# digital energy journal

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How to work with semantic web

Digital engineering and integrated operations - what's the difference?

How Kuwait Oil Company increased production by 7 per cent

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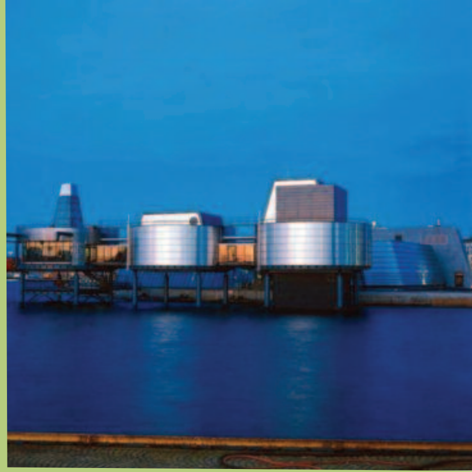
## BP: what we learned since Macondo



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***Cover Photo:*** *Delegates to the Oil and Gas UK "Piper25" event in Aberdeen in June listen to a speech by Bob Fryar, Executive Vice President, safety and operational risk, BP, "Advancing Global Deepwater Capabilities: Progress and Perspectives on Safety and Operational Risk Management"*

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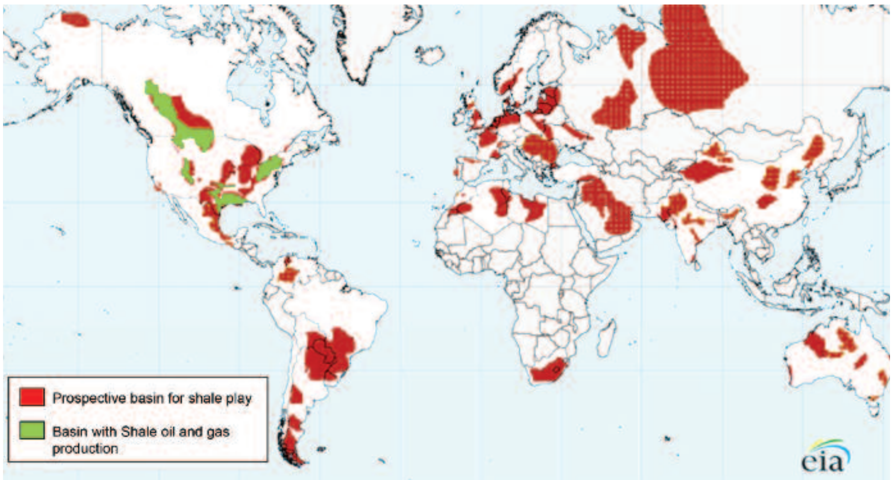
# Buy lots of tracing paper!

There is a major issue with integrating large amounts of multi-measurement subsurface data – how can it be done, if at all?

For example, let's suppose you and your team are exploring for shale oil 'sweet spots' above one of the world's great source rocks, in a tough regulatory environment where a key objective is to 'make every well count' and drill as few as possible.




*World-class source rocks: map courtesy of Kimmeridge Energy.*

At your disposal, you could have:

- Satellite (SAR) images showing a few active seeps and also possible petroleum-related variations in vegetation.
- FTG (Full tensor gravity gradiometry) data (and some 2D seismic) revealing basin shape, structural grain.
- Some passive seismic data showing a small number of zones of 'anomalous attenuation'.
- A semi-regional 3D survey, allowing a good geological model to be built.
- Seismic attributes from said survey.
- Some information on fracture densities and preferred orientations.
- Some micro-seep samples.

Powerful stuff.

Inevitably bringing these diverse data and information together will involve several people, some or all of your team. And it would be great if you could all sit down and look at the same thing, and form a coherent view of your play.

To do this, you will need large amounts of tracing paper and an old-fashioned light table!

Because I would assert that there is at the moment no other way of integrating all these different types of data and then visualising them together.

I wait for somebody to show me that I am wrong!

"David Bamford is a past head of exploration at BP and a non executive director of Tullow Oil"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# Getting to integrated operations

What does integrated operations mean, how do you get there, and how does it relate to digital engineering? *Jim Crompton and Dutch Holland explain.*

Dutch Holland

Jim Crompton

*Jim Crompton is former Senior IT Advisor with Chevron and Dutch Holland is one of Houston's top change management consultants*

Can Digital Engineering be the key to Integrated Operations (IO)? Or will Digital Engineers have to wait until operations are integrated to come into their own? Which comes first, the chicken or the egg?

Although Digital Oil Field and Integrated Operations programs have been around for over ten years now, some companies are still stuck at the starting line trying to figure out if and when they should take the plunge. Many others are re-evaluating their IO and DOF programs, having gone off-course or stalled in their efforts.

Other companies are listening to the discussions about the Digital Engineer and wondering if there is anything they should do about Digital Engineering and how it might fit into the challenges of the Big Crew Change.

An important question to answer upfront is whether IO is worth it or just another 'big idea du jour'.

Some operators believe IO is worth it, and have invested big.

For example, Statoil ASA claims that some of the benefits of Integrated Operations are as follows:

Improved health, safety and environmental performance; more efficient drilling operations; better placement of wells; production optimization; better reservoir and production control; better monitoring of equipment and more efficient maintenance; better resource exploitation and increased recovery; increased regularity (uptime).

## Definitions

The terms IO, DOF and Digital Engineer are peppering the literature, often with overlapping meanings. Perhaps our definitions below will be helpful to sort out the moving parts.

**Integrated Operations** - a way of operating an upstream business to maximize the performance of a business unit. IO coordinates and unifies the various tasks assigned to the operating units and vendors involved in order to maximize performance. Integrated Operations can use digital technology to remove the barriers between disciplines and companies.

**Digital Oilfield** - an application of digital technology for the improvement of upstream work processes in order to better meet the ob-

jectives of the petroleum business. DOF can be an enabling foundation for Integrated Operations that can help with surveillance, communication, collaboration, real-time data flow and analytics.

**Digital Engineer** - an energy professional suited to do the work associated with DOF as it contributes to IO. A Digital Engineer is an oil and gas professional with knowledge and skill in the use of engineering and digital technology to enable major process improvements that will result in performance increases in both physical and business operations.

## Success at IO

After the last decade it may be worthwhile to look at the fundamentals of what it takes to be successful in this world of Integrated Operations.

Here are four fundamental elements to think about, whether you are just getting started, making a course correction or trying to maintain the momentum of a successful IO program.

## Treat as emerging technology?

Should Integrated Operations be treated as an emerging technology initiative?

No. While an emerging technology may be used to help integrate operations, IO, in its truest sense, is an organizational design initiative.

Branding an IO initiative with a "technology project" label may become an immediate stumbling block for IO. For example, when the subject of the digital oil field is discussed, the context is frequently the difficulty companies are having in getting technology in place that will be used to generate business value. The topic is frequently talked about in terms of 'the people problem' that go along with technology integration.

After working the technology integration problem for many years, we have come to think about it not in terms of people problems but in business terms. An organization has the need for improving a work process with an idea of increasing productivity, efficiency or business value.

## Build it and they come?

If the digital technology that supports integrated operations works, won't people begin to work together in an integrated way? If you build it, won't they come?

Not necessarily. People work when they are 'ready, willing, and able' to work together. Available digital technology can certainly help people to be able to work together, but that ability does not automatically lead to "willingness."

In order to design and deliver the desired work process changes for IO, attention must continue to be paid to organizational design. The deployment of solutions that enable Integrated Operations strategy will drive significant change to some of the basic operational and engineering processes in the oil field.

Since the scope and impact can be wide spread, the use of organizational engineering practices will need to be employed to ensure acceptance of these new tools and processes.

To support these changes, senior management and leaders throughout the organization need to support the investments and cultural change required to successfully transform traditional work practices.

Culture, made up of beliefs, behaviors and relationships, is established by rewards, whether intentional or accidental. Changing culture, "the way we do things around here", takes a long time, but strong leadership can accelerate the momentum toward the desired change.

## Infrastructure, info-structure

Do we have to make establishment of infrastructure and info-structure a part of our IO initiatives?

Yes. Operators seeking integrated operations must invest in 'the enablement of IO.' Today operators install sensors, gauges and meters on well heads and selected equipment in order to collect measurements and test results to send back to a 'control room' environment.

These distributed control technologies are mature, especially in plants and producing facilities where we have moved to a 'closed loop' automated environment. In these examples, companies can move beyond baseline surveillance to control and even towards advanced alarming/ alerting and process automation.

But many times a company will find that there is a significant gap in their automation, telecommunication or collaboration networks.

Our industry must lay the foundation for the new Digital Oil Field/ Integrated Operations by continued investment in the following areas:

Instrumentation and field surveillance; network connectivity to wherever operations are located; collaboration and decision support environments; integration and analytics frameworks; and the trusted data foundation with easy access to visualize information in the workflow context, to make quicker and better decisions.

## Principles

Can Digital Engineering principles lead to a successful implementation of Integrated Operations?

Yes, but it is not an easy journey. There is a growing opportunity to converge the capabilities of engineering, digital technology with business capabilities, but to do this successfully requires the leaders in the enterprise to lead the way with a disciplined, business-focused approach, to change the way their companies operate, to take advantage of the growing amount of data available, to optimize their investments and their operations.

## Questions for today

The questions industry faces today are complex. Here are just a few of the digital ones:

How can companies take advantage of new technologies in training and mentoring (online, multimedia) to stretch the scarce training resources available? How will they be able to certify competence from training delivered in this way?

How will companies instill the discipline to protect the three IP challenges of information protection and security, intellectual property and individual privacy? Cybersecurity is a growing and very real concern.

How can we provide an accelerated learning program to align the 'virtual' view with the 'field' reality?

How do we leverage the elder generation's technical knowledge and experience into this digital space? How can we keep them 'plugged into' that space when it is accelerating at a faster and faster pace?

How will we 'regenerate' subject matter expertise when the new business model requires both breadth (jack of all trades, master of none) and depth?

The relationship between a mentor and protégé will become more important and complement the relationships that already exist between supervisor and employee as well as between technical subject matter expert and apprentice. But where will companies find mentors when they have all gone fishing or are on the golf course?

When data becomes easier to move around, how do we decide what expertise resides in-house and what is contracted and what are the long term consequences of those decisions?

## Edge of a transformation

Industry and technology challenges can seem overwhelming so it is understandable for companies to be cautious about starting an Integrated Operations initiative. It is very easy to see how programs start with good intentions, go off track, invest in the wrong technologies and fail to achieve the change desired or the intended business value.

But for those companies who can design and follow a disciplined digital engineering approach, the benefits can be significant. The era of easy oil is over and the new realities of complex reservoirs in remote locations or in the backyards of communities not used to oil and gas production, of higher safety and environmental performance, of greater transparency of operations and financial transactions are with us.

Given the growing emphasis on Digital Oilfield and Integrated Operations, we believe that we are on the edge of the transformation of our industry. That transformation will be made possible by digital engineering practices and by the new workforce of Digital Engineers themselves.

We believe that the future of the oil and gas industry belongs to the Digital Engineer.

Dutch Holland and Jim Crompton have spent their careers leading successful organizational change. Both are highly regarded as thought leaders and as consultants who will tell it like it is. Their new book The Future Belongs to the Digital Engineer is the first collaboration for Dutch and Jim, but it promises to combine organizational engineering experience with oil and gas domain expertise into a different kind of insight for today's digital technology challenge.

# BP Norge's "*Field of the Future*" projects

BP Norge (Norway) has completed 2 "*Field of the Future*" projects - on a new production and hotel platform on the Valhall Field, and an FPSO on the Skarv field. It includes fibre optic cables, remote condition monitoring together with a remote control room for Valhall" *By Eldar Larsen and Paul Hocking, BP Norge AS.*

BP Norge installed its first fibre optic communications link to the Valhall and Ula fields in the North Sea in 1999.

Since then, it has substantially developed its implementation of BP's *Field of the Future* programme of digital technology, ranging from the first advanced collaboration environments for drilling and operations to the world's first life of field seismic array on the Valhall field and advanced remote monitoring tools.

In 2005, BP embarked on two major facilities projects.

The first was a new field center for the Valhall field.

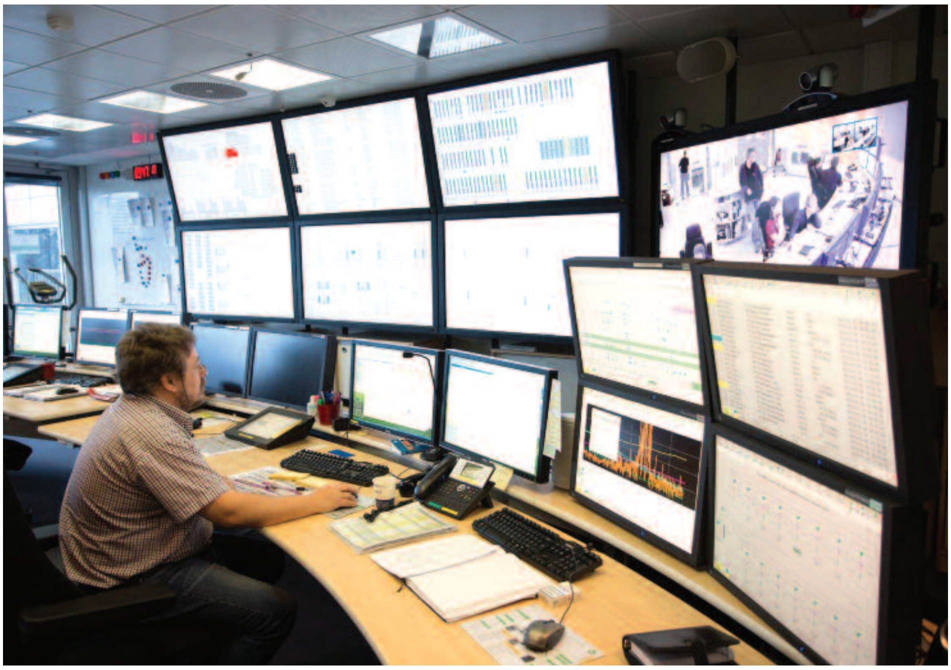
The second a green field development for the Skarv field based on a floating production and storage offloading (FPSO) unit.

These projects would enhance BP Norge's existing experience in digital oilfield technology and create two second generation fields of the future.

BP Norge, on behalf of its partners, operates three field centers; the Valhall hub, consisting of the Valhall and Hod fields; the Ula hub, consisting of the Ula and Tambar field; and BP Norge's new Skarv field.

