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Cover photo: The KS Titan 2 rig, operated by Atlantic Oilfield Services and chartered to ExxonMobil, with a Marlink Sealink VSAT communications system installed, providing 256 kbps data communications and 8 telephone lines, to be used for real time data management and data sharing. Atlantic Oilfield Services operates rigs in Arabian Gulf, Egypt, Kurdistan - Northern Iraq, Indonesia, Nigeria, the North Sea, Pakistan and Tunisia.

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Is subsurface data integration the most important technology?

David Bamford
Consultant Editor, Digital Energy Journal

Around the turn of the year, Barclays Capital published its annual review of the oil & gas industry, including within it a summary of its survey of the Most Important Technologies, based on the percentage responses received for each of 12 candidate technologies.

As in 2009 and 2010, the top 3 for 2011 were Fracturing/Stimulation, Horizontal Drilling and 3D/4D Seismic, accumulating between them more than 70% of the responses. What's more, the same 3 have dominated this survey for all 12 years for which data was published, invariably accumulating more than 60% of the responses between them. Over this period, the only other technology to win more than 10% of the responses has been Directional Drilling, garnering 11% four times.

One way to look at these results is to say that responses may be dominated by professionals working in North America and that the favoured technologies will therefore simply reflect what is happening there, in particular the pursuit of shale gas, shale oil, 'tight' gas, coal bed methane, as the domestic sources of conventional hydrocarbons begin to diminish.

But there is another way to look at it, I suggest. The survey-leading technologies are those that offer the means to identify the presence of hydrocarbons in 'tougher' reservoirs and then extract them. Put another way, wherever there is a prolific source rock, our industry has developed the capacity to move away from conventional reservoirs – whether sandstone or carbonate – with good porosity/permeability characteristics and extract petroleum wherever it is 'reservoired' – whether still in the source rock, in 'tight' sands, in fractured basement and so on. The North American industry is leading this charge.

If this is a fact, perhaps this should precipitate a dramatic change in the way many explorers think?

The starting point needs to be plate tectonics, palaeo-drainage systems and palaeo-climatology so that we can arrive at view of where prolific source rocks exist; and then understand petroleum systems in an integrated fashion so that we can model a source rock's maturation history and predict where expelled hydrocarbons might have migrated to – if indeed they have left the source rock! And then we need to understand the dynamic properties of these 'unconventional' reservoirs.

Now at this moment, I can hear a large group of both ex- and current colleagues saying "That's what we always do!" And that of course is true…… in some cases.

However, for the first step in understanding regional geology, what is obvious is that extraordinary amounts of very different types of data are now available in the public domain to supplement the proprietary data a company might itself hold, whether rock samples, geochemical analyses of seeps, well logs, seismic and so on.

Integrating this mountain of data and making sure everybody is looking at the same thing is both difficult and time-consuming, and demands innovative technologies. I have mentioned before that I am especially taken with the approach of Neftex Petroleum Consultants Ltd whose Earth Models have a global chronostratigraphy, capable of separating 'events' 50,000 years apart, at their heart. By the way, I own no shares in this company!

David Bamford is non-executive director of Tullow Oil, and a past head of exploration, West Africa and geophysics with BP

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Better interfaces might have prevented Macondo – Chevron VP

"It is apparent that the Deepwater Horizon crew had information they needed to know [to prevent disaster] and took no action," said David Payne, Chevron's vice president of drilling, speaking at the GE Oil and Gas Annual Meeting in Florence on January 31st.

"These were experienced men," he said. "My theory is that the interface [providing information about drilling operations] was too complex."

"The Macondo incident is a wakeup call that as wells become more and more complex we have to think about how we manage the man machine interfaces."

"How may engineers spend time learning about capacity of human brains? We need to get engineering solutions to match up with the people."

"Simplifying the human interface is an engineering problem most engineers don't want to deal with."

There are actions the industry can take to improve things after Macondo, which are "nothing to do with politics and everything to do with engineering," he said.

"We need to focus on simplicity and standardisation," he said.

"A good engineer is not one who can deliver the most complex project. My favourite engineer invented the bicycle. The basic design has not been changed since 1817."

"Even when the solution is complicated, enabling a human interface is critical."

"The Macondo and Montara (East Timor) incidents have changed my view on what is required," he said. "They have impact on our ability to operate our business. The incidents provided us with an opportunity to review internal processes and close some gaps."

"We have no right [to operate] anywhere," he said. "We are provided a license by the public. We have to earn that every day."

Boeing story

Macondo could provide a wake-up call to the oil and gas industry, similar to the one which hit the US military aviation industry in 1935, in a competition between Boeing and Martin & Douglas to design a new fighter aircraft, he said.

Boeing nearly lost a competition to build the next generation long-range bomber for the US Army Air Corps, because the aeroplane it built was too difficult to fly.

Before the flight test, Boeing's Model 299 was considered much better than the designs of its competitor, Martin and Douglas, since it could carry 5 times more bombs than the Army had requested, could fly faster and further. So the flight test was considered something of a formality.

But in the test, the Boeing plane climbed to 300 feet, stalled and crashed, killing the pilot, the US Army Air Corps chief of flight testing, one of the most experienced pilots in the US.

The subsequent investigation revealed that the crash was due to 'pilot error' or more specifically, the pilot had forgotten to release a locking mechanism on the elevator and rudder controls during take-off.

But the pilot had plenty of other things to occupy his mind during take-off, including the engines, landing gear, wing flaps, electric trim tabs, and propellers.

After Martin and Douglas was declared the winner of the competition, Boeing went back to the drawing board to try to work out how to make their plane easier to fly.

They couldn't suggest that pilots should just have more training, since the plane had been crashed by one of the most well-trained pilots in the US. But they came up with the idea of a checklist for everything pilots needed to think about in take-off.

Using the checklist, the Army went on to order 13,000 aircraft, and it became the B17 Bomber, making a big contribution to beating Nazi Germany.

Learning from other industries

Mr Payne is skeptical that the oil and gas industry should learn how to be safe by copying how the US nuclear power, US nuclear submarine and air transport industry manage risks, as many people have suggested. The oil industry is much more complex.

"The US nuclear submarines have a single fleet and a single boss," he said. "Airlines have a handful of companies. In the US, there are 104 nuclear reactors and 25 operators."

To compare with the oil industry, "In the US there are hundreds of operators and thousands of producing facilities," he said. "Anyone with a lease and a bank account can drill a well. I've seen guys drill without the second of those."

"We have a very complex business. Our wells facilities and companies don't look alike."

Standards

Mr Payne says that there is a perception that American Petroleum Industry (API) standards are based on the 'lowest common denominator' – ie the level of performance of the worst performing company is adopted as the minimum standard the industry must follow.

"Whether or not that's true, the perception has to change," he said. "When the public loses faith we are forced to take action."

At API, "we are doing a lot of very good work," he said.

"We need to do more standardisation," he said. "We have difficulty standardising in our own companies let alone across the industry. We have an inability to standardise on subsea trees and manifolds."

The nuclear power station, nuclear submarine and aviation industry have managed to adopt standards, he said. "None of their templates fit our industry but that's not an excuse not to look for a solution."

Wide reaching impact

One characteristic of the oil and gas industry is that any problem by one company has a wide reaching impact.

To continue the comparison with retail, if a superstore has a fire, nearly all of the impact is local. But if there is a large failure in the oil and gas industry, it impacts everybody's license to operate, he said.

"Demanding everyone in our industry holds to the same high standards is critical, Mr. Payne added."

Proud of oil and gas

"I am unabashedly proud to be working in oil and gas," he said. "I work in an industry that actually matters. If we get a bigger HD set or iPod, it doesn't actually matter. But if we didn't do what we do, lights go out, transportation doesn't run, people's lifestyles change."

Mr Payne cited data from the US Department of Labor Bureau of Labor Statistics, which shows that the oil and gas industry is safer than retail (the 2009 data shows 4.2 occupational injuries per 100 workers in retail, compared to 1.6 in oil and gas).

"Consider that," he said. "We have a highly complex, diverse industry that's safer than retail."

Making digital oilfield IT infrastructure work

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There is an enormous amount of development in the oil industry around IT infrastructure - including suggestions of standard architectures, new ways data exchange standards are being used, much faster data communications and processing, and new ways to work with it.

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Should you replicate databases locally?

When people are working on the same data in different places around the world, should the data always be stored and accessed from a central server (like with webmail), or a copy downloaded onto a local device (like with Blackberry e-mail)? By Philip Neri, VP marketing with Paradigm

Companies managing assets over large, if not global, geographical areas often operate these assets from multiple locations, with at least one office positioned in the assets' state or country, and with activity taking place at a centralized technical location, be it the company's headquarters, regional main office or elsewhere.

For the best efficiency, it is important that each geoscientist, engineer or data administrator be looking at the same collection of data wherever they are working from, inclusive of all the most recent edits, transformations and metadata that may have been contributed at any of their locations.

