped off. The geophysicist radioed a request to add extra shots to the grid, which cleaned up the image.

"Real-time seismic imaging has major business implications," says Duncan. "For one thing, the internal rate of return on a project can be demonstrably increased by shortening the cycle time. Money isn't tied up for years awaiting production. Even if a

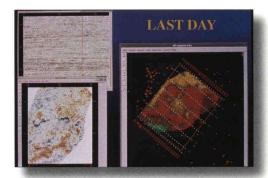
prospect turns out to be uneconomic, you're better off finding out quickly and moving on to the next one without wasting resources."

Duncan also observes that the urgency of this real-time process keeps every team member's creative energies extremely focused and maintains a level of enthusiasm rarely seen in the industry today. As Eric Gardner, 3DX team leader and geophysicist, put it: "This project was a hell of a lot of fun—one of the most exciting things I've ever worked on." For more details, read the full case study published in *Oil & Gas Journal*, October 28, 1996, pp. 44-50.

Reprinted from Solutions, Vol. 1, No. 3, Winter 1996



Interpretation of time-migrated data from first day of acquisition (130 shot records).



Interpretation of time-migrated data from last day of acquisition (1700 shots), completed less than two weeks after shooting began.

"Real-time seismic imaging has major business implications.
The internal rate of return on a project can be demonstrably increased by shortening cycle time. Money isn't tied up for years awaiting production."

— Peter Duncan, VP of Technology



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3D Seismic Pays Off for Brunei Shell.

Executive Summary

Brunei Shell Petroleum, Sultanate of Brunei Darussalam, Asia/Pacific. **Customer:**

Challenge: Maintain pace of exploration and development in mature province.

Solution: Extensive 3D seismic data; integrated suite of Landmark geophysical

applications; OpenWorks® corporate well database; advanced client/server

network; on-site training and support by Landmark applications specialist.

Results: Significant gas discovery, offshore Brunei, late 1995; additional

opportunities for future development.

Since the early years of the century, Shell has been operating successfully in the Sultanate of Brunei Darussalam on the northwest edge of Borneo. The giant Seria oil field was discovered in 1929. Other major fields, mostly offshore, were discovered in the 1960s and early 1970s. Today, Brunei Shell Petroleum (BSP) is the country's sole hydrocarbon producer. Total production last year averaged 175,000 bopd and nearly 1,000 MMcfd of gas.

The technical challenge facing Brunei Shell

"Landmark was

a pioneer in seismic data analysis

on computer

workstations. They understand clients'

requirements and

provide technology solutions that meet

those requirements

in a timely and reliable manner..

[And] Landmark

seems to have

a head start in

integration.'

Paul Wood,

Chief Geophysicist

today, according to Paul Wood, Chief Geophysicist, is to maintain the pace of exploration, appraisal and development."In a mature hydrocarbon province like this," says Wood, "we need to use the best technology available to replace produced reserves with new discoveries, and

our reserves base." Extensive use of 3D seismic technology is helping BSP accomplish those goals.

Suni bin Sulaiman uses an integrated suite of Landmark applications to interpret 3D data from one of Brunei's major offshore gas fields.



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ultimately, to increase

A Landmark customer since 1989, BSP has one of the largest, most advanced Landmark networks in the Asia/Pacific region. All of the company's 3D seismic — over 9,000 sq. km. — is stored on-line. There are about 25 Landmark users, mostly geophysicists and geologists. They have 16 client workstations, networked with two SparcCenter 1000™ servers and two other database servers. Besides having Landmark's complete 2D and 3D seismic interpretation suite — including RAVE™, PostStack™, PAL™ and VoxCube™—BSP is evaluating EarthCube®, which it considers a key

application for the future.

"Landmark software

is both intuitive

and versatile. I'm impressed with

the integration of

on one workstation,

as well as the ease

of learning new

utilities and applying

them quickly to the

problem at hand."

–Bong Poh Yuk,

Seismic Interpreter

Wood explains why BSP evolved over the years into a predominantly Landmark center. "Landmark was a pioneer in seismic data analysis on computer workstations. They understand clients' requirements and provide technology solutions that meet those requirements in a timely and reliable manner. Besides, Landmark workstations are used throughout the Shell group, so staff joining Shell in Brunei can benefit

BSP without extensive retraining."

Integration was another factor. "Landmark

seems to have a head start in integration," adds Wood.
"More work needs to be done, but things are going in the right direction." That's why BSP selected OpenWorks as its corporate well database. "It is essential that we maintain a single validated database, and that multiple applications have easy access to data without the need to make multiple copies." He said the use of 3D seismic in reservoir management is

just beginning at BSP, and that integration of seismic and well information with statistical analysis, inversion and other techniques is vital to growth in the future.

BSP also contracted for a full-time Landmark



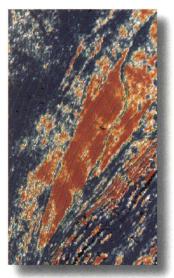
3D visualization tools help sort out complex faulting associated with rollover structures along Brunei's inner shelf area.

applications support specialist on-site. Wood considers this support essential to proper technology transfer. "The key to ensuring the software gets used to its technological limits lies in continual on-site training and coaching by an applications expert," he stresses. "Many PC users purchase a full-blown word processing program and then just type the odd memo. We cannot afford to let that happen

with seismic interpretation software."

As an example of how Landmark technology has contributed to Brunei Shell's success, Wood cited a significant gas discovery made in late 1995 based on mapping seismic amplitudes.