## Digital infrastructure

The installation of low latency high bandwidth fibre optic based telecommunications in 1999 underpinned the successful implementation of the *Field of the Future* technologies in BP's Ula and Valhall brownfield hubs and was a turning point for the operation of BP fields.



*The Valhall onshore control room*

The new Valhall Process Hotel Platform development includes the provision of a 294km high voltage direct current power (HVDC) cable, delivering 78MW of power to the Valhall field.

BP augmented the HVDC cable to include its own fibre optic communications cable, adding a new dimension to the robustness of the fibre optic communications to the Valhall field, which opened up the potential for remote control of the field from shore.

Fibre optic communications were successfully implemented in the southern part of the North Sea and convinced the Skarv partners that it was important to provide similar wide bandwidth low latency communications to the field.

## Valhall – new platform

In late 2004, due to subsidence at the seabed of the original processing facilities leading to subsequent reduction in the air gap between the

The offshore Valhall field

bottom of the deck and the sea, sanction was given for work to commence on the front end engineering of a new production and hotel platform for the Valhall field.

This became known as the Valhall Re-development Project.

With a life expectancy of 2050 and beyond, the project was considered the best alternative to resolving the subsidence problem, rather than to jack-up the old facilities.

BP implemented the project as a *Field of the Future* facility, making use of all the capabilities of the new digital technology to facilitate remote monitoring and control.

Recognizing the challenge, the company developed a *Field of the Future* automation blueprint outlining the project and what its contractors were expected to deliver to meet the company's requirements.

This was important to ensure the engineering contractors delivered the required sensors necessary for best in class remote performance monitoring and optimization of critical process plant and equipment.

An audit of planned *Field of the Future* capability for the Valhall Re-development Project in 2006 proved its success with a high degree of conformance to expectations.

## Skarv field development

Located 210km West of Sandnessjøen, Norway, the Skarv field development concept was based on an FPSO designed for the area's harsh environment.

It was agreed in the early stages of the front end engineering of the project that a fibre optic telecommunications infrastructure to shore should be implemented on Skarv, based on positive experiences from Ula and Valhall.

The *Field of the Future* automation blueprint was also successfully implemented and specifically updated for Skarv to cover marine and subsea aspects.

Since 2005, this blueprint document has evolved into a set of company standards addressing automation, remote performance management, advanced collaborative environments and the digital infrastructure and is now applied globally to all new major projects across BP.

The Skarv field

## Remote control

BP adopted a degree of remote control for the Valhall field from shore and combined it with the extensive use of advanced collaborative environment (ACE) technology.

The installation of a second independent fibre optic communications link associated with the 78MW High Voltage Direct Current (HVDC) Power provided the robustness of communications needed for remote operation.

Based on a review of value, risk and tactical considerations, all the primary processes, surveillance and control of the safety systems remained offshore whilst some specific functions, such as controlling the wells, would be done from shore.

The control room was designed to reflect the same look and feel as an offshore facility, with the same access to wireless communications and PA systems. A large video wall with high quality audio equipment was provided offshore and onshore to give staff the feeling of being in the same room.

With more than 100 drilled wells and approximately 100 wells yet to drill, significant value is to be gained through well optimisation.

Well management complexity is increasing due to a shift from primary depletion towards depletion based on water-flood, expanded gas lift and the use of more advanced wells.

As a result, it is leading to more fragile wells requiring scale management and careful well surveillance. Well management was improved by strengthening communications between the onshore support and operators, thus improving the well operator's skills and capabilities.

Valhall, which has a remaining lifetime of 40+ years, is expected to remain a highly complex field to operate. New technical capabilities and work practices are constantly under development and the general industry trend is to move an increasing amount of the control and administration functions from offshore to onshore.

The operational onshore control room will provide improved flexibility for harvesting potential benefits from these new capabilities in the future.

## Skarv's ACE concept

The Skarv green field development saw the opportunity to use ACE technology, but since it is an FPSO with associated marine operations it was decided not to implement remote control.

Based on experience from BP's other assets, the company coupled Skarv into the existing mid-Norway fibre optical communications network.

This enabled the full integration of onshore teams both in Stavanger and Sandnessjøen, with the offshore operation, including real-time data access to systems, CCTV coverage and links to other centers, providing a capability for delivering business benefits in the areas of production efficiency improvement, production increase and operating cost reduction.

As in the Valhall project, the Skarv development project utilises mirror image purpose-built ACE facilities offshore.

## Remote Performance Monitoring

Valhall has 40 individual Remote Performance Monitoring (RPM) applications, which have been assessed as providing high value, whereas Skarv with more marine and sub-sea infrastructure has 46 RPM applications.

Condition Monitoring (CM) and RPM was recognised as a key component of the Valhall and Skarv Projects. The systems and techniques that are being provided under the projects fall into two broad categories:

Those that are well defined and understood which should be expected to work reliably


*The Skarv FPSO*

quickly, and be available from plant start-up Those that are less well defined, where there is less experience or which are known to require configuration / set-up / optimization during early stages of operation (nominally the first 12months)

Each requires its own management to realize the expectations for the effectiveness of the techniques employed and to identify additional opportunities.

With ACE's both onshore and offshore, the asset teams will support the day-to-day business of the fields, while the engineering support teams are responsible for following up and operating the RPM tools using their own ACE environment together with their specialist contractors.

## Lessons and challenges

Installing some of the best technology available on two new installations will enable BP Norge to continue to develop and improve concepts commenced more than 10 years ago on its brownfield installations.

Many lessons have already been learned but certainly many are still to come in the years ahead.

Using blueprints to deliver a true *Field of the Future* installation has been a great success. Not all applications or capabilities which were initially envisaged have survived to handover of operations, but the reasons for this are well understood and can be corrected in future editions of the blueprints.

As one of the first companies in the world to try to perform remote control on a major oil and gas field, the projects have been challenging and have required a great deal of effort and attention to detail, although the company is confident that the safety benefits through consistency of processes and production optimization will justify the investment in time and resources.

It has been important for senior engineering staff, who will be responsible for RCM on the new assets, to align themselves with the key objectives and truly understand what is envisioned to deliver the desired results without deviation.

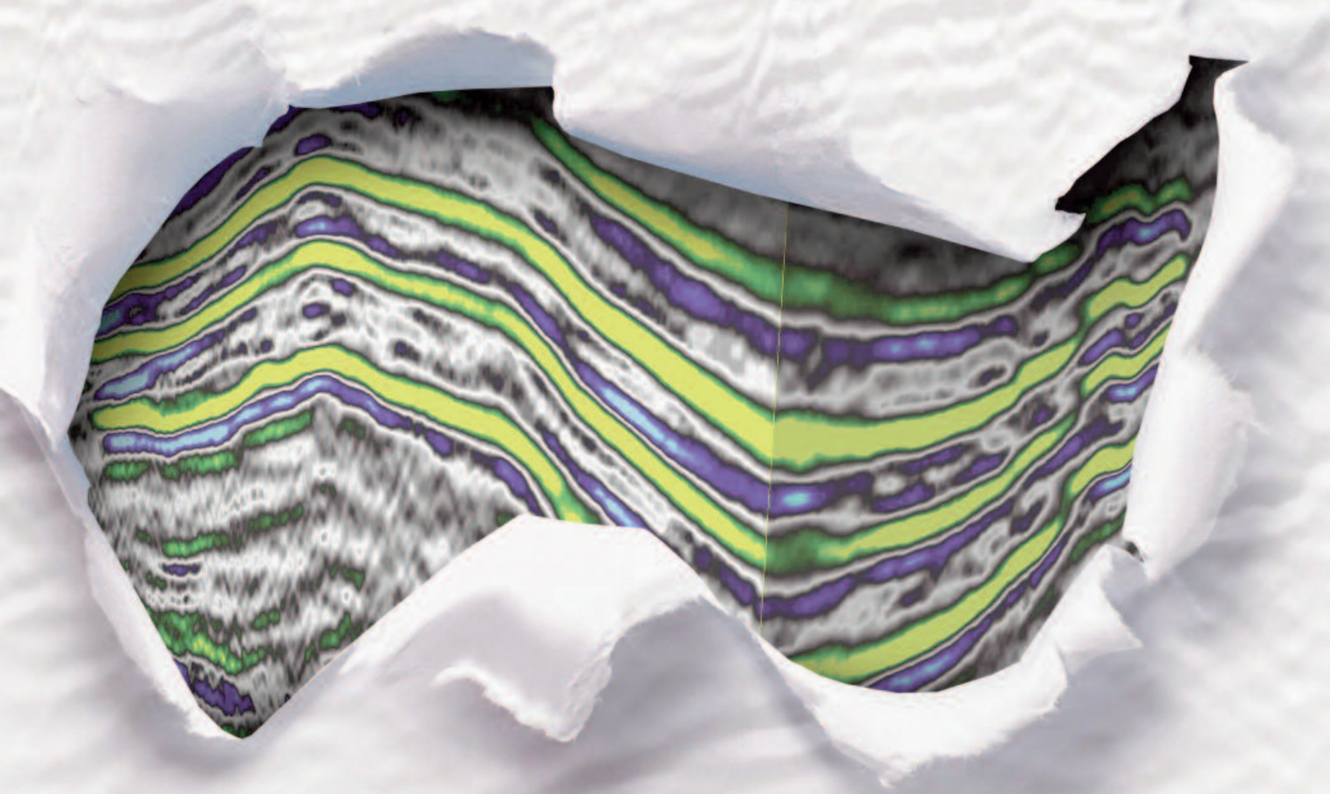
## Conclusion

BP Norge has put an ambitious strategy in place for its most recent developments on Skarv and Valhall and has made a significant step in the industry's progress towards the second generation digital oilfield.

To drive recovery and uptime, an increasing amount of cross discipline collaboration is required, and various technologies will have to be developed and deployed to obtain the maximum economic recovery from all fields.

Remote condition monitoring, data analysis and interpretation, real time high fidelity data and collaboration technology are in this portfolio of technology, and BP Norge has progressed this significantly, but with a recognition that there is still much to do on this long journey.

Field of the Future is a registered trademark of BP



# Kuwait Oil Company - increasing production by 2,500 BPD or about 7%

In a pilot digital oilfield project, Kuwait Oil Company managed to increase production from a field by 2,500 barrels of oil per day, or about 7% – and also helped staff work more efficiently and reduce downtime.

*The Kuwait Oil Company Ahmadi collaboration centre – with electronically activated walls, desks which can rotate in any direction and raise or lower 24 inches, and a display wall where users can show what is currently on their workstations*

Kuwait Oil Company, operator of the Sabriyah field in North Kuwait, has been running a pilot digital oilfield project on its Mauddud reservoir, covering 49 wells out of about 500 in the field.

The project was done together with service provider Halliburton, and is called the Kuwait Integrated Digital Field project (KwIDF).

Kuwait Oil Company wanted a system where staff would make effective informed and consistent decisions, using accurate real time data.

The project was sponsored by Kuwait Oil Company's Research and Technology Department, with the main users being field development, well surveillance and production operations staff.

The project achieved efficiency improvements by reducing downtime in artificial lift systems, increasing well productivity, and preventing water production (described in more detail below).

The project included instrumenting 49 wells (44 production wells and 5 water injection wells) to provide real time data; upgrading power and IT infrastructure to support the wells data gathering; and deploying 2 smart well completions.

The project included developing workflows and automated work processes to optimise production, including reservoir, well, production and facilities engineers as workflow users.

The 'smart' workflows developed are for key performance monitoring, well performance evaluation, production surveillance, production losses, reservoir visualisation and analysis, electrical submersible pump diagnostic / optimisation, production allocation, gas lift optimisation, reporting and distribution.

## Collaboration centres

There were also 2 collaboration centres built, one at Kuwait Oil Company's headquarters (Ahmadi, called North Kuwait Collaboration Centre or NKCC) and one close to the oilfield.

The Ahmadi collaboration centre has walls which are electrically activated, enabling the centre to be divided into one, two or three different work areas.

Each area has a display wall where users can show what is currently on their workstations, so their colleagues can see it.

There are video cameras, so you can do video conferences.

Each desk can rotate in any direction, raise or lower 24 inches, and has its own microphone.

## Improving wells

Altogether, actions leading to 2,500 barrels of oil per day were identified, or about a 7% increase.

The project made it possible to identify some wells with electrical submersible pumps which were not achieving their full production potential.

Through the production optimisation workflow, it was possible to identify some equipment control automation, optimum frequency and well head pressure changes.

In one well, the variable speed drive was set to "I-Limit", which means that the Variable Speed Drive frequency can be automated. This led to a significant improvements in operation of the pump - with no unplanned shutdowns in 6 months since the change, compared to unplanned shutdowns every 2 weeks before the change, where the well was closed for one week each time. Benefits were estimated at 1250 barrels of oil per day.

On two wells, the real time intake pressure was shown to be above the bubble point pressure, and the suggestion was made to adjust the frequency to increase production. Benefits were estimated at 130 barrels of oil per day.

On another well the choke setting had been reduced, leading to a production loss. By adjusting the choke to previous settings, production increased 125 barrels of oil per day.

## New ways to do business

One of the main objectives of the pilot was for the operator to change its way of doing business – and so the advances in ways of working were seen as a bigger benefit than the increases in oil production.

It typically takes an experienced production engineer 7 hours to optimise a well, with 90 per cent of the time on non-value adding activities.

With the workflows developed as part of the project, less experienced engineers can analyse wells in 1.6 hours, with 5 minutes time on low value added work.

## Case study – improving production

On one well, the asset manager asked the team to look for ways to increase production. The team included one surveillance engineer, one reservoir engineer, one facilities engineer and two production engineers.

The well was producing 1,300 barrels per day of liquids, including 630 barrels per day of oil, i.e. a water cut of 54 per cent. Flowing bottom hole pressure was 2,100 psi and tubing head pressure was 663 psi.

A multi rate well test was executed in the well, which showed that the maximum potential oil production was 4,400 barrels of oil per day, and reservoir pressure could be increased to 2,800 psi (by increasing water injection in adjacent injection wells), so there was potential for increased production.

A production engineer had concerns that water could increase if total production was increased, and collaborated with reservoir and facility engineers to get a better understanding of what effect increasing production would have.Another production engineer checked that there would be a net increase in oil production in the well given the well's Productivity Index.

The reservoir engineer agreed that, since the voidage replacement ratio (injected fluids divided by produced fluids) is around 0.75, if water injection was increased, the reservoir could provide the expected production.

The facility engineer agreed that the facilities could handle the expected pressure increase, and worked out how to re-distribute the water injection in the system.

So the whole team worked together to make the change. The asset manager expects oil production to increase by 1,100 barrels per day.