Data strategies may be relatively easy to implement if all locations are in close proximity, and in a region where network infrastructure offers good bandwidth and reliability. But processes become more involved if (for example) the operating unit is periodically disconnected from a wide area network, and on a low-bandwidth connection.

Background

In the 21st century, technology has brought together distant places at a pace that was not anticipated some 15 or 20 years ago.

In the energy industry, many companies had trans-regional or international operations from the very early days of oil and gas exploration and production.

However there was not an expectation of frequent and intensive communication and collaboration, and remote or regional offices would operate as independent entities in terms of their data, their activity and their resources.

Two factors concurrently put pressure towards a change in the way operations are conducted: the increase in reservoir complexity, and the need for more advanced technologies in order to be successful.

It became increasingly unrealistic to populate each operating unit with all the highly-skilled resources that would be required oftentimes only on an occasional basis. Putting experts from a central pool onto airplanes on an on-demand basis was the alternative, but this was not a very effective use of such high-value persons' time. The solution that emerged as the most effective was to have teams working both on location, close to assets, and in one or more central facilities where specialists can cover a wide diversity of specialized tasks for numerous field locations. Satellite links, video-conferencing systems and improving infrastructure made it easier and easier for such geographically-separated teams to work together.

With two or more teams working on different aspects of a same asset at the same time, the one element that still needed to be addressed was the synchronization of all the data being worked on such that at all times each team would see and be able to use information, knowledge and results emanating from the other team.

Satellite links and video-conferencing systems made it easier for geographically-separated teams to work together

The two main options for how people work with data are (i) multiple views on a single database (like looking at your hotmail from anywhere in the world); or (ii) replicated databases with synchronization (like how your Blackberry can download your e-mail, but the main e-mail database is somewhere else).

Single database multiple views

With a single database multiple views architecture, all the data, the applications and the compute power are located in a centralized server facility.

Users log in remotely, and execute the applications remotely. The graphical interface and the display of results is transferred over the network to show up on the user's screen, wherever he or she may be.

From a data management point of view, the only vital requirement is a very rigorous management of data ownership. As a project moves forward, the interpretations and results generated by each user must be clearly labeled as such. There must be flexible capabilities to establish and enforce policies that define who can see, re-use, edit or delete different types of data created by other members of the geographically-distributed team.

This centralized architecture is of course very dependent on the quality, speed and reliability of the network, and for mission-critical activities many companies still see a risk factor for remote users either operating on or close to drilling facilities (i.e. away from major urban areas), or for operations in developing countries where network infrastructure is not yet fully established and reliable.

Replicated databases with synchronization

But many companies choose to have a copy of the complete project dataset running locally, in order to shield each operational location from any wide area network (WAN) interruption or performance degradation.

They end up replicating many hundreds of megabytes, or even terabytes, of data multiple times.

The relatively low cost of storage makes this a reasonable choice when set against tight work schedules and other business priorities.

The challenge is to ensure that at all times updates made at any one of the operational locations becomes available to the other locations within a reasonable time-frame.

While any granularity of an updating process would be envisaged, in most cases a daily refresh is considered satisfactory, especially if the locations are linked by weak network connections.

The data management infrastructure must then run a synchronization process that will make it possible to compare activity on the different versions of the dataset since the last update took place, and perform an update of all instances such that once the synchronization process has run all the most recent edits, modifications, new objects or other changes to data are reflected and identical in each place.

Portable devices

With increasingly high-powered portable computing resources, many companies now entrust field geoscientists and engineers with increasing amounts of data and sophisticated applications that allow them to integrate new data, perform comparisons with initial models or older data, review surrounding or regional data, and perform other tasks that involve both large data collections and substantial compute capabilities.

Field locations, often at a distance from major communication networks, favor a stand-alone operational model where the portable computer is assumed not to be connected to any remote resources.

On returning to a more substantial facility, there will be the same need for synchronization between the portable device and the company database.

Data ownership

In all scenarios, remote access to shared systems, synchronization of replicated databases or dealing with offline portable devices, probably the most important feature of a data management infrastructure is the ability to label and control the access / edit permissions of each data item for individual users or groups of users.

Rigorous control systems are often perceived as inhibiting productivity, but on the long run they actually act as a facilitator in ensuring project data integrity and in solving inconsistencies in results.

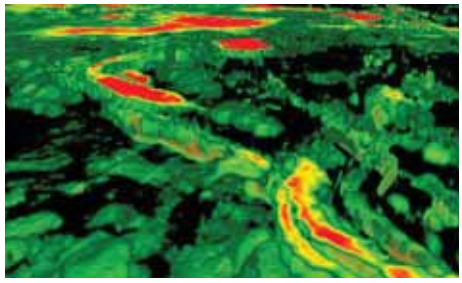
For example, if two or more users are editing a same data instance, it is better that they each work on their version of the item, while being able to see the progress their colleagues are making.

Selective copy and paste utilities can help take on and leverage the work of others, but each version is under the complete control of the respective users.

Synchronization processes will keep all sites updated, but will not result in overwriting any one user's data with the version or versions of other colleagues.

At some point, when work is close to completion, decisions can then be made to merge different user contributions into a single final entity.

Should the final version later be challenged, it is possible to go back to the individual contributions and check to see if the best choices were made when merging.



Modern high-quality data is rich in information; this illustration of a 3D rendering of a channel system is of interest to many disciplines: geology, sedimentology, stratigraphy, reservoir characterization and drilling engineering

Maturity

The management of terabytes of geoscience and engineering data over the many years of an oil and gas asset's life cycle is critical in order to ensure that the accrual of knowledge and information is always accessible and put to use for future operations.

The maturity of the data infrastructure that supports the asset, and its alignment with the business model of a distributed global industry, will impact significantly the efficiency of the teams working towards optimal exploration and production outcomes.

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Wireless Seismic – getting ready for commercial launch

Wireless Seismic Inc of Colorado is gearing up for a commercial launch, manufacturing and selling a wireless seismic acquisition system which can send all recorded data back to a recording truck in real time, wirelessly, eventually with up to 100,000 channels.

The company has been developing the technology since its founding in 2006, and is now ready to become a "full blown commercial operation late this year (2011) or early next," said company chairman Gary Jones, speaking at the Jan 25 Finding Petroleum forum in London, "advances in seismic".

"We believe we are disruptive technology in an established market and that's a good place to be," he said.

The company expects that "up to 50 per cent" of land seismic recording systems will be cable-less in the next 3 to 5 years, an increase from about 7 per cent of systems sold in 2010.

"There are now authorities in the US requiring companies to go for cable free systems – we expect that trend will continue," he said.

The company already has 2 customers and a third one is ready. "We're happy to take orders," he said.

It has committed an initial run to manufacture the devices, and wants to see how well they are performing in the field before commissioning any more.

There are several cableless seismic systems already on the market, but these are mainly autonomous blind recording systems which store the data locally in a memory for later retrieval. Wireless Seismic claims to be the only system which delivers the data from large numbers of channels in real time to the recording truck.

Gary Jones, chairman, is previously president of WesternGeco and also a director of Ingrain, ARKeX and Novadrill.

In December the company announced $19.5m in its latest funding round, from Chesapeake Energy, which claims to be the second largest producer of natural gas and the most active driller of new wells in the US, and Energy Ventures, an energy venture capital company.

Real time data

The seismic data is recorded by cable-free transmitters and sent back to a central base station wirelessly, which means that it is all immediately available for processing, not stored on the receiver units until they are collected later.

By making the recorded data available in real time in the central recording truck, it can be quality checked immediately and any problems rectified, rather than only going through the data a few weeks later.

The wireless seismic equipment on the small truck on the left can do as many channels as the cabled equipment on the large truck on the right

"Our thesis is quite simple - that real time data matters and its pretty imperative," says Mr Jones. "How many people would prefer to get their data back in real time if they could on a cost competitive basis?"

Some earlier wireless seismic devices stored the recorded data in onboard flash memory devices for downloading later, a very tedious job. "I hate to be the person trying to transcribe a million channels of data collected through flash memory and putting them in proper order for data processing. That's a tough challenge," he said.

By immediately transmitting the data to a central location, it avoids the risk of data being lost, for example if a recording unit is stolen or damaged before the data on it is collected.

There are two separate wireless communications systems involved – a short hop system between individual wireless remote units (WRUs) along a line to a backhaul unit, and then a longer range communication system from the backhaul unit back to the central recording truck using a different radio frequency and 20 foot high antennas.

Better without cables

A seismic survey without cables should be much faster to deploy, because transporting and laying cables takes a lot of time. And the faster the survey can be done, the cheaper it can be done.

Cables are dangerous. "Most lost time injuries in seismic crews are called by trips slips and falls mainly due to neck rolling cables [people rolling cables around their necks], "he said.

"If you can eliminate the cables you'll get more uptime, less cable troubleshooting and safer operations."

"We are aware of increased environmental footprint for less line cutting. Everyone .. would accept there's a strong case for this direction."

"Road and river crossings become a breeze if you have a cable less system."