According to a published report, the Selangkir-1 exploration well, near Brunei's Iron Duke field, tested up to 450,000



Seismic amplitude mapping of stacked gas-bearing sands led to the discovery of the Selangkir field in late 1995.

cubic meters of gas per day from a series of stacked reservoir sands at a depth of about 4,000m. In that report, Svein Sandal, BSP's Exploration Manager, said, "This success is a direct result of the application of new and better technologies such as 3D seismic for subsurface evaluation. Using 3D seismic

data, we have identified a number of other attractive exploration opportunities which we will pursue in the near future."

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offer excellent

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improve our ability

to predict and map

reservoir architectures

and fluids.They also

enable easy, effective

transfer of data and

interpretations to

other software,

including Shell's

proprietary system."

Suni bin Sulaiman,

Seismic Interpretér

Chevron Builds Regional OpenWorks Archives.

Executive Summary

Results:

Customer: Information Technology group, Chevron Overseas Petroleum, Inc.

Challenge: Reduce user time wasted tracking down data; improve data quality.

Solution: Extend OpenWorks® data model; create 15 OpenWorks regional data archives;

develop utilities to merge projects and synchronize databases; incorporate

innovations into future Landmark technologies.

Shorter turnaround time for users in strategic business units; simplified

I.T. support; higher quality project data.

Headquartered in San Ramon, California, Chevron Overseas Petroleum, Inc. (COPI) operates in over 30 countries. The Information Technology (I.T.) Support and Planning group maintains master data archives for about a dozen strategic business units worldwide. Five years ago, COPI stored all of its master data on mainframes. Today, it supports 15 regional archives built around OpenWorks, and expects to be off the mainframe within a year.

As a project database, OpenWorks had been widely deployed in Chevron's domestic and international offices for years. Bill Garnett, Information Management Team Leader, explains why he and Alan Lindberg, Application Support Team Leader, decided to use

OpenWorks as a regional database as well. "When we started down this road, OpenWorks looked like a good

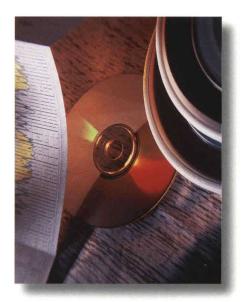
"Interpreters
(in Nigeria) estimated
60 to 80 percent of
their time was spent
just tracking down
data, before they
could do the work
they were hired to do.
If we can build them
a project in a day
and they can start
interpreting a new
area tomorrow, that's
a huge advantage."

— Bill Gamett,

- Bill Gamett, Information Management Team Leader, COPI match with our business needs," he says. "In most countries, the total number of wells is small compared to the U.S.; so OpenWorks has plenty of capacity. We felt having the same data model for the archival and project databases would be helpful too. We could compare databases more easily, and write applications for either one. And we could use a lot of OpenWorks' existing tools.

Besides," he adds, "our interpretation strategy has centered around Landmark for quite some time."

(Continued on back)





COPI's goals are to improve data quality and reduce turnaround time."On a study team in Nigeria a while ago, we interviewed many interpreters," says Garnett. "They estimated 60 to 80 percent of their time was spent just tracking down data, before they could do the work they were hired to do. If we can build them a project in a day and

"Chevron is

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Through rapid

deployment of a flexible, integrated

solution assembled

from Landmark's

technology and off-the-shelf

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Chevron has

created a distinct competitive edge

in its global

operations."

Landmark

they can start interpreting a new area tomorrow, that's a huge advantage."

As UNIX® workstations proliferated, Chevron began porting its mainframe data management applications to ORACLE®, to make data readily available to users. Because of this, COPI was an early adopter of the ORACLE version of OpenWorks. But certain innovations were necessary to make it an effective archival database. With the help of Chevron Petroleum Technology Company, Garnett's group

of a regional data management solution currently in development, as well as future versions of OpenWorks.

innovations will be part

"Chevron is using OpenWorks in ways our original development team used to dream about," says



Sherman. "Through rapid deployment of a flexible, integrated solution assembled from Landmark's technology and off-the-shelf components, Chevron has created a distinct competitive edge in its global operations. Many other companies are interested in this approach," he adds. "I think OpenWorks and our new regional data management products will offer similar advantages to them as well."

> The next big step, says Bill Garnett, will be to integrate business information with reservoir and field data. "The business units are operating more as

> > cross-functional teams now. At the decision-making level, they don't just look at geology. They

also want to know how much money they're spending. So people are beginning to analyze financial and other data at the same time."

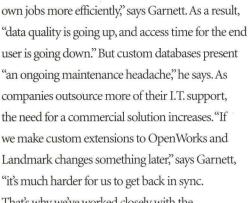
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John Sherman, VP Data Management, added extensions to the OpenWorks data

model; wrote links between OpenWorks and non-Landmark applications; developed comparison scripts and special utilities to merge multiple projects and synchronize databases.

"These tools help my database people do their user is going down." But custom databases present "an ongoing maintenance headache," he says. As companies outsource more of their I.T. support, the need for a commercial solution increases. "If "it's much harder for us to get back in sync. That's why we've worked closely with the OpenWorks team."

President of Data Management, many of Chevron's data model extensions and other ideas have been incorporated into OpenWorks 4.0. Additional



According to John Sherman, Landmark's Vice



Chevron geoscientists have used Openworks as a project database for years. Now they're using it to store regional data as well.

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