## Case study – preventing pump failure

A second well was producing 1,600 barrels of oil per day, with nearly 5 per cent water cut, and tubing head pressure of 169 psi, intake pressure (to the downhole pump) at 900 psi and discharge pressure (from the pump) at 2,300 psi.

The multiphase flow meter lost signal around July 2012, and the well test reported that the oil rate had reduced to 1,300 barrels of oil per day.

The surveillance engineer had been monitoring an alarm, showing that discharge pressure was decreasing and behaving erratically, whilst intake pressure was constant at 900 psi.

In September 2012, 2 months later, the production engineer did a diagnostic of the pump and found that it had a problem with gas interference, of around 40 per cent by volume. This was affecting pump discharge.

The engineers decided to increase the tubing head pressure to 320 psi by reducing the choke setting.

After this had been done, the asset manager wanted to increase production to compensate for the deferred production over the past 2 months, and asked the production engineer how this could be achieved, without affecting pump behaviour.

The production engineer saw that the pump frequency was 47 Hz, and the frequency could be increased to 51 Hz so long as the tubing head pressure was increased first, leading to expected production of 2,300 barrels per day.

The reservoir engineer agreed with the idea. He could see that the reservoir bubble point pressure associated with the well was 1,100 psi. If the intake pressure was 900 psi, gas would be liberated into the pump. However the voidage replacement ratio was 0.8. The engineer suggested increasing water injection to re-pressurise the area associated with the well, increase bottom hole flowing pressure from the bubble point pressure, and achieve the desired production rate.

The team asked the facility engineer if the power supply and voltage were available to increase pump frequency to 51 hertz and if water injection could be modified.

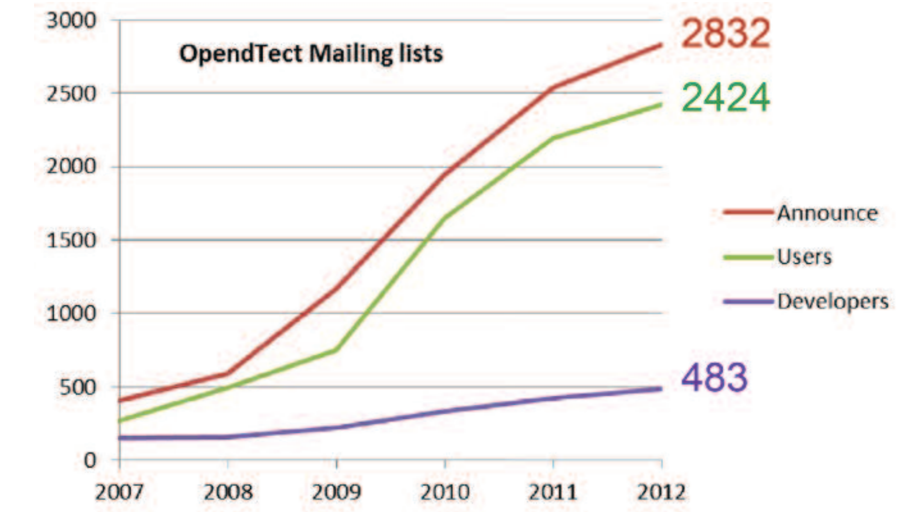
The tubing head pressure was increased from 169 to 250 psi by reducing the choke setting and from 250 to 390 psi by increasing pump frequency.

In the first step, free gas was reduced from 40 per cent to 25 per cent and stabilised at 30 per cent. In the second operation (changing pump frequency) the liquid rate increased from 1,385 to 2,374 barrels per day.

For further information see SPE 163696-MS "Maximizing the Value of Real-Time Operations for Diagnostic and Optimization at the Right Time." A. Al-Jasmi, H.K. Goel, A. Al-Abbasi, and H. Nasr, Kuwait Oil Company, and G. Velasquez, G.A. Carvajal, A.S. Cullick, J.A. Rodriguez, and M. Scott, Halliburton

# OpendTect seismic interpretation software - doubled in 3 years

dGB Earth Sciences of the Netherlands reports that its "OpendTect" seismic interpretation software has roughly doubled in usage over the past 3 years.




*The number of users and developers on the OpendTect mailing list 2007 to 2012*

The company does not have direct data about who is using it, but it can see that there are 4188 users on its mailing list requesting information on the latest updates to OpendTect - an increase from around 1600 in 2010 and 500 in 2008. Since September 1, 2009, there have been over 120,000 downloads of the software direct from the dGB web site.

The number of developers on its mailing list has also doubled in the past 3 years to 483 now.

There are 3020 academic licenses to the software, being used at 340 different universities worldwide.

The Open Seismic Repository, for storing seismic data which is freely available, has seen 20.7 terabytes downloaded so far.

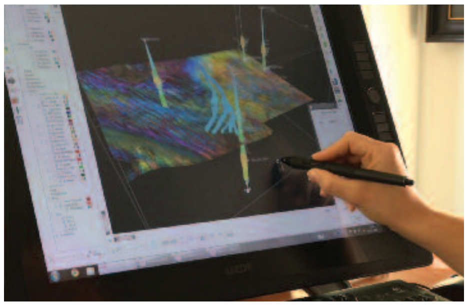
dGB has drawn a comparison between OpenTect and its competitors according to the only metric publicly available - LinkedIn group members.

OpendTect has 855 members to its LinkedIn Group, compared to 3884 members in the Petrel Independent User Group; 992 members in the Seismic Micro Technology Kingdom User Group; 1177 members of the Landmark Openworks Independent User Group; and 744 members of the GeoFrame Independent User Group (data counted in Aug 2013).

Companies who are using the OpendTect software include:

NOCs: ADA Oil (KNOC), Saudi Aramco, BAPEX, CNOOC, Ecopetrol, KJO, KNOC, MOL, NIOC, OMV, ONGC, Petrobangla, Petrobras, Petrochina, PTTEP, Sinopec, Sinochem, Statoil, ZADCO

Majors: Chevron, ENI -Agip, ExxonMobil



*Big growth in users of the opensource seismic interpretation software OpendTect*

Independents: Anadarko, Addax, Apco, Abundant Resources, Aspect Energy, BG Group, Cathedral Energy, Cairn, CAPEX, CNR, Det-nor, DNO, GDF SUEZ, Geoproduction, Gran Tierra, Inpex, Jogmec, JGI, Lukoil, Maersk, Marathon, Maness Petroleum, MEO, Nettlecombe, Newfield, Noble Energy, OGX Petroleo, Pan American, Petrolero, Premier (oilexco), Reliance Ind., RosNeft, Rocoil, Samson Resources, Santos, Sigma Energy, Wintershall, Woodside

Service companies: 3D-Geo, AGR -Tracs, ARK CLS, ArkEx, Beicip, BGP, CGG, Dana Geophysics, Dakon, DegeconekNigeria, Earthworks E&R, EOSYS, Fugro-Jason, Fugro-Robertson, Gas-KCO, GCT-GeoCruiser, GeoInfo, Geokinetics, Geostan, Holleman& Kenney, IF Technologies, Ikon-Science, KerogenResource, Norsar, Optim, Petroguard, ThrustbeltImaging, Predict Geocon PGS, RPS, SIGSA, Spice Inc.

# How to standardise well identification

Developing a standard system for identifying wells continues to be a constant challenge in the E&P industry, *writes Nalin Jena, Upstream Data Manager with Reliance Industries, Mumbai.*

*Nalin Jena, Upstream Data Manager with Reliance Industries, Mumbai*

The Unique Well Identifier (UWI) issues we face are manageable with effort and planning. These problems will not solve themselves. How much pain, loss of performance and mistakes the company is willing to tolerate will drive a careful UWI.

With over 500,000 wells drilled world-wide so far, and unconventional oil and gas staking to drill a million wells in this century, wells are going to be plenty.

Wells are the medium for the reservoirs providing the hydrocarbons. They are long-living, expensive and the business agents.

Loose well naming is quite common leading to (for example) a complete lack of traceability of 100,000 wells drilled in the state of Pennsylvania in 19th century.

The industry has learnt the hard way the importance and methods of proper well naming.

Evolution of digital oil fields, real-time subsurface data like cross-borehole seismic, and integration of technical data with business and commerce, is increasing the need to have a correct well name.

But independent and mutually discordant UWI (unique well identifier) can become a pain when acquiring or relinquishing blocks with wells.

## Uniform naming standards

There is no uniform world-wide well naming standard.

Physically, a well is a fairly complex entity that can change in a number of ways over time.

Due to its physical complexity, a well is also a very complex data modeling entity.

Within the PPDM Data Model, there are over 1700 tables and 43000 columns, and a significant number of field characters deal specifically with aspects (attributes) of a well through its entire life-cycle, from planning through licensing/permitting, drilling, completion, production and operations, abandonment and reclamation. It is therefore, impossible to embed all aspects of a well in its name.

The challenge for data managers is to be able to maintain the identity of the well, through all its various aspects and phases. The UWI (unique well identifier) is the thread of life to this important hydrocarbon asset.

## Defining the well name

You need to define a unique name for the well for its computerized access and usage. You need a naming method that can be made consistent (algorithmic) across different creators. Establish methods of validating the name for it consistent interpretation and use.

There are 3 different types of name.

The "common well name" is the name popularly used and followed in the company. Ideally, this should be limited to early stages of well life-cycle and slowly replaced by a more robust name.

The "short well name" is an abbreviated identifier normally derived from the field-code, well-number and the orientation.

The "unique well identifier" is a code which definitely identifies every borehole distinctly. No two wells in the database can have same UWI.

You need simple, consistent methods for identifying all wells –an identity that will not change through time and an identity that will not change with various well operations.

It is imperative that each well (i.e. hole-in-the-ground) be uniquely identified in order for computer oriented data to be most reliable in storage, extraction and analysis.

All well activities are discriminated to identify changes in data. This assures correct data integration.

*Does this well have a unique number?*

## Issues

The basic problem is that the various standards were created about 50 years ago, and technology has moved forward in such a way that there are cases where the structure of the UWI simply can't accommodate the way that the wells can now be drilled.

Accounting of every well-bore and its data is necessary for integration and proper access to large volumes of data.

Geoscientists and engineers unknowingly gamble on a routine basis. Every time they assume the datasets being used, like velocity, paleontology, logs, reservoir /core analyses, production and test information have been digitally integrated to the correct well / wellbore. Seldom are these audited or checked in work processes.

## Qualities of good name

A good well name has fixed fields of precise definition – Name has definite and clear parts.

It has clearly and completely identified the well, wellbores and its interventions affecting data.

It doesn't carry extra attribute information, which can be easily and surely looked-up.

It is scalable, expandable to different known conditions; amenable to sets of new conditions.

It can be explained and followed in a concise manner.

## Impact to business

There are many problems which can arise from poorly labelled wells.

Well names can misappropriate expenses and revenues.

You can get litigation.

You can get incorrect and incomplete data assignment leading to erroneous analysis and interpretation

## UWI implementation and governance

This is the process for implementing a "unique well identifier" system.

Collect and define all existing well-bores with a UWI.

Build and verify the master. Update the fields of all attributes.

Maintain a data dictionary of the attributes to ensure consistent interpretation and use.

As all wells are drilled by the drilling department, the responsibility vests with them to get the UWI right.

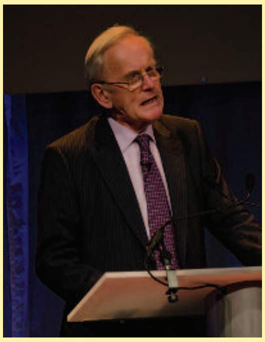
The data management team will issue and maintain the UWI for all approved, ready-to-drill wells.
Periodic audit and review of the UWI.

Publish the UWI and well data master.

Reliance Industries Limited (RIL) is an Indian conglomerate holding company headquartered in Mumbai, Maharashtra, India. The company currently operates in five major segments: exploration and production, refining and marketing, petrochemicals, retail and telecommunications. RIL is one of the largest publicly traded companies in India by market capitalisation and is the second largest company in India by revenue after Indian Oil Corporation. (source Wikipedia).

# Lord Cullen – what have we learned from Piper Alpha?

Lord Cullen, who conducted the 13 month government enquiry into the Piper Alpha Disaster, used his keynote speech at the 2013 Oil and Gas UK conference to question how much the industry has learned since then.



Lord Cullen, led a 13 month UK government inquiry into the Piper Alpha disaster of 1988. The inquiry led to 106 recommendations, all of which were accepted by the industry.

His talk at the 2013 Oil and Gas UK conference to mark 25 years since Piper Alpha, aimed to "give you some reflections on the Piper enquiry and look at them in the light of recent developments," he said.

When starting the Piper 25 enquiry, it was not obvious what direction it should take, Lord Cullen says. "I was asked to make observations and recommendations with a view to preservation of life and avoiding similar accidents in the future," he said.

There did not seem to be much point in limiting the analysis to the one specific accident, because this would only help prevent that specific accident from re-occuring. "Major accidents are relatively rare – history does not repeat itself in the same fashion," he said.

So intstead, "I examined the significance of whatever had a tenable connection with the chain of events which led up to the catastrophe, and I also took account of other factors which played no part in bringing about the result, but which were in themselves cause for concern."

## Management

Before starting the enquiry, he expected that it would be concerned with hardware, he said. "To some extent it is. Take subsea isolation valves, which were lacking in Piper Alpha."

"But I quickly realised the fundamental, and running through everything else, was the management of safety."

"And as I dug down to the background of what happened, I discovered it was not just a matter of technical or human failure. As is often the case, such failures are indicators of underlying weaknesses in management of safety."

"Management shortcomings emerged in a variety of forms. For example there was no clear procedure for shift handover. The permit to work system was inadequate. But so far as it went, it had been habitually departed from. Training, monitoring and auditing had been poor, the lessons from a previous relevant accident had not been followed through. Evacuation procedures had not been practised adequately."

"There had not been an adequate assessment of the major hazards and methods for controlling them."

For example, no-one had fully understood the implications of a high pressure gas fire, which would have consequences for the structure and integrity of the platform, for safety of personnel, and for the means of evacuation and escape. "The gas pipelines would take hours to de-pressurise – and this became a dreadful reality on the night of the disaster," he said.

"These provided possible starting points for recommendations to the industry and changes to the regulation of safety."

"I was conscious that no amount of regulations can make up for deficiencies in the quality of management of safety. That quality depends critically on effective safe leadership at all levels and the commitment of the whole workforce to give priority to safety."

"I saw those factors as intertwined with each other, and together making a positive learning culture and all that entails in the way of values and practises. It is essential to create a corporate atmosphere or culture where safety is understood to be and accepted as the number one priority," he said.