You can carry the same amount of channels on a mule if they are wireless, as you can with a truck and trailer if they are cabled.

There is also a lot more flexibility in survey design. "One of the beauties of going wireless is that we're going to free up your geophysicists," he said. "We can do coil designs, triangular designs, all sorts of designs that will allow for better geophysical attributes. "

"You can do variable density of line spacing. If you 've highlighted some areas of greater interest through gravity gradiometry survey ahead of time, you might want to double up your density there."

Wireless remote units

The wireless remote units, which are spread

around the recording area in their thousands, each weigh about 4 pounds (1.8kg) not including batteries. A string of geophones can be plugged into it.

To switch the unit on, you just turn it to a certain position – an accelerometer inside the device switches on the electronics.

Then you put it down and plug in geophones, and it runs through a series of tests.

The units have GPS in them so they know their location. Each wireless unit will look for nearby wireless units and communicate with them. Then they go into a quiet state (to save battery power) and wait for instructions.

The units also have a clock which is disciplined (synchronised) from the recording truck, rather than by using a GPS clock. "It works faster and with greater precision than the GPS clock," he said. The clock is disciplined all the way through the recording, so it does not lose synchronising partway through.

The system will work in the full temperature range from the Arctic to the desert, and will record at under 10hz and up to 200khz.

The unit has 8 different levels of power consumption, and will automatically use the lowest power consumption which will carry the data communications required.

Two batteries in the WRU will provide at least 17 days field life, he said. Batteries will normally last for the duration of the survey, so they won't need to be replaced part way through.

The charging status of both batteries can be monitored remotely from the recording truck.

The batteries can be charged up easily using a power supply in a hotel room. Electronics in the battery can manage the charging process and show whether the battery needs more charge or the charging is finished. "We decided to go for smart batteries and dumb chargers," he said.

Backhaul unit

Midway along a line of up to 120 wireless remote units, you position a backhaul unit, which sends the data back to the central recording truck.

The backhaul unit has a 20 feet high antenna, which telescopes. It can be carried by one person and deployed in 10 minutes.

Some people asked for a fibre optic cable for the backhaul. "We have that in case someone really wants that. But the wireless data backhaul is not the bottleneck," he said.

There have been many recent advances in short distance data communications technology, and the speeds continue to increase. "We're expecting 3-5 times increase in the very near future in that capability," he said.

A wireless receiver unit in operation

Using chemical sampling to decide where to drill

Geochemical sampling gives you an alternative view about whether your chosen drill site is likely to lead to hydrocarbons, said Dirk Hellwig, regional director of exploration with Gore Surveys

By using Gore Amplified Geochemical Imaging service, you can get an alternative view about whether or not your chosen drill site is likely to hit oil, said Dirk Hellwig, regional director of exploration with Gore Surveys, talking at the Feb 15 Finding Petroleum London Forum "advances in exploration technology".

The results of a Gore geochemical survey are to be integrated with other G&G and are able to derisk drilling decisions significantly, he said.

From more than 600 exploration surveys, Gore was able to obtain validation data on 179 drillsites where the system was used, and a well was consequently drilled.

For drill sites where the Amplified Geochemical Imaging predicted prospectivity for hydrocarbons, hydrocarbons were found 93 per cent of the time. So the operators achieved a 93 per cent success rate from drilling, something any exploration company would be pleased with.

For drill sites where the geochemical imaging predicted that there wouldn't be any hydrocarbon, and yet the well was still drilled, it turned out to be dry 92 per cent of the time.

The system can be used for reservoirs below salt: it successfully showed the location of hydrocarbons in Egypt beneath 3.5km of salt, using sample modules with 250m spacing.

It can also be used on stacked reservoirs, differentiating the signal from the different reservoirs, provided calibration by tested wells. However the system cannot tell anything about the depth of a reservoir or volumetrics.

Over the past 18 years GORE Surveys have carried out over 600 surveys, in a range of different terrain, from desert to permafrost soil and swamps, onshore and offshore.

Wide area survey

The system can also be used to survey a wide area, and get a low resolution idea of which regions are worthy of deeper study, with sampling units placed every few km.

For sampling macroseep sites, Gore works together with satellite company Astrium, which maintains a global database of seeps which is continually updated.

The sampling units (GORE Modules) let vapour pass through but block liquids, like the membrane on your Gore-Tex jacket

Once the geochemical samplers have been analysed, Gore draws probability maps, showing the likelihood of hydrocarbon presence in different areas of the map.

Sampling units

Gore has developed a special sampling unit which can detect a much broader range of hydrocarbons than conventional soil gas sampling, and therefore more useful information about the likely presence or absence of hydrocarbons beneath a specific spot on the earth's surface. Also the sensitivity of the method is orders of magnitude higher than in conventional sampling.

The Gore Module captures hydrocarbon compounds from 2 up to 20 carbon atoms long, compared to conventional soil gas geochemistry which can capture C1 to C5.

The presence or absence of C6 to C20 molecules is very important in working out if there are hydrocarbons below.

Gore is famous for making the Gore-Tex membrane, used for waterproof clothing and which allows vapour to go through, but not water. This means that the clothing can breathe while keeping the wearer dry.

The chemical sampling devices feature a similar membrane technology – so gases can pass through the fabric into the sample device, but not liquids.

The sampler contains adsorbent materials which capture the hydrocarbons from the gas.

For land surveys, the sampling units are long narrow tubes, which are dropped into a hole 1cm diameter and 50cm deep. They are left in the soil or seabed for about three weeks.

For offshore slick surveys, the sampler can be dragged through an oil slick for a few minutes to see what it can collect.

Alternatively, you can use a coring tool to collect about 100cm3 of seabed sediment, put it in a jar and put the sampling module inside the jar for 3 weeks.

Sample units are normally laid out in grids, at 200-250m distance for high resolution surveys and 2km distance for low resolution surveys.

The sampling units are subsequently shipped to Gore's laboratory for high definition chemical analysis, on a nanogram scale. They are first put through a thermal desorption process, to remove the hydrocarbons from the adsorbent material, before the gas is analysed by Gas Chromatography and Mass Spectrometry.

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Watch Oswald Clint, senior analyst with Bernstein Research, one of Wall St's top analyst companies, talking about what is proven to work (financially) and what doesn't, with enhanced oil recovery.
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Watch Jørgen Hallundbæk, CEO of Welltec, talking about using robotic devices inside wells to massively reduce the cost of doing workovers.
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Doesn't need seeps

Because the sampling units are so sensitive, they are not restricted to only sampling oil which has travelled from subsurface reservoirs through faults (Macroseepage).

Miniscule quantities of hydrocarbons can also find their way through a seal rock up to the surface.

This process is known as Microseepage, with microbubbles of gas moving up through grain boundaries in the rock, driven by pressure and buoyancy. "This occurs in every type of lithology," Mr Hellwig said.

Signal from noise

One challenge with the system is detecting signal from noise – ie it is not enough just to have a sample from above a possible reservoir, you also need a sample which is nowhere near a reservoir and compare them.

There is also a possibility that hydrocarbons collected from the sampling unit have come from another source than a subsurface reservoir.

Mr Hellwig emphasises that conventional soil gas sampling can only normally detect C1 to C5, and there can often be similar geochemical responses for C1 to C5 whether there is a reservoir below or not. "So if you restrict yourself to the C1 to C5 you might not be accurate," he says.

Gore also has an idea what typical hydrocarbon signatures above different types of reservoirs (gas / oil) look like based on its experience so far, and that is helpful when trying to understand the information.

Gore's system does not measure methane (C1) at all, because methane is ubiquitous and a differentiation between thermogenic and biogenic methane is needed. This involves isotopic analysis, an additional and complex process, he says.

Ideally, you would have a well control – a producing well in the region – so you can compare the hydrocarbon signature in the zone of interest with the signature around the producing well.

If there is no producing well, then you can analyse the data to look for similarities in the geochemical patterns, aided by Hierachical Cluster Analysis, to develop geochemical calibration points.

Helping you detect hydrocarbons from sampling tiny amounts in the surface soil gas - Dirk Hellwig, GORE Surveys for Exploration, W.L. Gore & Associates

digital energy journal

Santos sponsors Open Source software for better reservoir visualization

Australian energy company Santos is sponsoring Open Source technology that is improving collaboration between its geoscientists, who can now work on their subsurface data models from just about anywhere

In 2010 Santos became a major sponsor of VirtualGL and TurboVNC to enable employees to use their laptop PCs to interpret geoscience data visualized by servers running Paradigm software. Paradigm is a leading supplier of exploration and development software to the oil and gas industry.

Whether in a regional office, at home or in an airport lounge, users can reconnect to the same high-performance 3D graphics session that had been running at their regular desk.

It enables real-time national and international collaboration and peer support between remote geoscience colleagues, irrespective of the number of participants or their locations.

Feedback from geoscientists shows that using this new technology via laptops easily rivals the performance of more expensive workstations, Santos says. This has led to many users swapping their traditional geoscience hardware in favour of running TurboVNC on their laptop to display data and application images produced by Paradigm and VirtualGL in Santos' Adelaide headquarters.