"Management have to communicate this at all times and at all levels within the organisation. Most particularly by their everyday decisions and actions in tackling the issues which arise. They provide the opportunity for subordinates to see real practical substance. Leaders undoubtedly set the tone."

These ideas were echoed by the board which investigated the loss of Space Shuttle Columbia and its crew in 2003, where the investigators had written, "If reliability is preached as organisation bumper stickers but leaders constantly emphasise keeping on schedule and saving money, workers will soon realise what is important and change accordingly. Be thorough and inquisitive, avoid leadership by PowerPoint, and question untested assumptions."

Safety means "ensuring all the companies' employees and contractors not only know how to perform their job safely but are convinced they have responsibility to do so," Lord Cullen said.

## Safety representatives

Regulations were introduced in 1989 that staff should elect safety representatives and the company should train them. "They are not part of the management but they have important functions, such as power to carry out investigations and reporting safety concerns to management, without fear of recrimination," Lord Cullen said. "It helps reinforce the principle that each employee is responsible for his own safety"

The definition of the required training was "somewhat cryptically expressed – 'Such functions as may be reasonable in all circumstances.' The kind of words only a lawyer would use," Lord Cullen said.

"In practise it seems this means basic training in health and safety, the employers health and safety policy, and how safety representative should carry out their functions."

Lord Cullen said he strongly supported the development of an OPITO industry standard for training safety represenatives including investigating acccidents and use of audit.

## Process safety

A theme of accidents over the past decade has been too much emphasis on personal safety (hard hats) and not enough on process safety (the accidents which cause the big disasters).

"The shortcomings on Piper Alpha represented failures on the part of management to give adequate attention to process safety, where the frequency of incidents is low but the potential consequences are very serious," he said.

Similarly the (UK) Buncefield disaster in 2005 showed poor process safety. "An overflow of petrol led to the ignition of a vapour cloud and a massive explosion," he said. "A monitoring gauge had been sticking for months without an effective response. A high level switch for closing down the flow was inoperable. It had not been locked in a working conditions. Bunds for containing fuel were inadequately designed and maintained. A report published in 2011 stated that various pressures had created a culture where keeping the plant running was the primary focus."

"The safety management system focused too closely on personal safety and lacked any real depth on control of major hazards. There should have been an understanding of major accident risk and systems designed to control them."

Also in 2005 was the BP Texas City Refinery disaster, with a release of flammable liquid and explosion and fire. "The US said it was caused by deficiencies at all levels of the corporation. Cost cutting, failure to invest and production pressures had impaired process safety performance," he said.

"The reliance on a low personal injury rate as a safety indicator had failed to provide a true picture of the health of the safety culture."

"That disaster led to setting up a panel under James Baker III which looked at BP's US refineries.

It said 'BP emphasises personal safety but not process safety and did not set an appropriate process safety tone at the top.'"

"5 years later came Macondo. Among the many words that have been written on this disaster was a report by Deepwater Horizon Study Group by members of the centre for Catastrophic Risk Management.

Findings were strikingly similar."

"It said BP's system was geared to a 'trip and fall; mentality rather than being focussed on the big picture. It had been observed that BP forgot to be afraid."

## Auditing and learning

For a safety system to work, "auditing is essential – and as far I am concerned it should be inquisitive auditing," he said.
"On Piper there had been audit of the permit

*Delegates listen to a keynote speech by Lord Cullen, who conducted the enquiry into the 1988 Piper Alpha Disaster, speak about areas he thinks the industry still needs to improve*

to work procedure 6 months before the disaster. No deficiencies had been reported. The management assumed that in the absence of such feedback all was well, but the practise was very different."

Once signs are spotted, you need to make sure people learn from them. "If you read the report of a major incident you will often see that it was preceded by the neglect of signs that all is not well," he said.

"9 months before the Piper Alpha disaster, a rigger had been killed in an accident which was due to the members of the night shift improvising in the course of a lifting job without an additional permit to work, and to them not receiving adequate information from the day shift. After that incident management made some steps but they were not followed through."

"I recall a chief process engineer from Piper saying in the course of his evidence, there were always times when it was a surprise that you found some things were going on."

"In Buncefield there were signs that the equipment was not fit for purpose but nothing was done apart from temporary fixes."

"Warning signs in Texas City refinery had been [ignored] for several years."

The risk control systems give warnings about problems which don't themselves escalate into major incidents.

## Communications

Communication is critical in many areas of safety management – from shift handovers to company communications about safety policy. The James Baker inquiry into the Texas City Refinery said that corporate managers and refinery workforce should both understand the importance of process safety, and BP's corporate management must clearly and frequently and consistently communicate that value.

"During its review, the panel found little to indicate that before March 2005 – BP corporate management had effectively demonstrated its commitment to process safety – either through its communications or through a regular presence at US refineries," Lord Cullen said.

"Communication is no doubt especially demanding in the offshore industry. It is normal that different workforces have to work together and they are doing so in an isolated and demanding environment."

"The commission which investigated the blowout at the Montara well head platform in the Timor Sea in 2009 found that a contributing factor had been a systemic failure of communication between the owners and the rig operators – and between rig and onshore personnel of both companies."

"The rig operators were ultimately responsible for rig safety, but when they came to certain critical procedures it was the owners that were calling the shots.

"The commission observed that communications between owners and operators needed to be more formalised with explicit sign-off on importance decisions affecting safety, well integrity and the environment."

"8 months later we come to Macondo again where the National Commission observed [afterwards] that BP and other operators needed an effective system in place for integrating the various corporate cultures, internal procedures and decision making protocols of the many different contractors involved in a deepwater well."

## Making it happen

"Many companies have safety slogans such as absolute safety and zero accidents. Piper was no exception," he said.

"The Baker Panel said, "BP has the aspirational goal – no accident, no harm to people – but it appears that refinery managers have had no guidance from corporate level refinery management as to how to achieve that goal."

## Safety cases

Lord Cullen spoke at length about safety cases, which is a document, or 'structured argument', showing that a system is as safe.

Safety cases had been required for onshore management of hazards since regulations introduced after the Flixborough disaster of 1974, an explosion at a chemical plant where 28 people were killed and 36 seriously injured.

However in 1987, the UK's Department of Energy advised against introducing a safety case regime offshore. This proved to be "a serious setback for development of the offshore regime," he said.

"Onshore the hazards were serious enough. Offshore they were compounded by the isolation of installations, concentration of the workforce on or near them, unpredictability of the weather, and the fact that in the event of an emergency immediate protection for workforce had to be provided.

Conduct of one set of employees might affect that of others."

After Piper Alpha, Lord Cullen recommended an offshore safety case regime, which would include identification and control of major hazards, safety management systems, temporary protection for crew in the event of an emergency, and full evacuation and rescue.

"I said it was an important component of the regulatory regime. The safety case should include provision of how safety should be achieved, covering both operators and contractors," Lord Cullen said.

"The requirement for safety cases is no doubt demanding, for operators and for those who have to discharge a regulatory function. "It calls for expertise, vigilance and resources. It means a thorough assessment of risk, asking and answering the 'what if' questions."

Lord Cullen quoted the report by Sir Charles Haddon-Cave on the Nimrod aircraft disaster in 2006, causing 14 deaths of RAF personnel. The plane caught fire after a routine mid-air refuelling manoeuvre.

Sir Charles had said that the MOD safety case for Nimrod "was riddled with errors, a story of incompetence and cynicism. It was fatally undermined by a flawed assumption. It was seen as one of proving something which everyone knew as a fact, that Nimrod was safe. This attitude was corrosive," Lord Cullen said.

"A company which is competent to operate an offshore installation should be competent to produce a safety case," Lord Cullen said. "The involvement of the company's own personnel [to put together the safety case] is the best way to obtain the full benefit within the company – and for the purpose of dialogue with regulators," he said. "They should be in a position to contribute to the production, review and revision of safety case."

"On the other hand, consultants have a role in bringing an independent perspective and novel techniques."

"Some people see the preparation of safety case as little more than a paper exercise, he said. "To my mind that would be to misunderstand its value.

"Focussing on safety in a systematic way may reveal gaps in safety protection. It provides a learning opportunity.It can enable senior management to communicate their safety strategy. It can assist the workforce to understand the rationale for systems and practise. It should assist in making improvements."

"This pre-supposes that those who should have the information from a safety case can find it and understand it."

"As I understand it, the typical safety case is extensive – and due to the need for it to be technically robust, much of it is complex. That can be a problem."

"The Maitland panel [which looked into the UK offshore safety regime after Macondo] said safety cases should be living documents central to the way facilities are operated, with contents widely understood."

"A safety case should reflect the organisation's safety culture. If that culture is sound and healthy – it should show."

# BP – what we did after Deepwater Horizon

After the Deepwater Horizon disaster, BP has re-organised its company so that technical specialists report to a senior technical specialist in the company, not the manager of the asset they are working on, *says Bob Fryar, Executive Vice President, Safety and Operational Risk, BP.*

"Following the Deepwater Horizon accident, Mark Bly, who was my predecessor as Head of the Safety and Operational Risk function, led the BP internal investigation of the accident, which was conducted by a team including internal and external expertise," said Bob Fryar, Executive Vice President, Safety and Operational Risk, BP.

He was speaking at the Oil and Gas UK event in Aberdeen "Piper 25" to mark 25 years since the Piper Alpha disaster, on June 18, 2013.

"The Bly Report included 26 recommendations addressing important areas of deepwater drilling, including cementing guidelines, equipment certification, assuring the competence of individuals, and testing of blow-out preventers.

"The recommendations directly addressed the findings of the investigation. For example, they recommend a review of all cementing contractors and new mandatory practices for cementing.

"They recommended revising the relevant BP engineering technical practice to include more details on negative pressure tests, including areas such as success criteria, responsibilities of personnel and configuration of valve positions.


"With regard to blow-out preventers, the recommendations contained new provisions on maintenance, testing and design."

"The implementation of these recommendations is an ongoing major programme of work within BP. Each recommendation has to be applied across multiple locations –and many require new processes or agreements with contractors."

"We have broken down each of the recommendations into defined and measurable deliverable actions."

"The closure of the recommendations is verified by our Safety and Operational Risk audit team, which worked with the Bly report program team to make sure that the deliverables flowing from the recommendations would be verifiable. Closure is also verified by an independent expert who was appointed by BP's Board of Directors in June 2012."

"Fourteen of the 26 recommendations are now complete."

## Moving to functional model

BP is re-organising the company. "We wanted our upstream organization to be structured in a way that would encourage the building of capability and the consistent application of standards across the world, wherever they apply," he said.

"We did this by moving from an asset model to a functional model. It means that, instead of organizing the company in regional teams, we organized our upstream in centralized functions that bring together the people who do the same jobs around the world.

"All the explorers report to the head of exploration. All the people who build new projects report to the head of the Global Projects Organization. The people involved in drilling, completions and interventions all report to the head of the Global Wells Organization."

"A benefit of this is that we can build on our expertise within the teams to deliver excellence in each function and also drive standardization more readily where we wish to do so, with each team using standard procedures. We believe these procedures contribute to consistent implementation and safer execution of work."

## Capability

"We also have looked at capability development within the framework of the new functional organisations."

"Part of this is about technical specialist capability. In our global wells organisation, we have brought deep expertise in house. We now have 12 cementing specialists in the company, as well as the cementing contractors we work with. We also have a team of 30 dedicated solely to BOP reliability.

We have set up the Global Wells Institute, which brings all our Wells training under one roof. The institute emphasises practical, experiential learning and a big part of that learning occurs in the state of the art well simulator area which we have commissioned.

The simulators are used by BP personnel as well as by the contractors who actually drill the wells and who ultimately are responsible for well control. I'm told that the room contains the world's largest collection of drilling simulators in one space.

The simulators replicate three major operations: the offshore environment, land-based drilling, and workovers. This simulator allows for the observation and assessment of individuals as they manage hypothetical well control incident scenarios.

## Supporting drilling operations

We have reviewed our requirements for drilling rigs in service on BP-operated wells. Any proposed departures from those requirements need approval from the appropriate person in our Safety & Operational Risk organisation – what we call S&OR.

We have also set out to use technology to enhance our integrated decision-making on drilling and wells.

In Houston we have created a Monitoring Center that enables offshore crews to consult in real time with onshore experts – viewing the same data and linked by video.

While the responsibility for well monitoring remains with the rig crew, having a monitoring center means more people can be available as resources in a given circumstance. We believe this can lead to more considered decisions by those who have ultimate accountability.

"Accountability for the final decision will always remain with the rig crew – the Monitoring Center is about informed decisions, not collective decisions."

## Spill response

"Since 2010 there has been a strong industry-wide programme of activity in the area of spill response. "

"At the international level, the Global Industry Response Group was set up and has launched several work-streams. One is looking at data from incidents and communicating good practice, so the entire industry can learn together. Another relates to developing a well capping toolbox. Another is focused on response in general – capturing the lessons we learned in areas such as relief well drilling and crisis management.

"BP has built its own capping stack and other containment equipment. It is stored in Houston but can be mobilised worldwide quickly."

## Safety organisation

"Following the Deepwater Horizon accident, we established a Safety and Operational Risk organization (S&OR). Mark Bly initially headed the organization and I have recently taken over from Mark. "The S&OR organization helps us provide an expert view of safety and risk that is independent of the business and its line management."

"The S&OR team is made up of hundreds of professionals whose focus is on safety and operational risk. Many of these professionals are based around the world alongside our operating businesses.

"The existence of S&OR does not absolve the line managers of responsibility for safety and operational risk. The people who do the work must shoulder that accountability. But we – S&OR – are here to help them manage the risks effectively and to conduct risk-based assurance, and to challenge them where necessary."

The organization has very clear roles: setting clear safety and operational risk requirements; maintaining its independent view of risk, in particular by conducting assurance and audits on the work of the line organization; and providing deep technical expertise, including expertise in engineering, security, safety (both personal safety and process safety), health and the environment; and, if necessary, intervening to cause corrective action based on our independent view.

## Leadership

"We are expecting leaders to spend time in the field and engage with staff on the front line. We are providing them with tools and guidance on how to do that effectively, giving them valuable insights into conformance, barriers and risk management in the operations for which they are responsible."

"We have enriched our leadership team with people who bring experience from other industries with strong records in managing high hazard operations. We have some former NASA astronauts – including one who worked on the Challenger Space Shuttle response. We have former nuclear industry professionals and military safety experts."

"On our Board we have Admiral Skip Bowman who is a former leader of the US Nuclear Submarine navy."

"We're now just piloting another program called Leading in the Field which is specifically about how leaders engage staff and inspect operations."

"We have created ways whereby sites can learn from each other, including a program called EXEMPLAR which brings specialist coaches onto sites to help them accelerate in particular areas of OMS (operations management system)."

## Risk assessment

"We have a single BP-wide required framework within which risks are identified, understood, managed, reduced and if possible eliminated," he said.

"Every BP operation performs an annual review of the risks it faces, refreshed as necessary during the year if there are substantial changes in circumstances. The operation confirms that controls are in place and sets priorities for further reduction or elimination. The output of the work can be captured in a matrix where risks are plotted to show both their potential severity and probability."

"It allows us to set accountabilities for specific risk reduction actions, track the completion of those actions, and confirm when risks have been reduced or eliminated entirely."

"One of the tools we find effective is the bowtie tool – many of you will be familiar with this tool. On the left it shows the barriers we create to prevent incidents – and on the right, the things we do to mitigate the impact if an incident occurs."

"It helps users to understand and manage both prevention barriers and mitigation barriers in place for each risk. This contributes to a deep and consistent understanding of the specific risks and can be used to help drive risk down."

## Checks

"When it comes to safety, as long as you are careful to maintain clear accountabilities and a clear sense of ownership by decision-makers, two heads can be better than one and three can be better than two," he said. "We have a 3 tier approach to assurance.

"As the line is accountable for safety, they conduct self-verification to confirm whether they are conforming to OMS and their barriers are robust, and to enable them to take action as needed."

"Second, S&OR provides targeted, risk-based assurance by checking to see how the line is meeting requirements and maintaining and operating barriers. We do this on a structured way where we have a set topic, say control of work, where we see how well the line is demonstrating conformance. From looking across the company through these assessments, we can determine if there are points that need to be addressed across the company."


"Last, we have audit. In addition to the company's group internal audit team that looks beyond safety and operational risks, we have an audit team which sits inside S&OR and conducts a risk-based programme of regular safety and operations audits of the businesses operating on our OMS. We also audit third party rigs and ships to see if they meet our applicable standards."

## Improvement

"In 2008 when we first put the LOPC (losses of primary containment) metric in place we had 658 releases. Last year we had 292. That was a 19% reduction versus 2011."

"Process safety events are categorized by tiers depending on their severity, with tier 1 being the most significant. For BP, we saw a 42% reduction in Tier 1 PSEs in 2012 on 2011."

"Tracking this data is only part of BP's efforts to drive continuous improvement. But I believe the data suggest we are beginning to see the benefits of the various ongoing activities I've described. Even one LOPC can have high consequences, and any accident is one too many - and of course there is always more to be done."

Admiral Skip Bowman says "when you think things are going the best, you should be losing the most sleep". And of course that is a clear message about never being complacent.

"While we believe these things are making a difference, we also know there is always more to do at BP and in the industry, and we must remain vigilant.The Piper Alpha and Deepwater Horizon accidents remind us all of the consequences when things go wrong. They also provide lessons from which we all can learn and improve."

# Offshore worker's perspective on safety

Trade Unionist Jake Molloy provided the offshore worker's perspective on safety at the Piper 25 conference.

"I was offshore on the night of 6th July 1988 [the night of the Piper Alpha disaster] along with 10,000 offshore workers," said Jake Molloy of the UK offshore worker's union RMT, speaking at the Oil and Gas UK conference to mark 25 years since the Piper Alpha Disaster.

Mr Molloy is regional organiser for the UK's National Union of Rail, Maritime and Transport Workers (RMT) with responsibility for offshore operations and a former offshore safety representative.

"I climbed into my bunk that night knowing it was a dangerous industry but I don't think many of us understood how dangerous it was."

"Cutting edge technology and communications extended to a telex and fax machine, for the most part we didn't have television offshore."

"The first meaningful picture of what had occurred came when the newspapers arrived offshore.

As the day slipped by we were reminded of colleagues lost and of the terrible events and images witnessed by those who made it off the platform alive. The headlines kept coming, as did the funerals."

"Along with the horrors came the PR people and political apologists," he said. "They tried to put together a story which was fit for public consumption arguing that the Piper catastrophe had in fact been unforeseen and unforeseeable. But the workforce knew differently."

"The alternative workforce opinion emerged, slowly and a bit fragmented at first. But intense media interest ensured that every near miss was conveyed to an increasingly outraged public."

"What was exposed was a rotten safety regime being overseen by a government department whose core function was to ensure uninterrupted production."

"A little more than 6 months after Piper, thousands of offshore workers took their campaign for safety improvements onto the streets, marches took place in Newcastle, Aberdeen, and Glasgow.

Industrial action followed. Commentary by the national opinion formers like Panorama and Newsnight, suggested that the workers won the media war," he said.

"At the beating hearts of these disputes were thousands of principled offshore workers who put their livelihoods on the line."

## Regulations

"Later, Lord Cullen worked his magic and produced two tablets of commandments which we know as the Piper Alpha enquiry. These volumes were the prelude to new regulations," he said.

"However it has to be said that the regulations on their own would never have delivered.

Only the presence of a regulatory authority in the form of the HSE, coupled with the ever present challenge of organisations like my own, brought about significant improvements in safety."

The problem is not solved. "The fact is, we've come close to disaster a number of times during the last 25 years, closer than some of you can probably imagine," he said. "Too often, luck, as opposed to good management has been the only thing saving us."

## Key programs

There is a lot of confidence among offshore workers in the UK Health and Safety Executive's "key programs" of the past decade which aim to address specific areas of offshore safety – hydrocarbon leaks, drilling and deck operations, maintenance backlogs, and ageing assets, he said.

Key program 1 (or KP1) started in 2001 looking at hydrocarbon leaks offshore. "There were simply too many hydrocarbon leaks occurring and HSE wanted us to address this," he said. "Workers had been shouting about gas leaks for some considerable time."

KP2, starting in 2003 looked at improving deck and lifting operations, and drilling operations, following 8 fatalities in drilling which had happened in 3 years. "The use of a lagging indicator and specifically one which counts bodies was completely unpalatable," he said. However the program stopped the fatalities. "There hasn't been a death in drilling operations the UK sector since 2004," he said.

KP3 started in 2004, was to make sure safety critical items were being adequately maintained, following complaints from workers about a backlog in maintenance tasks. It involved 100 targeted inspections over 3 years.

It led to a report on offshore asset integrity, published in 2007, which "was extremely critical of industry and demanded significant improvements," he said.

"The report was so critical that in 2008 the UK government called on HSE to conduct a review of progress made about the 2007 findings. That review found there was raised awareness of the need for improved process safety management, but still room for improvement, and most important to us, improvement in the area of workforce involvement."

The KP4 program, looking at ageing equipment, started in 2000 and is due to report in mid 2013. "The safety of 28,000 workers is depending on structures," he said.

"The regulator is driving the agenda and highlighting the concerns they have which industry is expected to address."

## Industrial relations

"As employers you cannot continue to ring fence HSE matters and industrial relations issues as two separate and distinct matters, it cannot be done," he said. "They are inextricably linked."

"Existing industrial relations allow employees to apply discriminatory practises – in every aspect of employment. Pay, leave entitlement, redundancy, promotion, disciplinary procedures. It creates power imbalance, which acts as a significant barrier to greater involvement of workers."

"If you are worried about your career to be affected or ended by challenging [your employer on a safety matter] are you really likely to challenge?"

## More to be done

In future, "more needs to be done around leaks and integrity," he said.

"The hardware is delivering but it has to be maintained."

"The regulations are by and large fit for purpose. But there can be no attempt to water them down or deregulate in any way."

Mr Molloy said he thought that the fact that the UK's Health and Safety Executive (safety regulator) has a division exclusively devoted to offshore safety "has served us well," but there are concerns about talk about restructuring the HSE.

# What is a safety case regime?

Professor Andrew Hopkins, professor of sociology with Australian National University, explained what a safety case regime is with offshore – how to make it work – and how safety cases can be improved.

Safety cases are a critical tool in managing and improving safety, says Professor Andrew Hopkins, professor of sociology with Australian National University and a consultant to US Chemical Safety Board on its investigation into both the Texas City disaster and Macondo.

The trouble is that they are not well understood, he said.

Professor Hopkins was speaking at the Aberdeen event in June "Piper 25" to mark the 25th anniversary of the Piper Alpha disaster.

After Macondo, the US presidential commission recommended that a safety case regime be introduced in US offshore waters, modelled on the UK regime, he said.

"Very little headway has been made," he said. "There is a general inertia, a lot of vested interests in the status quo."

"There is also a widespread misunderstanding of what safety case regime involves, a widespread feeling that it amounts to deregulation. If you think that you will be wary of this idea."

The important features of a safety case regime, are that it must have (1) a risk/ hazard framework, (2) there must be workforce involvement, (3) you must be required to make the case to a regulator, (4) the regulator must be engaged, and (5) there must be a requirement of duty of care, he said.

There is little point in introducing a safety case regime unless all 5 components are in place, he said. "The US has (1) and (2), but items (3), (4) and (5) are lacking. People say which should you do first, my argument is this system won't work unless you see it as a package."

## (1) Risk hazard framework

A safety case regime must have a risk / hazard framework rather than a prescriptive framework. This means it starts by people identifying what their risks are, rather than being told what their risks are by a regulator ('prescriptive').

"That is the least controversial element- because it already exists," he said. Companies with process safety management systems probably already have a process hazard analysis.

However in the US offshore, before Macondo, that was not the case. Regulations were purely prescriptive, he said. "Since Macondo things have changed."

Post Macondo the US regulators introduced a requirement for a safety and environmental management system offshore, with a hazard analysis at the heart of it.

## (2) Workforce involvement

Workforce involvement is "widely recognized as a very important element of a mature safety case regime," he said. "The input of employees is really vital."

## (3) Make case to regulator

A safety case regime must require operators to take their 'case', or argument to a regulator, he said. "The regulator has to sit in judgment and say, you've made the case or no you haven't made the case."

"This is where the US system falls short of a mature safety case regime," he said. "They are required to go through the hazard analysis [but] they do not have to make the case to the regulator."

US regulators are concerned that if they make a judgment, that means accepting some kind of liability if something goes wrong, he said. Yet somehow this problem does not seem to apply in the UK and Australia.

Experience also shows that "when something goes wrong in the UK, it is not because the safety case was deficient, but because companies were not in compliance with their safety case.

"So that's a really significant difference between systems in the US."

## (4) Engaged regulator

"You must have regulator which is competent, engaged, and independent," he said. "Unless you have a regulator that can be characterized by these adjectives it is not going to work."

It is easy for regulators to think that all they need to do is specify requirements for the operator, and ask the operator to carry out a hazard analysis, and the operator is under obligation to do everything that needs to be done. But this is a serious error. "A safety case regime introduced in that way will almost inevitably fail."

This point was tragically illustrated by the report on the crash of a Nimrod, a UK Air Force aircraft which crashed in Afghanistan in 2006 killing 14 personnel. The report showed that the safety case for the aircraft was "totally inadequate," he said.

"It was approved without scrutiny at what was called a 'customer acceptance conference'. It wasn't scrutinized by the regulator."

"The safety case is not worth the paper it is written on unless it is presented to regulator for scrutiny."

People have used the Nimrod report as an example of why safety case regulations will fail. But it is actually an example of how safety case regulations will fail without an engaged regulator, Professor Hopkins said.

The regulator needs to test whether the controls are in place and whether people understand the significance of those controls. "This is not a prescriptive exercise, it's a much more thoughtful process," he said.

"This audit function of the regulator is not accepted yet in the US."

The director of the US offshore regulator has made disparaging comments about regulatory audits, saying that he did not plan to do many audits, because he did not want industry relying on government to maintain safety, rather than doing it themselves.

"By pulling back in that way he's removing that very vital function," Professor Hopkins said. "His vision of the regulator is not an engaged regulator."

It is also important that regulators are independent of any government official, particularly the government department which seeks to draw revenue from the oil and gas industry. “We find the same issue comes up over and over again around the world,” he said. “Regulatory and revenue functions are combined.”

”There has been some separation of that in US since Macondo but [revenue and safety regulation] remains in the same department,” he said. “So the legitimate question remains of independence.”

## (5) Duty of care

For a safety case regime to work, there must be a general requirement for duty of care, an umbrella requirement and operators reduce all risk as low as reasonably practicable (ALARP).

“People often forget how significant this is,” he said. “It provides leverage for regulators to be able to nudge standards higher. They don't have to wait for [new] regulation. They can just question whether a different way of doing things is ALARP.”

“I understand this is why fire detection standards are higher on rigs in UK than in US. Because regulators have been able to nudge people in that direction.”

This requirement also makes prosecutions easier for the regulator to carry out. In the US criminal prosecutions are conducted by the Department of Justice which has little understanding of the issues

“One of the really tragic outcomes of the Macondo accident is that the US Department of Justice is prosecuting two of the well site leaders on the rig, who are basically foremen, low level managers in the role they performed. In the US we are seeing a “clumsy and misdirected prosecution,” Professor Hopkins said.

“These are the only 2 individuals the Department of Justice is going to prosecute for criminal negligence.”

“That seems to me to show a complete misunderstanding of what is going on and what the causes are.”

This duty of care requirement also forces operators to go beyond compliance, he said. They have to continually question, have we really reduced risk ALARP.

In the US, “there's a general duty to comply with regulations, then the question arises of what regulation must I comply with, so there are endless disputes about what precisely the regulations require.”


“If the overarching duty is to reduce risk ALARP then it becomes irrelevant precisely what the details of the descriptive rules are.”

“I suspect this is probably one of the biggest obstacles to producing an effective safety case regime in the US.”

## US

Another difficulty with safety regulation in the US is that new regulations of any sort have to be approved by the Office of Budget, which demands that the financial benefits outweigh the cost, he said.

This is hard for offshore safety rules. “It is very hard to do cost benefit analyses to justify regulation for rare events.”

A further problem in the US is that the political system makes it “very difficult to get anything through Congress,” he said. Compare this with the UK system where “if a government makes up its mind to do something and it has a majority, it can do so.”

## Organisational design

One lesson from Macondo is that organisational design is important. “The engineers working on the Macondo rig were answerable to the well site leader of Macondo and not answerable anywhere else,” he said. “Their activities were not scrutinized anywhere else in the organisation.”

“Engineers had no independence from the commercial pressures imposed on them by line managers.”

“BP was a highly centralized organisation until 2000, then it decentralized in a radical way.”

There are arguments both for centralized and decentralized organisations in terms of safety, but safety regulators “should be thinking about these things.”