The company's users across Australia and south-east Asia now have shared access to more processing power than was previously provided by individual high-end workstations at the users' desks, Santos says.

Use reservoir visualisation software wherever you are: in this photograph, a Santos geoscientist is running TurboVNC from his docked laptop

Benefits

The software is used to locate new oil and gas reserves and optimise production from discovered reservoirs by creating dynamic digital models of the Earth's subsurface.

The Open Source technology being pioneered by Santos displays seismic data from prospective oil and gas fields, as well as models of existing fields, to Santos' offices in Australia and Asia.

Significant investments in data are de-

pendent upon accurate interpretation and comprehensive data management.

Combining Paradigm products with VirtualGL and TurboVNC enables Santos to serve its interpretation data and applications from its headquarters in Adelaide, South Australia.

The stability of the solution allows Santos to rely on this technology for the success of its widely dispersed operations but the real magic is in how fast the Open Source technology can render and deliver 3D graphics back to a user's desktop thousands of kilometres away.

The move towards Open Source is saving Santos – Australia's leading natural gas producer – over $1 million a year in operating costs, the company estimates.

At the same time it is increasing the speed with which data is interpreted and models are analysed.

Darren Stanton, Geoscience Systems Specialist and the architect of the Santos solution, said the most exciting part of centralising seismic interpretation was the freedom it afforded Santos' geoscience teams and the ability to collaborate between offices.

"Now that the processing power is housed in the same server room as our storage, much faster network technologies can significantly reduce seismic data access times," Mr Stanton said.

"Our annual sponsorship of the TurboVNC and VirtualGL projects gives us direct access to the Open Source technical brains that have made this all possible. Any bug-fixes or feature enhancements are dealt with quickly, and it's not uncommon to have a new version of code sitting in our inbox ready for testing the morning after emailing a request to the programmers."

"The move to Open Source thin client deployment has been a huge success for us in so many ways, and we would encourage other companies to adopt and support Open Source technology."

VirtualGL and TurboVNC

To make it work, Santos has been sponsoring development work on Open Source software packages VirtualGL and TurboVNC, which can enable high performance 3D graphics software (such as Paradigm's geoscience interpretation suite) to work with a thin client (such as someone's remote laptop computer).

VirtualGL is an Open Source program which redirects the 3D rendering commands from Unix and Linux OpenGL applications to 3D accelerator hardware in a dedicated server and displays the rendered output interactively to a thin client located elsewhere on the network.

TurboVNC accelerates the JPEG encoding paths. It can deliver a dual screen image (3840 x 1200 pixels @ 20 frames per second) over local and wide-area networks including the Internet. Santos has seen outstanding results using TurboVNC in its Jakarta, Indonesia, office to display Paradigm projects running in Adelaide.

When Paradigm software is used together with TurboVNC and VirtualGL, Santos' geoscientists can view all their visualisations on any PC in a high performance 3D graphics view regardless of their location.

Open Source refers to software in which source code is made publicly available for use or modification by others. Open Source software is usually developed by public collaboration to progress information technology.

Through its ongoing annual sponsorship, Santos provides the Open Source team with the necessary financial resources to further develop and improve TurboVNC and VirtualGL.

IT setup

Santos uses IBM X3650 M3 servers running Red Hat EL5 with NVidia Quadro Plex 2200 S4 graphics hardwareto create a VirtualGL server farm which runs the Paradigm application suite in Santos' Adelaide server room.

Santos' Turbo VNC servers - enabling remote access to 3D reservoir visualisation software

The images generated are transmitted on a dedicated graphics subnet within the company's network or via the Internet and displayed on standard Windows laptops running the TurboVNC client.

Santos developed its own web portal to initiate the TurboVNC session and configure appropriate compression settings based on the user's network connection. The portal also allows users to create and resume their own TurboVNC sessions without logging on and off as they move between desks or offices.

This new thin client technology has greatly simplified many aspects of data management, Santos says.

All Australian-based users now share one common set of applications, databases and seismic data, removing the need for discrete islands of infrastructure and overnight synchronisation of data between Santos sites.

Your IT department is not ready

Many people assume that upstream technical organizations already have technical processes covered. They rarely do, writes Dutch Holland

The term Digital Oilfield (DOF) practically screams: "We have digital technology that can make the company money, if we can just get it deployed on the operations side."

Translated: the technical side is ready and just waiting for operations to catch up.

Unfortunately, such is not the case.

Upstream technical organizations today are both ill-equipped, process-wise, and inappropriately staffed, oilpatch-wise, to help their companies exploit digital technology's potential.

Business value architecture

When an upstream organization decides to go for it to maximize digital technology use for business value, the organization's architecture (its "moving parts") must be altered and configured specifically for digital technology, called the DOF Business Value Architecture (DOFBVA) of the organization.

This consists of:

Strategic Business Architecture: the company's DOF vision and strategic goals, measures and incentives

Work Process Architecture: the technical and business work processes needed to achieve DOF strategic goals

Technical Process Architecture: the processes to manage digital resources required to enable work processes and business value optimization.

Technical Process Architecture

Very specific technical workflows or processes are required for the organization-wide exploitation of digital technology.

While some of the processes below may look familiar, some may be seen as "new" for a company's technology-end.

Five technical work processes, or organizational elements, must be in place and aligned by senior managers to gain full business value from DOF. These are Needs Discernment, Technology Architecture Design, Acquisition, Systems Readiness, and Technical Implementation.

Needs discernment

A Business Needs Discernment Process that accurately comprehends the range of operational transactions and decisions which could be made by the business both now and in the future will be needed.

The dictionary definition of discernment is "the quality of being able to grasp and comprehend what is obscure or not well defined".

This is a major challenge for what has been called requirements definition.

Unfortunately, discernment may not yet be a strong suit today in many upstream technology units. Who has the discernment to articulate appropriate needs?

Perhaps it is only technologists experienced in both operations improvement and technology design and development.

Therefore, staffing and managing the interface between technology and operations will be critical. The technology unit must put its strongest people into the discernment process.

At this point two things are clear: Discernment will always be necessary, and recent graduates with a "Requirements Interview Guide" will not be an adequate mechanism for discerning needs.

Technology architecture design

A Technology Architecture Design Process will be needed to optimize the company's technical capability to support all types of work processes that the operations side requires to meet its goals.

This is easier said than done.

A famous hockey player once stated that the secret to his success was "to skate to where the puck was going to be."

Such is the challenge in the Design of technology architecture - to position functionality so that the operations side of the business can skate toward the most vital and productive business improvement opportunities, using/counting on IT support to enable their direction.

As in the first technical process discussed, positioning architecture is dependent on great discernment, based on the technologist's understanding of both operational upsides and technology capabilities.

The goal is not to just follow the direction of operation's needs but to design-in functionality and capability that might lead operations to see and solve their business and technical problems in fundamentally new ways.

Technology architecture is at its best when it can both follow and lead the operations side toward business value

Acquisition

A Technology Acquisition Process will be needed to both drive vendor innovation and to acquire needed technologies to support technology architecture design.

It's not enough to build a DOF to fit the company - sometimes the company has to change to work better with a DOF, says Dr Dutch Holland, Holland Management Coaching

This deceptively simple statement requires a technology architecture design rooted in current and future operational needs.

While some technologies may be developed in-house, many DOF technical elements will likely come from technical vendors. The ideal would be for the technologist to give clear functional specifications to vendors so that they might put their innovation processes to work to serve up technical elements meeting the needs.

However, many technical vendors today state that DOF technology buyers are not able to well-articulate functional requirements.

Rather than a buyer holding a requirements conference for several qualified vendors, vendors are holding conferences to show their wares, hoping to serve up one that the buyers can see fitting into the company's future. And, as buyers acquire what's being sold, they accumulate bits and pieces that must be cobbled together as requirements eventually become clear.

Systems Readiness Process

A Systems Readiness Process will need to be in place that can produce/ready apps and systems meeting Business Improvement Opportunity requirements.

As discussed in earlier articles, two distinct "readiness processes" are required for digital technology: getting the technology ready for the business and getting the business ready for the technology.

Most technology shops have an appli-

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cations development function (Systems Readiness) containing a proven and refined systems development process.

That process, used in a disciplined way, will be key in digital technology deployment - with a few twists.

The first twist will be that systems readiness will only be one of two key processes. System Readiness and Business Readiness efforts must be "joined at the hip," targeting Business Improvement Opportunities enabled by digital technology. This means some key people must have access to both readiness efforts and have the discernment needed to modify plans and expectations.

Testing to perfection, a second twist, is critical for digital technology to be applied in operations … where a software failure is quickly seen as an immediate threat to steady-state operations. Operations is not a test environment.

Discern Business Needs	Architecture Design Process	Technology Acquisition	Systems Readiness Process	Secure Implement Capability	Ready for Optimal Results
X	Architecture Design Process	Technology Acquisition	Systems Readiness Process	Secure Implement Capability	Unable to meet needs of business
Discern Business Needs	X	Technology Acquisition	Systems Readiness Process	Secure Implement Capability	Inadequate technology performance
Discern Business Needs	Architecture Design Process	X	Systems Readiness Process	Secure Implement Capability	Unrealized business goals
Discern Business Needs	Architecture Design Process	Technology Acquisition	X	Secure Implement Capability	DOF Apps Fail to work
Discern Business Needs	Architecture Design Process	Technology Acquisition	Systems Readiness Process	X	Business unwilling to implement

Technical implementation

A Proven and Secure Technical Implementation Process, in sync with business readiness, must be in place while not jeopardizing operations during technology implementation and test.

Realistically, operations personnel will not take the risk that the implementation of the "Oh so wonderful app" will compromise or shut down operations.

The key idea is that a well-designed and reliable app must be supported by an implementation process that is just as well designed and bullet proof.

Safety and reliability of the implementation process must be tested, tested, and tested, and then demonstrated to operations managers who cannot afford disruption issues.

For implementations that were declared "deployments" by top management, one would think that all parts of operations would be equally receptive to implementation in their units - but it is not so.

Unless technical implementation is proven bullet-proof, needs to "delay implementations because of operational emergencies" will pop up like wildflowers in the spring.

All or nothing

The reader might ask, "Does all this stuff have to get done to get Technical Process Architecture into play?"

The short answer is "yes." As the table above indicates, if one category of technical process architecture is missing, the results are unacceptable.

Hopefully this article makes the case for strong technical processes as critical success factors in gaining business value from DOF.

The perplexing aspect is that the contents may be very different from both the perspective and daily work of a company's technology side. In short, many technology shops approaching their DOF future have a long way to go in building technical processes that can rise to the occasion.

More information

This is the third article in a five-part series that defines and explores the ways an upstream organization would need to be re-configured to fully leverage the use of digital technology to improve the business. This article puts the responsibility for exploiting digital technology squarely in the court of the operations organization.

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Increase production 25-200% by pulsing EOR

The effectiveness of enhanced oil recovery by flooding can be improved if the injection fluid (water or carbon dioxide) is pulsed, says Alberta company Wavefront Technology Solutions Inc.

The company has developed downhole tools which can release the injection fluid in pulses, rather than a usual steady flow.

The company claims that its clients have seen an increase in production rate 25 to 200 per cent within 4 to 12 months after installing the technology, and achieved a 2 to 5 per cent increase in ultimate recovery as a result of using it.

To understand how the system works, consider that after earthquakes in California, oilfields produce better, and geysers in Yellowstone National park produce more water, says Brett Davidson, CEO of Wavefront Technology.

The earthquakes shake up the subsurface, and mobilize oil from the pores.

In a similar way, if EOR flooding fluid is pulsed – switched on and off repeatedly – it can mobilize oil from the pores like an earthquake can.

The technology was originally devel-

Wavefront's tool to add pulses to EOR fluid downhole

oped as a project by Dr Tim Spanos, a physicist who specialised in general relativity, as a study of the relationships between energy in the earth and fluid property.

"We took his theory from the pages of a notebook and put it into practise," Mr Davidson says. "It was a series of equations."

"Dr Spanos and I started working on the lab proof of his concept in 1997. It has taken us a number of years to develop the necessary downhole tools to have a fully commercial technology. We're getting to the point where we have a critical momentum of acceptance of the technology.

Mr Davidson was previously manager of the geomechanics Research Group at the University of Waterloo, Ontario.

Wavefront Technology Solutions Inc. won its first client in 2007, an Alberta oil company, which tested the technology on 3 injection wells, pushing oil to 16 producing wells. After a 2 year pilot, they ordered 50 tools, to be followed up by another order for 10, and they have a further 45 tools to be delivered during 2011.

The company has deployed 107 tools altogether, in Alberta, Texas, California and Saskatchewan. It has contracts to deploy a further 227 (or is a further 120 check it's a further 120 for a total of 227). Clients are using it both for waterfloods and CO2 floods.

The company has experimented with different pulsing patterns, it can find a pattern best suited to the type of rock and its attributes.

The company has created a simulator to model how the system will behave in different types of reservoirs. It varies with the fluid viscosity, permeability, thickness and well structure.

The company is also selling the technology for use in groundwater remediation, where chemicals are injected into groundwater to help decontaminate it.

Brett Davidson, CEO of Wavefront Technology

In its published results for the quarter ending November 30 2010, the company had revenue of CAN$925k, 60 per cent more than the same period of 2009, and expenses of $2.4m, compared to $1.9m for the same period of 2009.

digital energy journal

Maersk – plan to make CCS pay for itself

Maersk Oil and Gas believes that it can significantly reduce the costs of carbon capture and storage of carbon dioxide sequestered, by burning gas directly from an oilfield in oxygen, generating electricity, using the resulting CO2 immediately for enhanced oil recovery, and possibly selling the resulting water if it is in a region of water shortage (for example, desert)

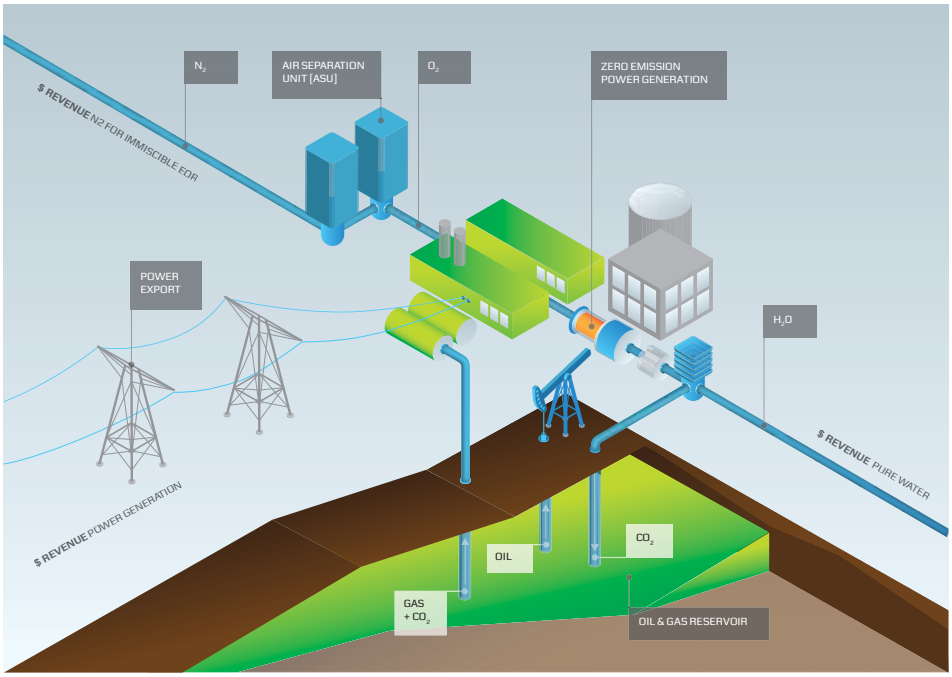
The plan "gets us significantly closer to CCS that pays for itself (i.e. without subsidies)," says Pieter Kapteijn, director Technology and Innovation at Maersk Oil and Gas.

It has licensed a special combustion technology from Clean Energy Systems of California which enables the gas to be burned in a combustor directly from the field, with little or no pre conditioning required on the gas.

What is special about the idea is that most of the necessary systems – a combustor, a generator, and a condenser, can be installed in a single plant, which is small enough to fit inside 3 x 40 foot box containers.

The only other piece of plant required is an air separation unit, a much larger piece of plant, which needs to be kept a good distance from the combustor for safety reasons. However this could be located offshore (see below).

This means that the overall capital cost of the system can be much cheaper than the "conventional" concept for carbon capture for gas.



With the "conventional" carbon capture and storage concept, the gas is piped from the well to a gas power station (which may be a long way away); the gas is burned in air, to produce a mixture of carbon dioxide, water and nitrogen; and this gas mixture goes through an expensive and high energy separation process to remove the carbon dioxide. An expensive pipeline infrastructure is built to carry the carbon dioxide out to an oilfield.

With the Maersk concept, the gas enters a relatively small plant which can be close to the well (if it is on land) or close to where the gas comes to shore. The outputs

from the plant are electricity (which is relatively easy to transport) and carbon dioxide (which can be sent directly back down neighbouring oil or gas well). There might even be a customer for the water (from the reaction of gas with oxygen) if it is in a desert environment.

With only a relatively small plant required on land, it seems likely that there should be less local objections to installing it, compared to (for example) a new gigawatt scale power plant.

The financial benefits of enhanced oil recovery or enhanced gas recovery are hard to quantify at this stage, and depend greatly on the field and its stage of life and the revenues that can be generated from the electricity and water.

In enhanced oil recovery, carbon dioxide (which becomes liquid under high pressure) can mix with oil and reduce its viscosity, making it easier to produce. This is a good way to increase overall recovery from the 35 to 50 per cent possible on conventional operations, up to 60 per cent or more. The theoretical maximum is estimated to be between 70-80%.