“If regulators come across a company which is highly decentralized, I would argue this is not an organizational structure which reduces risks as low as reasonably practicable,” he said. “Regulators should be challenging operators to justify their organizational design.”

“Ultimately as the maturity experience of the regulator builds up, they might end up with guidelines of the best organizational design.”

## Incentive arrangements

Incentive structures can have a big impact on safety. At both Texas City and Macondo, “the incentive structures drove ferocious attempts to reduce costs and ferocious attempts to reduce injury rates, but did nothing to encourage managers to focus on process safety, nothing to focus on well safety” he said.

Incentive structures need to include the right indicators, he said. “Many companies are now trying to do this, struggling with the issue of what kind of indicators indicate how well [we are doing with] process safety.”

"The one which many companies settle on is loss of containment. That's a very good start."

"Regulators should challenge companies around those issues, asking what indicators have been included in bonus arrangements."

## Bad news

"Organizations serious about safety need to find ways to encourage reporting of bad news," he said. "There is always news on safety, some of it will be bad news. If there's only good news you worry."

Professor Hopkins told the story of a senior manager who received a report from a subordinate which was full of good news, so she got on the phone and said 'please rewrite your report to include bad news.'".

"This same manager had a system of financial rewards for providing important pieces of bad news - and moving it up the line."

In another example, a crewmember noticed that the limits of a compressor had been changed without going through a management of change process. "He wrote an e-mail to the boss who passed it up the line and passed it to the person I was speaking to. She was so impressed she made a 1000 dollar reward."

"My challenge to regulators is that they should be challenging operators on how they are encouraging reporting of bad news."

## Ongoing learning

To improve safety, you need to learn as much as you can from any accidents or near accidents, and routinely this doesn't happen, he said.

For example, the Texas City disaster was caused by the overfilling of a distillation column, something which had happened before, he said.

Transocean had an event in the North Sea four months before the Macondo disaster, where they finished drilling a well, cemented the bottom of the well, carried out a negative pressure test then stopped monitoring the well, just as they did with Macondo. The well blew out, and they didn't know because they had stopped monitoring the well, but "fortunately the blow out preventer worked."

"Transocean in the Gulf of Mexico had not learned from the event, wasn't aware of that event and made the same basic mistake."

"Safety case regulators should ask companies how they are learning from such events in their organisation."

"Many organisations claim they are learning organisations, the challenge is to demonstrate that you are," he said. "It is not enough to circulate bulletins of lessons learned."

In Texas City Refinery, they had "failed to learn the lessons from Exxon Longford accident in Melbourne several years earlier," he said, although there was literature about the Longford accident circulating around the Texas City refinery.

BP hadn't implemented lessons from an incident it had in Grangemouth (UK) five years earlier.

"The safety case regulator could ask companies to demonstrate how they are incorporating lessons from previous events."

One company is doing this by writing a list of 12 "process safety basic requirements", each with learning from a well-known accident. For example, the requirement for permit to work systems is linked to Piper Alpha, the requirement for alarms management is linked to the Melbourne Longford accident, and requirement for siting of portable buildings is linked to Texas City.

"They represent the learning from these accidents which occurred in industry in the past."

"The final step is to get people to tell the stories," he said.

You want to get to the point where "anyone in the organisation can tell you why the Permit to Work system is important, and tell you about Piper Alpha."

## Bladder effect

Speaking to Digital Energy Journal after the event, Professor Hopkins gave his insights as a sociologist into one of the causes of the Macondo disaster, the misreading of the negative pressure test, which was testing the integrity of the cement seal around the well.

As reported in the Presidential Commission report, five staff members onboard the rig (including 2 working for BP) collectively decided that they could ignore the pressure test reading (which was actually indicating that the cement was not making a seal), after one of the Transocean staff members gave a technical explanation for what was happening (the notorious 'bladder effect').

Professor Hopkins' suggest that the drillers could have such a strong culture that they managed to effectively bully the BP staff into accepting their point of view. "Drillers say, 'that's what's going on'. The culture of the drillers is so strong they sway the doubt."

Other psychological factors are that the men had all already persuaded themselves that the well was sealed, so had a bias towards rejecting the test results. In other words, they were already looking for reasons to reject the test results, not looking at the result with an open mind.

A better decision making process would have been one which acknowledged that the BP and Transocean staff had different responsibilities, because their employees have different responsibilities, Professor Hopkins said.

The BP staff could have acknowledged this and decided that they needed to make their decision in isolation, away from the Transocean staff – and if they had doubts, they could have contacted their colleagues at BP's office in Houston, not Transocean staff.

"Someone has to make the decision - the person should 'withdraw' from the group," he said. "You must pinpoint who is the decision maker."

We all have experience of letting social factors override procedures – for example if you hold a security coded door open to let the person behind you through, because it seems rude to close the door in their face, to make sure they have the code themselves.

The only way around it is to have procedures which you can check are being followed, he said, and make sure you check they are being followed, he said.

Andrew Hopkins has written a book on the Macondo "Disastrous Decisions: The Human and Organisational Causes of the Gulf of Mexico Blowout", available on Amazon.com for $61.20

# Digital technology to improve safety

The Oil and Gas UK Piper 25 event in Aberdeen in June had some interesting technology to improve safety in the exhibition.

### Return to Scene - www.r2s.co.uk

Return to Scene of Aberdeen records panoramic images of an offshore installation, so it can be viewed on a computer screen like with Google Street View.

The panoramic images can be used for training, to familiarise staff with plant which they have not yet worked on.

Using the software, anybody can 'walk' around the offshore installation, without any special training or software. It could be useful both offshore (for pre-trip training) and onshore (before work is about to be done in an area the staff do not know very well).

It can also be used to plan modifications. The company has software which can combine a computer generated piping diagram of proposed new plant from a Plant Design Management System (PDMS) with a digital photograph of existing plant, so everything is at the same scale. This means you can see how well the new plant will fit.

You can add tags to the photographs, with information about the various plant items on display, or link it to other audio or video files. For example, if you spot a possible electrical risk you can add a tag.

The images are taken by photographers who are specially trained in technical and investigative photography. The photographs are taken at typical eye / shoulder level, and 600mm higher.

### BusinessPort

BusinessPort of Aberdeen, a company which develops software to help businesses follow processes and procedures, reports that the company has doubled in size over the past 12 months, now has 45 staff and has opened an additional office in Houston.

The company has recently formed a partnership with Robbins Gioia, a company based in Virginia, USA, which employs 300 consultants to helps organisations optimise business processes. Robbins Gioia will sell its own consultancy services together with BusinessPort software as a package.

Companies using the software include Total E&P, Subsea 7, Petrofac, Nabors Drilling and GDF Suez, E&P, Transocean.

The company is also building additional modules to its core "AgilityBMS" software where clients have the option to select which modules they need in order to to help manage competence development and audits within their business.

"People are doing the tasks consistently and transparently and everyone gets the right information when they need it," says Alastair Shakeshaft, Sales and Marketing director of BusinessPort.

### Infotechnics – making it easier to manage logbooks

Infotechnics of Aberdeen reports that its business has doubled in size every year for the past 3 years, providing electronic log book tools for control room operators.

Companies using it include BP, Centrica, Scottish Power, and Conoco Phillips, MOL (Hungary) and BP Wind in North America. There has been a growth in business in the US and Australia over the past few years.

The software tools can be used by control operators to enter important details about their shift which people on the next shift might need. It can also be used for handing over important information at the end of a 'trip' (a 2 week period working offshore).

The software does a lot of tasks automatically – like add in the date and time of the entry, and make sure the correct fields are filled in, and allow people to categorise entry, and adding a digital signature of who entered it.

When the time comes for a shift handover, the log book entries can be presented as a 'shift handover report', with relevant entries presented by category, rather than in chronological order, or people might want to gather a report from a number of different logbooks.

# Oil and Gas IM – a long way from maturity

Whilst oil and gas information technology is getting quite mature, information management is at very early stages of development, reckons Neale Stidolph of AMOR Group. Do you know anyone who likes their IM system?

*Neale Stidolph, Business Manager – Energy and Head of Information Management, Amor Group.*

Oil and gas companies say that their business is 'all about people', but since people often move between companies, it is perhaps better to say that "the company is built on the information they have and can access," said Neale Stidolph, Head of Information Management, Amor Group.

He was speaking at the Digital Energy Journal Aberdeen conference in May 2013, "improving IT and IM infrastructure decisions".

Information management, the discipline of keeping this information well managed, is still in an early stage of development, Mr Stidolph believes,when you compare it to the IT business, where computer hardware is becoming a commodity, and there are no great advancements happening in (for example) IT helpdesks.

Most companies have a standardised way of doing IT, but IM is often set up on a project by project basis, for example when one project team develops its own way of exchanging data with vendors.

Companies are not even sure where IM should sit in the organization – some companies put it under Health, Safety, Environment and Quality (HSEQ), others put it in the business improvement or IT department, he said.

IM is very different to IT because it calls for an understanding of what the company is trying to do with the information, what it needs and whether certain information can be trusted, he said.

There is a growing demand for IM managers, and salaries are increasing too. "The pool of these people is relatively small there is not a lot of new ones coming in," he said. "The demands for the projects are huge."

*Discussion panel at our Aberdeen May 29 conference. From left to right: Sean McCue - Solutions Architect, Dell SecureWorks; Peter Black - Managing director, EnergySys; Neale Stidolph - Business Manager - Energy, Amor Group; George Ilko - Solutions Architect, ISN Solutions*

One of the biggest drivers for information management projects is the growing threat of criminal action.

"I talk to operation directors, project managers and managing directors because they are worried about what they have to sign off, and whether they can trust it or not. If things go bad everything points to them. So some of these boring sounding IM projects, which have not moved in years, are moving really fast."

## Systems

One thing we can nearly all agree on is that our information management systems aren't good enough.

"People are waking up to the fact that we can be lot more effective and efficient," he says.

"Wherever I go, people say 'the [IM] system we have is rubbish'. [but] it can't be the case with everybody, because usually people are about to move on to system of someone else, which someone else just said is rubbish."

It can't only be the systems. Probably it's the information in them, and the way people are working on them that is at fault," he said.

Information technology people like to buy something, turn it on and let people use it, and then they wonder why it doesn't work as planned. "Changing people's behavior is very difficult, especially when you are talking about engineers, they like a certain way of doing things," he said.

Many IM systems are too complicated. "Don't show people hundreds of fields when they only want to see half a dozen," he said. "What we [often] find is you need some sort of translation in there to give people information the way they want to handle it.

Many people are installing 'enterprise search', where you have a tool which can search all company documents like Google does. Enterprise search is "technically easy to do", he said. "The problems tend to arise when you are not sure who gets to see what."

Company information might include disciplinary records, salary information and health information, which all needs to be kept confidential.

## A good IM system

A good IM system will enable people to find the information they need and do what they need to do with it. There are systems for how information is managed and labelled, and people comply with the system.

The system can manage the flow of different types of information around the company - engineering data, geoscience data, legal contracts and corporate information.

It can also handle the way information is used through the lifetime of an asset, from design, commissioning, operations, acquisitions, divestments, modification and decommissioning.

The information management system needs to manage the version control, so you don't get lots of different versions of the same document being e-mailed around, and people aren't keeping out of date versions of a document because they don't want to walk to the control room to get the most recent one.

The IM system also needs to work with data, rather than documents. "Contractors tend to just give you nice PDF drawings and say there we go," he said. "It be nice if they gave Auto CAD drawings that you can modify, or even better, get the data itself."

## Business reasons for IM

One company needed to find a seismic survey from many years ago. It was eventually found in a cardboard box under a desk. It would have cost £10m to reproduce the survey.

One company said that it could not find the certificate for a piece of subsea equipment and risked having to raise a piece of subsea equipment off the seabed and re-certify it if it could not find it.

Another company received a letter from DECC saying we don't believe we have given you permission to abandon the well, can you provide the note we sent you giving you authorization. The company said it had lost the note, and asked DECC to resend it, and DECC said, no we don't keep them, you need to produce it because it is your liability.

Another company had just done an acquisition and ended up with 2000 boxes of documents with no records of what was in them. They have to find someone to go through every box and work out what is in it, if it needs to be kept, and which version of the documents it is, an enormous amount of work.

Sorting through a million documents manually could take one person a decade; but it is hard to sort documents automatically, with many of them very old and hand drawn. Doing it with an offshore agency can also be fraught with problems, he said.

One operator in Aberdeen currently has 210 terabytes of data in shared folders, Mr Stidolph said. "The company says, it's all there, its secure, we know how to handle it, but we don't actually know what it is, who owns it or what we do with it," Mr Stidolph said.

Engineers can spend 25 per cent of their time searching for information. "If you have 80 engineers and 25 per cent of them are idle, that's costing them three, four, five million pounds a year."

Companies have to manage data when assets are bought and sold. "I've got a client with a million documents from an acquisition," he said. "Some of them will be canteen menus from five years ago, some of them will be vital P&IDs or cause and effect diagrams."

"If you want to be able decommission you need to be in control of information," he said. "If you don't know how things are built, they can't be easily taken apart, not without going out and re drawing and building everything from scratch again, which you can do but will cost lots of millions."

Another problem is disposal of information. "Getting rid of electronic information is very difficult it has incredible persistence," he said. "How can you find every copy of an e-mail in your archives and kill it for sure? If you get involved in an incident you are obliged to legally disclose."

## Stories

In the Flixborough disaster (UK, June 1974) which killed 28 people and injured 36, a temporary bypass pipe had ruptured. The bypass pipe had not been pressure tested and had been built by staff who were not experienced in high pressure pipework. There were no plans or calculations.

The oil and gas industry also has a lot of equipment built in the 70s still in operation, he said.

There was another fatal incident in 1998, where company had a system with a 3 stage separation, with the first separator built to hold 95 bar, the second to hold 35 bar and the last was not a pressure vessel at all and had no pressure release valve, but this was not widely known because there had been no drawings. If the valves were configured to send the high pressure stream through the third separator there would be an explosion.

In another example, a pipeline had a let down valve (to release pressure), a safety relief valve and a check (one-way) valve to stop pressure going back up the system. Unfortunately the check valve was hidden behind the installation and people forgot it was there. At some point in the future, there was a blockage downstream, which meant that pressure backed up the pipeline and hit the check valve, and there was no pressure release. "Bits fly everywhere and it's not pretty," he said.

A further example was a system which had a unit with a 5.5 bar supply of nitrogen. It needs a downstream pressure of above 2 bar to make sure the gas flows through the system. Someone added an additional gas processing unit which meant that the outlet pressure would fall below 2 bar. Subsequently the downstream gas was sucked upwards, which meant that the unit contained the wrong gas and there was an explosion.