In enhanced gas recovery the carbon dioxide can be used to maintain the pressure of the overall field.

The idea of burning fossil fuels directly in oxygen is not a new one – the "Integrated Gasification Combined Cycle" (IGCC) technology for coal involves burning gasified coal in oxygen. But IGCC technology has a much higher capital cost and involves a much larger plant.

Maersk plans to spend 2-3 years further developing the technology and is looking for a launch project.

Combustion technology

Maersk has licensed the combustion technology from Clean Energy Systems of Rancho Cordova, California, which provides a way to burn natural gas which is "dirty" (ie containing CO2 and other contaminants, without separating the CO2 and contaminants out first.

The combustor is also much simpler than a conventional gas combustion plant.

The combustion is carefully controlled, with oxygen and natural gas or other fuels fed in exactly the right quantities for maximum efficiency.

The technology for the combustor was derived from the space rocket industry, where the combustion has to be very carefully controlled to ensure that the rocket combustion products ejects from the combustor in a stable and safe way. The key is to achieve proper mixing of the O2, fuel and water to ensure that the flame is stable and the temperature controlled.

Clean Energy Systems won a USD $30m grant from the US Department of Energy to further develop the technology and demonstrate its integration with a gas turbine and generator.

Air separation unit

The system also requires an air separation unit to separate air into oxygen and nitrogen by cryogenic cooling.

The air separation unit is much bigger than the other equipment and must be positioned away from the rest of the process for safety reasons.

Maersk is looking at installing the air separation units offshore. "It seems to be feasible without too much development work," Mr Kapteijn says.

Making it viable

For the system to be feasible, at a minimum you would need a gas well, a customer willing to buy an additional steady supply of electricity at the megawatt scale, and nearby depleted oil or gas wells which could use a steady supply of carbon dioxide for enhanced oil recovery or enhanced gas recovery.

The combustor carefully reacts natural gas with oxygen

The system could only work if everything could be operated continuously – so there was a continuous supply of gas into the system, electricity was generated continuously, and the carbon dioxide produced would continuously be pumped into a gas or oil field.

This means that there would need to be a customer in need of a continuous supply of electricity ("base load"), or the electricity would need to be stored in some way.

Pieter Kapteijn, director Technology and Innovation at Maersk Oil and Gas

The overall viability would increase if producing gas fields which already contain a large amount of carbon dioxide, because it would not require a process to separate out the carbon dioxide before feeding the gas into a combustor, and the carbon dioxide from the field could be sequestered together with the carbon dioxide from combusting the gas.

The system could also be more viable if it could earn money from carbon trading schemes. EU emission allowances are currently being traded at around Eur 15 per ton of carbon dioxide equivalent, which means that a system like the one described above could earn Eur 15 for every ton of carbon dioxide sequestered.

Estimates of the overall cost of 'conventional' carbon capture and storage vary but are often around the Eur 50 per ton level, which means that if the Maersk concept could reduce the cost by (for example) Eur 10 a ton, it would still cost Eur 35-40, too high to be paid for by carbon trading at current levels.

But if the carbon price rose, and a system like the Maersk one could earn more money than anticipated from the enhanced oil recovery / enhanced gas recovery, then it could start approaching viability.

Maersk also envisages providing the system in partnerships with national oil companies, whereby it would agree to produce gas fields effectively (using enhanced gas recovery) and provide electricity, without adding a single molecule of carbon dioxide to the atmosphere, even if the gas fields are already high in carbon dioxide.

For example several Middle Eastern counties are showing a great deal of enthusiasm for low carbon technologies, and might be keen to invest in a technology which would enable carbon free electricity generation from gas.

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Survey of spend analytics

OFS Portal surveyed 6 oil and gas operators who had recently done spend analytics programs to ask them how it went - By Elaine Rothman, writing for OFS Portal

Oil and gas e-commerce organisation OFS Portal conducted a survey of 6 oil and gas operators in different parts of the world that were known to have active spend analytics projects (to analyse how they spend their money).

The objective was to determine why they had embarked on the projects, what they were trying to accomplish, how they had implemented the project (with a project team or consultants), what were their results, what % of their spend was under management, what KPIs they used, what could they have done better, what were the project pain points and where are they going from here.

Unanimously the companies contacted said they were looking for visibility.

Companies were looking for a clearer vision of spend while allowing greater visibility to more category managers, business units and often to provide business intelligence to improve purchasing.

Two of the companies interviewed used spend analysis to implement business transformation, either creating a new central purchasing organization or expanding the scope of an existing purchasing organisation.

Some of the companies were managing a project with 5 operating divisions where others were collecting data from over 700 operating units.

In all cases the companies interviewed had embarked on spend analytics as they were deploying e-procurement and electronic transactions with their supply base.

Spend analytics - do you know what your company is spending and what you get for it?

At the lower end the objective was for 25% of spend "managed in the system", to up to 98%, where the last 2% of spend was considered to be outside procurement.

Implementation project teams were used in general, but not always. The teams when present were often multidisciplinary – purchasing, project management, IT, and external consultants.

External consultants were from the software provider or technology implementation consultants.

With or without a team, the implementation time was from 12 – 18 months but for varying "spend coverage".

Some companies implemented a spend analysis project to help prepare for implementation of an e-procurement project, segmenting suppliers into types of spend, and looking for the best purchasing strategy for each type of spend.

Some companies implement a spend analysis project to help expand an existing e-procurement project, focussing on the best ways to control spend and increase adoption of its e-procurement project.

Sell the project

Not surprisingly, when the spend analytics project was "sponsored" by the executive committee, buy-in was less of an issue, though at times some business units were reluctant to have their numbers added to a corporate project.

When the project was not sponsored by top management there was a need to "sell" the project internally – either to new business units or to new category managers.

The task was to convince them to add their data to the pool, and also to be trained on the system to generate reports that they could use.

In the case of one of the companies interviewed who had neither top management support nor a real project team, currently after 3 years only 30% of spend was under management.

Software solutions

Many different types of (software) solutions were implemented. All were with the addition of a specific tool, whether from the same supplier as the enterprise resource planning (ERP) software, or another software vendor (in this case integrated to the ERP) or a SaaS provider (meaning the software is hosted by a third party and used as a service, Software as a Service, now sometimes referred to as "in the Cloud").

Elaine Rothman

The ERP alone is not seen to be sufficiently flexible to provide the needed reporting facilities as those of a tool designed specifically for spend analytics.

All the companies interviewed were SAP users, though some had other systems in place also.

Some chose an integrated spend analysis solution from SAP and others a third party SaaS provider.

Interestingly the results of an integrated versus a non-integrated solution from a SaaS provider, in term of the benefits of spend analytics were equivalent.

In the case of the companies that were interviewed, those who had a real project management focus and a "top down" view where top management was behind the project reached above 80% spend under management whether they were using a third party SaaS provider or had an integrated solution. The implementation side and the use of the tool, however, were different.

Some of the companies interviewed had multiple ERP systems, as many as 50, others had just 1.

Key performance indicators

The KPIs for spend analytics that were put in place, were largely the percentage of spend "captured" by the system, and a growth rate of that spend.

In some companies it was the number of business units reporting into the tool and their respective % of spending being reported.

For companies with a "category" approach it was the number of purchasing segments covered by the reports.

In all cases implementation was tracked and KPIs reported.

Data problems

Surprisingly, whether a company had a single instance of an ERP or 50, the difficulties encountered in all cases were data related.

Data is the key to spend analytics, taking steps to enhance and control Master Data Management prior to implementing, or in conjunction with implementing spend analytics is the key to success.

Even in companies using just a single ERP instance, in this case SAP, data was still a key issue, as many items are coded multiple times, supplier names can be abbreviated, and supplier affiliations are not always documented, product information records may be created by multiple business units and users.

If no program is implemented to control item creation in the ERP even with only 1 system, problems arise.

For spend analytics to provide the maximum value, the classification of products and services must go to line item or SKU level. Items need to be classified to know what is being purchased, without this classification widget A may be the same as widget B but the system will be unable to recognize it, and items may be counted twice or even more times. The UNSPSC code standard would be good.

As the goal of spend analysis is visibility and accuracy – the data issues need to be addressed.

In the companies interviewed, some began cleansing once they began to realize the effect it would have on the spend analytics project, others used the project to kick-start a program they had on a back burner, but all agreed that data and the accuracy of the data was the largest hurdle.

Ease of use

Training for users and access to the spend analytics tool depended both on the solution deployed and the size and complexity of the company.

Even at smaller operators the roll out to more users seemed to be an issue, so this was not size dependent.

Ease of use was cited more than once as an important criterion to gain user acceptance, and widespread use.

Done differently?

When companies were asked what they would have done differently, the responses were varied.

One responded, "Next time I would have a consultant who really knew my business".

At another, more initial training to familiarize users with the tools would have improved acceptance.