*Our conference in Aberdeen on May 29 "improving IT and IM infrastructure decisions*

Moving outside the oil and gas industry, the Mars Climate Orbiter disintegrated due to poor information management in 1999. As it approached Mars, the ground based computer software was producing output in pound seconds, instead of Newton seconds. "If NASA can make this mistake, then so can the oil and gas industry," he said.

## AMOR Group

To help train a new league of information managers, Amor Group formed a partnership with Robert Gordon University of Aberdeen to build a foundation course in oil and gas document control.

In the first course a year ago there were 30 people – subsequent courses had 60 then 80 people, and one starting in May 2013 had 114. "This is the fastest growing, most successful launch of a new course in RGU business school history".

It is a distance learning course, with 40 hours of training, costing £400. It has students in Australia, Norway, Nigeria and the US.

There are also company IT managers going on it, to learn about the different documents and what they mean, for example piping and instrumentation diagrams (P&ID).

Next year it will start a project document control course, covering subsurface documents, topside models and green field data, 7 different categories of information altogether.

AMOR Group has created a forum for Aberdeen operators to try to develop standard ways to do information management, which has been running for 3 years. Operators are able to compare their progress with others.

AMOR can provide members of staff on loan for a period of time, or it can completely take over your company's information management – it has done this for Total in Aberdeen, with 30 IM staff on site, and it has taken over IM for Britannia Operator. It also has teams embedded in Centrica and Maersk Oil.

Dr Laura Muir from Robert Gordon University joined Amor group in August on secondment for a year to help with the development of the new foundation course.

AMOR Group does information management in energy, transport and public services. It has 600 staff, and revenues of £60m, expected to grow to £250m in the next 3 years. It has offices in Dubai and Houston.

You can see a video of Mr Stidolph's talk and download slides at
**http://www.digitalenergyjournal.com/video/705.aspx**

# Semantic data in oil and gas

Semantic data standards already exist in the oil and gas industry which can enable you to integrate different types of data together or answer difficult questions. David Price of TopQuadrant explains how. *By David Price, Director of Oil & Gas and Engineering Solutions, TopQuadrant*

What if the data you use every day was freed from the shackles of a Microsoft Excel spreadsheet or an Oracle database?

What if it could be published, reached and linked as simply as browsing a website?

What if the apps on your computer, tablet or smartphone had more understanding of what your data actually means?

What if your data could grow and change and be more dynamic?

What if your data is rough and not clean but you'd like to throw it together and see how it looks anyway?

What if you have data needs like these:

Finding existing data, for example "where is the analysis of wellbore 7/4-3 performed last week"

Relating existing data, for example if you have data relating to the Morvin field and Åsgard B platform that exists in different IT systems (and Åsgard B is called "ASB" in one and "Åsg-B" in the other)

Exchanging data, for example "I need to extract the 2009 Kristin volumes, pressures and temperatures and convert to spreadsheet to load into my reporting application"

Integrating data, for example "I'd like to know last month's production volume total for all fields in which GDF Suez E&P Norge AS is a license"

Analyzing data, for example "Over the past 12 weeks, what's the trend in barrels of oil per day for Kristin field?"

All this is possible today, right now.

## History of data

We'll start with a little history lesson about data.

Initially, computer data was driven by the application that used it, almost always in a form only understood by that specific application.

This was the case for many decades and is still true even today.

However, in the 1980s, databases like Oracle allowed for the separation of data and applications. They supported several users and made it much easier to find needles in the haystack within your data.

To make that possible, everything must be forced into the form of tables and links between tables, which are based on the values of key columns in both tables. This kind of database sits on larger servers in every large organization today.

Scaling down to your personal computer, spreadsheets like Excel are tables in the same way, except with less capability for linking and managing the data.

Spreadsheets add capability for analyzing and visualizing data that help organizations operate. The products that provide these tables-based capabilities are hugely successful.

However, your data is still locked away in databases or spreadsheets that are not easily sharable. And forget about extracting from one and getting it into another without help from IT.

## World Wide Web

In the early 1990s, people started looking at ways to address some of those issues.

Tim Berners-Lee was working at a European physics institute when he invented the World Wide Web. He invented and implemented his ideas and moved on to make standards of his inventions at the W3C to be shared worldwide.

One of those standards, HTML, is used in every web page you've ever visited. HTML supports links between pages on different computers. The Web runs on a network of computers spread around the planet and uses standard means of identify and communicating across computers.

Your internet Service Provider allows your computer to connect into the internet while your web browser understands the communication and HTML standards while you seamlessly explore the Web by following links between pages.

Throw in a search engine to help you find where to start that exploration, and the web is the basis for an astounding capability that has transformed the world.

While the web has succeeded like few inventions in human history, there is one critical limitation. It operates on the assumption that humans are the audience for the data it presents.

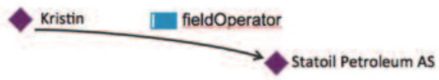
HTML is fine for presenting pages, images, tables and graphs to humans, but cannot define the idea of Person, Computer, Dog, Horse or Oil Rig.

## Semantic web

Over time, a vision removing that assumption has been realized.

Tim Berners-Lee and others realized in the late 1990s and early 2000s it was time to allow computers to communicate in the same way that the web has allowed computers and humans to communicate. This vision is called the Semantic Web.

The core of "semantically-aware" web data are simple statements like "Kristin field is operated by Statoil Petroleum AS".




This thing-property-thing statement is called a 'triple'.

Instead of thing-property-thing, you can think of node-edge-node and you'll realize that we are talking about graphs (in the network sense). You can think of logical subject-predicate-object statements, too.

Think of a triple as the equivalent of a single cell in a spreadsheet where the column name is the property, the row identifier is the first thing and the value in the cell is the second thing.

Which ever way you consider it, a triple is very small, in fact it's very hard to imagine how anything smaller could be the useful "atomic statement" we'd want to manage.

## Triplestores

Luckily, there's a long history of graph theory and database practice that can and has been applied to managing this kind of structure in what are called 'triplestores'.

The standard underlying triples is called the resource description framework (RDF).

RDF specifies that the things and properties all have web-wide unique identifiers so they can be linked from anywhere, accessed using normal web and internet technology.

It gets into details about various ways to encode RDF graphs of triples in files.

People often use the term RDF database rather than triplestore.

It should be noted that triplestores now scale into managing billions of triples and commercial ones have the same sort of database management capabilities as something like you'd expect from Oracle - in fact Oracle sell a triplestore.

On top of RDF, a standard query language has been created called SPARQL - equivalent to SQL for relational database folks.

However, unlike SQL, SPARQL queries can span databases spread around the planet, within your organization and can include files sitting on your own personal computer.

Imagine querying over a Norwegian government database, some Statoil Linked Data, Wikipedia, your corporate oil platform management system and a set of spreadsheets sitting on your hard drive all at the same time - that's what RDF and SPARQL allow.

This let's you can handle problems like "relating Morvin field and Åsgard B platform that exists in different IT systems (and Åsgard B is called "ASB" in one and "Åsg-B" in the other)".

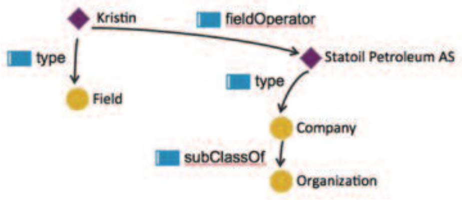
## Adding semantics

At this point, we've done little to add meaning to our data. With RDF we get graphs of triples, a little more meaning than an Oracle tables.

The semantics we're in search of are provided by two languages are, in fact, are just more RDF triples called RDF Schema and OWL.

RDF Schema (RDFS) is a simple language for adding basic meaning to data. Let's examine our "Kristin field is operated by Statoil Petroleum AS" statement.

Among other things, RDFS allows you to say that "Kristin" is a "Field" and "Statoil Petroleum AS" is a "Company", which is a kind of "Organization". It also lets you say that "field is operated by" is a relationship between a "Field" and a "Company".




Remember that "Kristin" is actually identified by a Web-unique identifier just like a Web page.

So in reality the identifier used is something more like this:

http://factpages.npd.no/factpages/field/18547 29

And the concept of Organization might be identified using a W3C standard for organizations as:

http://xmlns.com/foaf/0.1/Organization

The "type" property actually comes from RDF itself and the "subClassOf" property comes from RDF Schema, but as you can see it really is all just more data.

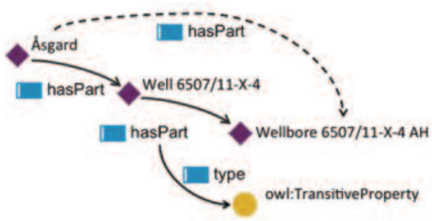
Since "Organization", "Company", "Field" and "field is operated by" are all specified as RDF data underneath, these can change easily at any time.

Since it's all data, merging datasets based on very different sets of concepts also works perfectly well. You can quite easily query over them using SPARQL if you happen to know, for example, that the "SerialNumber" property in on set of data has the same values as the "SupplierIdentifier" property in another set of data.

The Web Ontology Language (OWL) is a more powerful, logic-based language that is an extension to RDF Schema.

As an example, OWL includes the ability to say that a property is transitive.

The following figure shows how we can know that "Wellbore 6507/11-X-4 AH" is part of "Åsgard" without saying so explicitly




OWL also allows one to define classes (i.e. sets) where the members are required to have specific properties, or where anything with specific properties are implicitly members of the set.

There are software tools that make explicit all the implicit data through a mechanism called "inference," which is nothing more than making more data based the data you specify plus logic statements you've made about your data.

The details of OWL are too much for a short journal article. Let's leave it to say that it is a powerful language, but that you can choose to use some or all of it depending on the complexity of your data.

## Revelations

So, what have we revealed about how to free data and give it meaning?

First, that there are very simple, yet powerful, standards that can be applied to the problem. Being standards-based means no vendor lock-in.

Second, those standards ride on top of the Internet and web and data based on that infrastructure is easily made available nearly everywhere on the planet and on many kinds of devices. Globally unique names can be given for everything, so at least we always know what we're talking about – even if we might disagree on what it "is".

Finally, multiple open source and commercial software tools and database are available from community efforts, and large and small software houses.

These tools scale from desktop files to billions of data elements and the range covers everything in between.

This lets you answer questions like "I'd like to know last month's production volume total for all fields in which GDF Suez E&P Norge AS is a licensee".

Of course, other technologies can enable such questions to be answered. However, none are as flexible and extensible or have their basis entirely in Web technology that already exists on every server, computer and smart phone on the planet.

My suggestion is to find out for yourself. If you get stuck or confused, take some training, read some blogs or watch some videos on the topic.

As always, you're welcome ask me or any of my colleagues at TopQuadrant to explain what's possible too.

# CGI – better ways to work with production data

## Companies are looking to do more and more with their production data – which means that the systems to gather, manage and share it need to be increasingly sophisticated, says Susan Macleod of CGI.

Companies already have a lot of tools they use to manage production from day to day, typically spreadsheets and logbooks, says Susan Macleod, Manufacturing and Industry Client Director with CGI.

But they are looking to do more and more with it, which means that systems need to be increasingly sophisticated.

She was speaking at the April 2013 Digital Energy Journal Stavanger conference "Doing more with production data".

"Oil and gas companies are under pressure to make faster and faster decisions", she said. 20 years ago we made a decision every year, next it's every quarter, then it's every month, now it's every day. So everything is about the real time, doing it as fast as possible, and the problem becomes just how much data we can intelligently consume.

Storage is only one of many challenges, but the real challenge is making sure you get the most value out of the data you are collecting. "Is it shared with all of the right people, and is it easy to find when needed?" she said rhetorically.

Companies are collecting larger and larger volumes of real time data and in trying to make sense of it all, they are regularly developing and running new reports. It is collected in a variety of different tools and stored in different formats on different systems and networks, including paper and microfiche. Some of it you might not need to find again for years, but when you do it needs to be quickly available to the person who needs it.

"The volumes are getting so big that we just talk about data now, we can no longer call what we gather information," she said Data in its own right has value even basic surveillance and analysis can provide trending and more importantly help us understand what problem we want to solve.

There is still a big challenge capturing data in the field, including collecting, compiling, reporting and storing the data, without a lot of manual work. "Data integration is key, and that's what we, as consumers of information, are all struggling with," she said.

### License 2 Share

The Stavanger based E&P Information Management Association (EPIM), together with CGI, have developed License 2 Share, a tool to enable production data to be shared with the right joint venture partners, including daily and monthly production reports and drilling reports.

You can create and remove access to the data for different individuals, for when the joint ventures start and stop.

The software can be used to manage the documentation required for the joint venture, including legal contracts and the day to day operational reporting as appropriate. It can also manage data for the life of the joint venture, which could be over 25 years or more. Data is stored in the cloud for the life of the joint venture.

The software is widely used in Norway, but is now seeing growing take-up in UK, Germany, Netherlands and interest is being shown in South America, she said. "It is becoming a very useful tool."

### Internal data management

To help analyse the data internally, CGI has been working on software that can run in the field or in the office, to do quick analysis of the data.

You can also work with different types of tools – because most people have their favourites – and still be able to access data and information across the organisation using semantic search capabilities.

"So there are lot and lots of different things that become interchangeable as long as it is there somewhere on that connected network," she said.

There are tools within the capability that bring in elements of social networking to assist in getting a better understanding of the production data across communities of experts and can even provide sentiment analysis.

Companies are developing more distributed data storage architecture, where data can be stored close to where it is gathered and the database interrogated from there, rather than uploading it all into a central repository.
You can watch the video of the conference:
**http://www.digitalenergyjournal.com/video/ 667.aspx**

# Using design software to support the asset lifecycle

## There is a growing demand in the oil and gas industry for product lifecycle management software tools, says Dassault Systèmes

Oil and gas operators are increasingly demanding "Product/Plant Lifecycle Management" (PLM) software tools, which means tools which can manage the entire lifecycle of a product or asset from its conception, through design and manufacture, to service and disposal, says Harald Gunnerød, business development executive with Dassault Systèmes.

He was speaking at the Digital Energy Journal event in Aberdeen "Improving offshore design decision making" on 30 May 2013.

Dassault Systèmes is a leading supplier of PLM tools including market leading 3D design software like SolidWorks and Catia.

Dassault Systèmes has 45 per cent of its employees working in research and development, and spends ca 30 per cent of its revenue on software development.