One said, "We really needed true data strategy before beginning the project". Master data needs to be clean prior to implementation.

In some SaaS models the data can be cleaned in the spend analytics tool. However this may not be reflected in the ERP, as the process is to extract data from and not to re-inject it to the ERP.

Spend analytics tools typically "remember" and "correct" data errors before adding new data to the data set. An early implementer of a new technology felt they should have waited for the technology to mature; "we would have had a faster and cheaper deployment".

All companies plan to continue with their projects, and in some it has become business as usual and are no longer considered a project.

Respondents said that the points that could have been improved on were:

- Better control on the input data, whether in the ERP, on invoices or on orders or any other system the data was being extracted from.
- Extend the programs to include supplier evaluations such that spend and supplier performance data are all in one database for reporting purposes
- Enlarge the scope to include all suppliers working with the company.
- Make the system faster and more flexible – meaning that they need a better reporting tool, even though they now have something that is better than their ERP.
- Check and recheck data before loading.

E-commerce

There is no clear trend on which goes first, spend analytics or e-procurement but clearly both do go together for the companies interviewed.

Deploying electronic transactions with business partners forces companies to use or develop standards, and possibly adopt an industry standard.

This in turn requires suppliers to use the standards mandated by the company.

This standardization can have a very positive effect on data and particularly on invoice data.

When invoice data arrives electronically the quality and quantity of data available for input into spend analytics is automatically of a higher standard and can accelerate the breadth and quality of spend analytics.

An e-procurement project with supplier catalogues can go even farther down the standardization route.

Supplier catalogues contain data that can be used in spend analytics to the line item level. This allows for easier recognition that widget A is indeed the same as widget B, or not.

Depending on the company this data can be used to purify the ERP master data, and thus also the Spend Analysis data.

With the advent of the broad adoption of e-commerce, true collaboration within the supply chain gives the buyer community the opportunity to agree on product classification and description standards with its supplier community.

This then allows for all inbound invoices with its SKU detail from the suppliers, when electronic, to be ready to drop straight into the spend analytics program, giving accurate and timely reports.

Benefits of spend analytics program

A spend analytics program provides the following benefits:

Solid reporting (which means both accurate and timely data), spend visibility (which allows consolidation, globalization and improved sourcing strategies), true business understanding (who are my key suppliers, and which are strategic), faster response time – to retrieve the required data, a way towards contract compliance – without visibility, control is not possible.

Things you can find out about:

. Spend visibility – meaning what was bought, by whom, from whom, how much did it cost, where was it consumed.

. Controlling spend – do we know what we are buying? Is it on contract? Do we control who spends what?

. Off contract purchasing – do our contracts cover what we need? Are all business units implementing the negotiated prices and products? Are we correctly aggregating spend?

. Are processes and programs in place to address "strategic" spend as the company needs to collaborate more closely with the suppliers of complex products and services?

. Consolidating spend for better negotiations – if we know what we buy and from whom, it is easier to renegotiate and plan.

. Reduce numbers of suppliers – Some of the companies interviewed have upwards of 250,000 suppliers, each supplier relationship needs to be created and maintained.

Link to full white paper:
www.ofs-portal.com/OFS-Portal/Whitepapers/

Post Stuxnet – expect government hacking

After the Stuxnet worm attack which 'created problems' for Iranian nuclear centrifuges, every government in the world will be honing up its hacking skills – and testing them out on IT installations with a military value, like oil and gas companies, thinks LogRhythm's Eric Knight

After the Stuxnet computer worm, which managed to hack into Iranian nuclear plant, operators of industrial equipment around the world need to be more wary of hacking, thinks Eric Knight, senior knowledge engineer at LogRhythm, a log management and security information event management company.

It is not so much that Stuxnet revealed the weaknesses in industrial IT systems. The point is more that Stuxnet was widely believed to be created by a government organisation – and other governments around the world will want to make sure they have hacking capability which can keep up.

And when they look for industrial centres with high military value to test out their hacking skills on, the oil and gas industry will come high on their list, Mr Knight thinks.

"I would assume that every country that has observed what has happened at Stuxnet will be trying to create their own cyber security offence and defence plans to prevent them becoming a victim of this."

The oil industry is likely to be first on the list because of its high military value. "I'm sure that in the gas and oil industry they are one of the most crucial infrastructures, in a time of war or otherwise," he says.

"So the chances are – every industry will have a lot of prodding by people who are government backed."

"There are potentially hundreds of government sponsored organisations which couldtry to hack into your IT systems to determine the effectiveness of their programs and gathering data for the future in case something transpires."

Stuxnet

Stuxnet was discovered in July 2010, and was later credited by Iran's president, Mahmoud Ahmadinejad as managing to "create problems for a limited number of our centrifuges," according to press reports.

This was the first time a worm has targeted industrial systems, gaining control of the SCADA (supervisory control and data acquisition systems) to locate and infect the centrifuges.

Before then, computer worms had mainly only been developed to gain attention or to make money for hackers, such as to install key loggers and get hold of people's credit card numbers.

"SCADA systems are lowest value to a hacker. But the military value is extremely high," Mr Knight says.

Evidence for government backing

The amount of effort and organisation involved in building Stuxnet suggests a government backer. Security experts have estimated that it would have taken 5-10 people working for 6 months to build.

The worm simultaneously successfully targeted the Windows operating system (running on PCs behind the automation system); an industrial software program which runs on Windows, and a programmable logic controller in the equipment.

It also included code for faking industrial process control sensor signals so an infected system does not shut down due to abnormal behaviour.

Whoever did it would have needed to know which specific centrifuges were being used in Iran. "It required a tremendous amount of intelligence, time and a large diversity of resources, "Mr Knight says.

Other industrial attacks

There have been other attacks on industrial equipment before, including one in Australia which managed to open up sewage gates. "That one was a fellow was trying to get his job back by creating problems," he says.

There was another incident where people thought China had infiltrated US equipment for the power grid in order to start collecting information. "They saw the monitoring taking place but no evidence of sabotage," he says.

LogRhythm tools

To create the best possible defence against hacking, LogRhythm offers a system to continuously analyse equipment audit logs to get the earliest possible warning of something going on.

This means that, if a hacker wants to be undetected, they need to both hack into the equipment and hack into its logging system at the same time, a much bigger hacking challenge.

"It is very difficult if not impossible for him to have both the opportunity to break into the SCADA equipment, and get into the main data center to get into the log management system, to modify specifically the pieces they were looking for," Mr Knight says.

Oil industry "likely to be first on the list" - Eric Knight, senior knowledge engineer at LogRhythm

"This adds so many more levels of protection."

LogRhythm can receive a continuous stream of logs from the automation systems and scan it for operational anomalies, and provide immediate notice of impending attacks or attack attempts.

For example, the Stuxnet worm needs to reprogram certain microchips in preparation for an attack, and the LogRhythm product could spot this by looking through the logs.

"It can create a forensics view of what transpired," he says. "You can put together a time line of events that took place."

The company can also help companies install standards which will help them prevent hacker sabotage, including making sure they are storing the right information about who is doing what on the system.

The system will work with any computer system which can generate a log. "We've done everything from Windows type log – down to X-ray machines, door access. The management of the records is really where we're focussing on."

"Any type of computerised system with a digital record that can be translated back as a log can be sent back to LogRhythm"he says.

Sometimes you have to analyse logs from different systems to get a better understanding of what is going on. "When you add the business pieces to the common infrastructure pieces – you can create a very robust understanding – not only security but also risk and problems that are taking place inside your organisation," he says.

GE Oil & Gas - $210m on research

GE Oil & Gas reports that it is quadrupling its research funding

GE Oil & Gas, the oil and gas division of corporate giant GE, reports that it is now spending $210m a year on research, four times as much as it was in 2007.

Over the past 4 years, GE Oil & Gas has been gradually building its footprint in the industry, making 3 major acquisitions (VetcoGray, Hydril Pressure Controls and Sondex) and hiring 930 new employees (including 600 hired in 2010).

The company wants to be able to provide a wide range integrated services and equipment needed to support drilling and production.

It now has 6,500 employees in the drilling and production business. Its Oil and Gas Annual Meeting in Florence in February 2011 attracted 1000 customers from 70 countries.

The company is building new service centres in Angola ($40m investment), Brazil, Nigeria, Australia (new campus and training centre) and Singapore. It has 1600 services staff, all with consistent training.

It hired 600 people during 2010 and redeployed 700 people in the regions to be closer to customers.

"We want to have key shops in the major locations, around the product line and specific solutions," says Manuel Terranova, senior vice president regional operations and global sales, drilling and production with GE.

The company can now say, "we offer the entire drilling package," says Mr Terranova.

GE also harnesses expertise from other divisions of the company (outside oil and gas). This includes software (it is actually the 14th biggest software company in the world); rotating equipment; remote monitoring (including from aeroplanes); electronics in harsh environments (such as at the top of a wind turbine), equipment reliability (from work in the nuclear industry). The company has experts in materials sciences, aerodynamics, combustion, flow and motor dynamics.

The company operates an "Oil and Gas University" in Florence, which has trained 252 students since 2005, particularly in leadership, energy, oil and gas processes and rotating equipment.

Macondo

The company is very proud of the contribution it made to trying to stop the flow of the Macondo well in 2010.

After the disaster, "We were immediately contacted by BP and undertook a 24-7 effort to develop shutoff and containment equipment," says GE Product Manager Bob Judge. The chairman of the company put together a team of the top 30 people to assist. "Overall, we had 230 people working at various times on his effort, designing and testing different pieces of kit."

"We didn't stop to talk about terms and conditions, we said, we're going to step up and provide whatever help we can to assist in ending the crisis. We were fortunate to be a part of it, and in the end, BP was very generous in its thanks," said Mr Judge.

GE went on to provide the blow-out preventers on the final capping stack that sealed the Macondo well, and both vessels that drilled the relief wells had GE blow-out preventers installed on board.

Acquisitions background

In February 2007 GE acquired VetcoGray, a specialist in subsea drilling and production systems, including "capital" (ie large scale) drilling equipment, floating production systems, surface and subsea drilling systems, subsea production systems and flow assurance.

In October 2007 the company acquired Sondex, a manufacturer of wireline tools, directional drilling and formation evaluation systems.

In April 2008 it acquired Hydril Pressure Control, which manufacturers blow-out preventers, drilling control systems and subsea systems.

Another acquisition, still in the works at the time of writing the article, is of Wellstream Holdings, a UK company which makes flexible risers and static flowlines for deepwater. This will enable GE to connect seabed equipment to topside equipment without using solid risers.

Sharing technology

GE strongly encourages the sharing of knowledge between different parts of the company, and discourages people from keeping their technology to themselves.

"I tell product managers, you go steal the ideas from the other GE businesses," Mr Terranova says.

One example is the microchips developed for wind turbines, which are now being used in subsea equipment, replacing the custom-made microchips which GE's subsea department had been using.

"We offer the entire drilling package - Manuel Terranova, senior VP regional operations and global sales for GE drilling and production

GE's wind business had developed a chip that could withstand high levels of vibration and extremes of temperature (very hot from the electronics, but in very cold ambient temperatures).

"The wind guys worked with a chip fabricator to make sure it is adequate for the ruggedized environment," Mr Terranova says. "That would have taken us 3 years on our own."

Now many of the microchips in VetcoGray drilling systems use these microchips. "Vetco tradition has always been to embrace the best ideas regardless of where they are from," Mr Terranova says.

GE also strongly encourages the use of standard operating systems and communications protocols rather than developing proprietary ones. The software runs on the UNIX open source operating system and communications are in TCP-IP standard.

By using standard formats, it should be easier to replace, fix or upgrade equipment in the coming decades.

Semstar 5

GE has invested millions of pounds in developing a new control system for subsea equipment called SemStar 5. To date, 84 of the units have been supplied to Statoil.

Each circuit board in Semstar 5 has an entire computer on it – so if one circuit board fails, the other circuit boards are not dependent on it.

Having a control system on the seabed is essential for fast response. If the data had to go to a surface installation for processing, it would take too long. "Things are happening more quickly on the seabed," Mr Terranova says.

The control system uses Bayesian mod-

els (working with changing levels of probability) to determine if there is a serious problem.

It can be installed in older fields to replace the existing control systems, without lifting any of the subsea equipment to the surface.

GE is also building adaptors so that the system can be installed on subsea equipment (such as Christmas trees) built by other companies.

Making BOPs better

GE (through its 2008 acquisition of Hydril Pressure Control, a manufacturer of blow-out preventers), has installed 18 blow-out preventers s in Europe and 17 in the Gulf of Mexico, and more throughout the world.

"We have systems that have operated at higher temperatures and pressures than our competitors' systems," says GE product manager, Bob Judge.

GE has research projects to try to improve the shearing capacity, reliability and remote monitoring capability of blow out preventers . The Macondo disaster is likely to increase market demand for these.

There is speculation in the industry that there could be many new regulations about blow-out preventers following the Macondo disaster, such as asking for more shearing capacity and better monitoring.

GE personnel have attended all of the post-Macondo hearings, to make sure that GE gets as early as possible notice about any new requirements. "The only thing we've seen to date is potentially new shearing requirements," says Mr Judge.

GE is also looking at different materials, and different shapes ('geometries') of blade. "The results are not entirely clear. We've seen geometries that have a significant advantage and are scaling the promising designs up," he says.

Until now, the state of the art shearing ram could make a pressure of 4,000 pounds per square inch (psi). GE is developing a ram which can push at 5,000 psi.

One new idea is harnessing the pressure of the sea in the blow out preventer r ram.

GE has an idea for doing this which involves an empty (zero pressure) accumulator vessel connected to the ram.

The blow-out preventer functions due to a pressure differential across it, not absolute pressure, because everything is already under the pressure of the seabed. So for a 3,000 psi blow-out preventer r, if there is pressure on the seabed of 4,500 psi, you end up with 7,500 psi on one side and 4,500 on the other.

If there was a way to drain away the 4,500 ambient pressure to zero, then you would end up with a 7,500 psi pressure differential, a much bigger force. This can be accomplished without requiring additional accumulator bottles, which is important because the amount of accumulator bottles (holding high pressure fluids to drive the rams) increases exponentially with the amount of force required. A 4,000 psi blow-out preventer requires 8 x 160 gallon bottles, and a 5,000 psi blow-out preventer needs 61.

The Semstar5 subsea electronics module - GE has invested millions of pounds in the system, which can replace control systems on older equipment and give it a new lease of life

Another area which could be improved is the telemetry. For example, to monitor ram position, blow-out preventers send data to the rig about hydraulic fluid flow totals, leaving engineers to make the assumption that if fluid has flowed into the rams, they must have closed.

But GE is developing sensors which can tell you directly if the ram has closed, and how much pressure it closed with.

The company is developing software tools which can download and analyse data from a blow-out preventer, and report on its condition, showing, for example, how many more times it can be activated before parts need changing. The software can be connected to an enterprise resource planning (ERP) system, so it can provide advice. Next time you have the blow-out preventer on deck, you will need these parts to do the required maintenance tasks do.

GE is also trying to build a standard interface that equipment from other manufacturers' can plug into, like the USB interface on a computer.

It has also developed a modem that can be used to send video images from the seabed along a copper cable with limited bandwidth available.

It is looking for ways to extend the control pods. Currently GE's BOP control systems can handle 96 functions, and each valve or ram needs 2 control functions (on and off), giving a maximum of 48 valves on the stack. "We are developing a pod extension module which gives you 8 additional functions," Mr Judge says.

Subsea electronics and equipment

GE is developing a range of subsea electronics and equipment, in particular to help companies to revitalise old oilfields.

It is developing a 13 mW, 12,000 power unit which can run subsea.

With Shell and BP, it is developing a modular switchgear (system to control or isolate the flow of electricity), with switches stored in a watertight chamber.

It is developing a subsea transformer that can smoothen out AC, working with BP Chevron and Total.

GE is developing a 36,000 volt transformer for Chevron, to be run on its Jack and St Malo fields in deepwater Gulf of Mexico.

It is developing improved sensors, which can provide a better idea of what is going on, and new remote monitoring capability.

GE is developing a subsea mud pump that can be used in dual gradient drilling.

It has developed a 12mW electrically powered subsea compressor, which is running for Statoil on the Ormen Lange field offshore Norway, in 900m of water, pumping injection gas into the ground – this has been running since 2006. This avoids the need to build a surface platform to put the compressor on.

Statoil has been an important launch customer for much of the subsea equipment. The tax regime in Norway is very supportive of industrial research, because money can be spent on research instead of spending it on tax.

GE has set up a subsea 'centre of excellence' in Norway, with around 50 subsea engineers.

The company has set up a centre in the UK to digest information from subsea equipment and look for trends, to try to spot things that might be going wrong. It has developed this capability when supporting the aviation industry, and has many algorithms developed for aviation.

Finding Petroleum

Calendar of Events 2011

Business opportunities with subsurface data
Wednesday, April 20, 2011
Hallam Conference Centre, London, £300

Beyond Macondo
Tuesday, May 17, 2011
The Geological Society, London, Free

Making digital oilfield IT infrastructure work
Thursday, June 02, 2011
Hallam Conference Centre, London, £300

Exploration technology and business - focus on unconventionals
Tuesday, September 20, 2011
The Geological Society, London, Free

Improving inventory management
Tuesday, October 04, 2011
Aberdeen Douglas Hotel, Aberdeen, Free

Exploring in the Arctic
Tuesday, October 11, 2011
The Geological Society, London, Free

People and the digital oilfield
Thursday, October 20, 2011
Hallam Conference Centre, London, £300

Onshore 3D seismic
Wednesday, November 09, 2011
The Geological Society, London, Free

3rd collaboration and the digital oilfield
Thursday, December 01, 2011
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