Dassault Systemes 3D Experience platform aims to provide a working digital model within the computer. This model can be tested in a virtual environment and is connected to all information needed within its lifecycle.
"The traditional 3D CAD was used to design mechanical components," he said. "The main goal was to allow the user to create his product in a

3D system that was easy to use, and gave a good visual feedback". The end product was usually drawings and part lists (Bill of materials). The parts in the model were, and still are, stored like separate files.
"These tools are very easy to use graphically - you can undo, you can redo."

Plant design tools were much more focused on creating a database of the design. They were both less visual and harder to use. The databases remain proprietary and not easy to connect to other IT systems.

## 3D modeling in the future

"3D design technology is quickly evolving. It is now possible to make a realistic graphical representation of your product, be it a shampoo bottle or an oil platform. ," Mr Gunnerød said.

"Even more important is the possibility to connect to other sources of information. You can also communicate and collaborate on a global level. We are promoting this new holistic way on working as the 3D Experience."

Dassault Systemes has a big footprint within simulation in the Oil and gas industry. The 3D Experience platform allows for a better integration of these tools. The worlds remaining natural resources are harder to get, be it greater ocean depths, complex reservoirs or arctic conditions. Simulation is now required at an earlier stage in the engineering process as the engineering challenges are tougher.

How will a material behave at 3000m depth? How will our tool function when covered by ice? The traditional "check if it will break" can be complemented by an early study of the engineering challenge. Do we have the required material strength to solve this problem?

## Simulation software

Dassault Systèmes provides a sophisticated simulation and finite element analysis software tool called "ABAQUS", marketed under its 'SIMULIA' brand, following its acquisition of software company ABAQUS in 2005.

Finite Element Analysis is about analyzing the structure over many small cells (called 'finite elements') and adding them together to make an analysis of the entire structure.

ABAQUS can be used for many different types of structural analysis, including structural, thermal and electro magnetics," said Max Leadley-Brown, sales manager at Dassault Systèmes.

In the oil and gas industry, you can simulate the entire offshore rig, wave loading, steelwork stress and fatigue. "You can look at how the pipes and the pipe lines interact which each other, you can look at stress, crush bend, the well, pipe line and finally foundations and how they behave. You can actually see how most structural interactions behave," Mr Leadley-Brown said.

"Offshore platforms obviously are subject to crumbling and understanding how the structure age and cope with these stresses is very important."

You can watch the relevant video from our conference and download the slides in this link:
**http://www.digitalenergyjournal.com/video/701.aspx**

# Managing security throughout development

A "holistic" approach to security in application development – or managing security throughout the software development process, rather than just at the end – can make a big difference to your security.

*By Tim Rains, director, Trustworthy Computing Group, Microsoft*

A holistic approach to software development – incorporating security throughout the development process, rather than wait until the end - can help mitigate many of the software application security risks that oil and gas companies face.

To assist, Microsoft has put together a free application security development process called "Security Development Lifecycle".

## Money

According to a 2011 study by security firm McAfee, the average cost of 24 hours downtime in the oil and gas industry due to cyberattacks is around $8.4m.

Another 2011 study by research firm Aberdeen Group estimates that the average cost of remediating an application security-related vulnerability is around $300,000 per incident, but the average annual investment developers make in deploying a comprehensive approach to application security, including people, processes and training, totals about $400,000.

The study found that companies that incorporate security throughout the development process, rather than wait until the end of the process to perform reviews and tests, made four times the return on their annual investments in application security.

Corporations can lose millions of dollars in sensitive data, or worse, control over parts of their networks, by simply opening a malicious email attachment.

## Still vulnerable

Major portions of the oil and gas industry remain vulnerable to cyberattacks, ranging from state-sponsored corporate espionage to so-called "hacktivists" seeking to make political statements through their choice of target.

In May 2012, the U.S. Department of Homeland Security confirmed an ongoing campaign of attacks from state-sponsored actors against oil pipeline companies extending through the first half of that year. Companies' systems were invaded and proprietary information was stolen.

In July 2012, Wired magazine reported that the "hacktivist" group Anonymous published some 1,000 email addresses for accounts belonging to energy firms, as well as hashed and unencrypted passwords.

In August 2012, a limited number of oil and gas companies in the Gulf region were put on the front page following an apparent spate of Trojan malware infections.

## Outgunned

In this evolving threat landscape, companies can easily find themselves outgunned, said Paul Williams, executive director of security services at White Badger Group, who has experience advising clients in the oil and gas industry.

"When you're talking about economic espionage from a foreign intelligence agency, it might be thousands attacking forty guys who know what they're doing on defence side," Mr Williams said.

In the face of these daunting security challenges, industry leaders, outside security analysts, consultants and software experts have been calling for a comprehensive approach to cybersecurity in the oil and gas industry. Their message: given the nature of the threats, companies must install a bottom-up, company-wide security culture.

This includes procedures and policies to let all firms in the sprawling, decentralized industry respond to and defend against agile enemies, because any weak link in the overall supply chain can be a significant problem.

## Apache

"Security is everybody's responsibility in the company," said Aaron Merrick, vice president of information technology at Apache Corporation. "I don't want people on the network thinking, 'Oh that's somebody else's job,'" he said. "It's everybody's job because it can't be done without the participation and cooperation of everybody in the company that has access."

But ultimately, Mr Merrick believes security is an iterative process that will continue to rely on time-tested security skills such as the ability to locate and address dangers and to learn from security breaches if they do occur.

Apache Corporation uses a modified security framework that considers everything from physical to logical access to application security to data protection to data continuity, Mr Merrick said. The company also expects its key suppliers to address security concerns in a logical, holistic manner.

Mr Merrick expects to see more cooperation and standardization across the industry, with the possibility of federated authentication systems to help companies know what is safe and what is not when transferring data.

It is important to be able to identify real threats amidst the buzz and the type, Mr Merrick said, citing one prominent example in Illinois, where a pump failure at a water plant in 2011, first reported to be caused by hackers, was later revealed to be a false alarm.

"You can never be satisfied that you know everything, or that will be your Achilles heel," he said. "Anything out there that has been exploited is just teaching us the lesson that we don't know what will be exploited in the future."

## Open architecture

The oil and gas industry has unique needs that set it apart from other infrastructure, such as the nuclear power industry, where regulation is much tighter and protocols are more closed.

"In oil and gas the culture is very open. You have a lot more work done by consultants, vendors and suppliers," said Jonathan Pollet, founder and principal of Red Tiger Security, a data security consultancy with extensive experience in the oil and gas industry.

Increasingly, the applications companies use to conduct day-to-day business and control business processes in the field are becoming the major points of attack because that is where valuable data is stored.

Few companies have complete control over the application lifecycle, Mr Pollet said. Therefore, building transparency into security processes is a challenge.

Companies tend to develop unique approaches to security. That makes it tricky for best practices to flow through such a large infrastructure, which can make each company more vulnerable rather than less. "It only takes one weak link in the chain to take down the system," he said.

More and more, oil and gas companies are becoming integrators for a wide range of services and technologies they purchase to help them deliver their final product, said Alan Hasling, an account technology strategist for Microsoft who works with the oil and gas industry.

Mr Hasling cites the example of the compression process used to pressurize and transport natural gas. In previous years, a company might have bought a gas compressor and done the job in-house, but companies now are more likely to purchase a compression service, Mr Hasling said.

## Practical steps

Mr Pollet said there are practical steps he would advise any company to take in order to make itself more secure.

First off, he said companies must identify key assets and then do threat modelling on how to protect those assets.

Examples might include doing secure application development differently or dividing their network control assets into different sectors so breaches can be localized.

Companies must also determine how they securely manage outside access to their data systems and, after their systems are protected, how they will be continuously monitored.

This kind of integrated, disciplined approach to security needs to be built, Mr Pollet said, into the basics of system architecture and development practices. That includes access to secure infrastructure, rudimentary network security and the updating of software.

The next obvious steps are integrating these basic procedures into more sophisticated software security challenges, Mr Pollet said, which include managing access to directories, developing strong passwords and, finally, securing the actual deployed applications through better development practices.

## Microsoft's SDL

Microsoft offers a free security development process called the Security Development Lifecycle or SDL, to help address both software security and broader infrastructure design, incorporating security into applications from conception to release and beyond.

This approach can be used in companies of every size and in every industry, from small software development firms to global enterprises.

The Simplified SDL is a 17 page document designed as an accessible way to help managers create a long-term framework for creating secure software.

The SDL is general enough that it can be adapted to a wide range of security environments, but rigorous enough to meet exacting standards in the most security-sensitive industries.

One of the key constructs of the SDL is threat modelling, which helps prioritize mitigations and resources. This concept is now being looked at broadly in the industry.

"I believe we shouldn't even approve a project without doing threat modelling first," said one security executive from a major oil field services company who requested anonymity due to the sensitive nature of the strategic infrastructure the executive supervises. "If there is a project, security should be part of the project lifecycle; that is very clear."

"I still see a lot of projects where security is an afterthought," the executive said. "People need to understand that security needs to be part of the process from the beginning."

Some companies don't use the SDL in its entirety. Incremental application of SDL processes leads to incremental improvements in security. It's not an all or nothing equation.

SDL is a process-based approach that is flexible and designed to be incorporated into any organization's product lifecycle – even outside the software industry.

The SDL has been successfully adapted and deployed at infrastructure companies such as Iowa-based MidAmerican Energy Co. and at Itron, a global technology company and builder of smart grid electricity and water meters based in Liberty Lake, Washington.

At MidAmerican, executives held company-wide SDL training in response to attacks on company websites. Not only did the SDL-inspired security approach reduce the impact of attempted attacks, it also increased efficiency, including a 20 per cent productivity gain resulting from less change during testing and fewer after-the-fact fixes to code.

Itron, a company with explicit parallels to the oil and gas industry, adapted its utility meters, which are meant to live in the field for decades.

Its engineers adapted the SDL to the design of the smart meter, from how to prevent it from being broken into physically – securing seals and closures – to how to protect its electrical systems and software.

# Coriolis flowmeters – monitoring mud flow in drilling

"Coriolis" flowmeters, which can monitor fluid flow by sending it through a vibrating tube, are increasingly used for drilling, monitoring mud density and returns flow.

Emerson MicroMotion reports that its Coriolis flowmeters are increasingly used in the drilling industry as a reliable way to continuously monitor mud flow and returns, and so maintain well control.

These meters are frequently placed on the return line before the shale shaker.

They can also be used on the suction side of the mud pump to measure downhole flow.

They deliver a continuous, full stream flow measurement of the drilling fluid going downhole and the drilling fluid returns.

They provide an accurate and continuous measurement of volumetric flow rate, density, mass flow rate, and temperature,all within a single device. They can measure density of water, oil, or synthetic-based drilling fluids.

An added benefit is that this is not a nuclear technology. Nuclear technology is undesirable due to the radioactive sources it produces.

The meters' performance is sustainable in applications with changing fluid properties (e.g. density, viscosity) and high flow rate turndowns.

Drilling operations can involve situations where a reduced circulation rate is required, such as while making a connection, pumping of kill mud while circulating out of a kick, and manipulating flow rates in Managed Pressure Drilling systems.

Coriolis meters can reliably measure small volume changes while operating at reduced circulation rates. With more accurate, continuous and reliable volume and density measurement of the drilling fluid, the driller can identify influx or lost circulation accurately on surface for immediate remedial action and increased safety.

These meters can lower the cost of installation as there are no special mounting, flow conditioning, or straight pipe runs required and there is no need to adjust the factory settings. They also reduce maintenance and costs as there are no moving parts and no calibration drift and the device can be cleaned in place.

There are also no in-stream mechanical components in the design of a Coriolis sensor that can be damaged due to sudden flow surges, gas slugs or large particles. The non-mechanical design contributes to the sensor's reliability in harsh environmental conditions associated with temperature, pressure, transportation (vibration) and pulsating flows from pumps.

The mass/volume flow accuracy for a Coriolis meter can be as high as +/- 0.05 percent. The operating temperature range of the meter can range from -400 °F (-240 °C) to +662 °F (+350 °C). The pressure rating depends upon the size of the meter and materials of construction, and ranges from 1,500 psi (103 bar) to 2,973 psi (205 bar).

## How it works

Coriolis sensors are classified as a multivariable sensor because they provide a measurement of mass and volume flow rate, density and temperature.

The sensor consists of a manifold which splits the fluid flow in two and directs it through each of the two flow tubes and back out the outlet side of the manifold. (See Figure 1)

*Figure 1. Sensor Flow Path*

A drive coil is used with a magnet to produce the oscillation of the Coriolis sensor flow tubes.

The coil is energized to keep the tubes vibrating at their natural frequency. (See Figure 2.)

The pick-off coils and their magnets are electromagnetic detectors located on each side of the flow tube.
By producing a signal that represents the velocity and position at that point on the vibrating tube, mass flow is determined by measuring the phase difference between these signals.

The Resistance Thermal Device (RTD) is a 100 ohm platinum element that provides an output signal that consists of the flow tube temperature.

Process connections are sometimes called an end connection or fitting. There are two identical process connections that must be mated to a process line for successful installation.

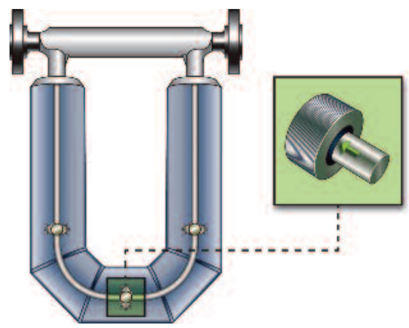


*Figure 2. Drive and pick-off coils*

The wiring for the drive coil, pick-off coils, and RTD element is routed to the core processor.

The core processor is a sophisticated set of electronics that controls the sensor, primary signal measurement and processing.

The core processor executes all necessary calculations to arrive at the measured process variable values and communicates these to the transmitter for interfacing with operators and control systems.

A case or enclosure protects the electronics and wiring from external corrosion. Some cases may have purge fittings that can accommodate the requirements of specific applications.

## Reliability

Coriolis sensors and electronics offer a wide range of sensor, electronics and advanced diagnostics to help identify in advance potential device or application problems.

For Coriolis sensors, flow tube stiffness is a critical parameter and any changes in tube stiffness due to corrosion, erosion or damage will affect both the flow and density measurement.

Coriolis sensors can include advanced diagnostics to enable in-situ meter verification for tube stiffness using the process fluid under flowing or zero flow conditions. The data is compared to baseline values stored in the electronics, and a positive indication means nothing has changed the physical integrity of the tubes or the calibration of the sensor.

For further information see
**http://www2.emersonprocess.com/en-US/brands/micromotion/coriolis-flow-density-meters/ELITE/Pages/index.aspx**