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The First

SPE Norway magazine

THE FIRST SPE NORWAY JOINT SECTIONS MAGAZINE

TO GATHER MEMBERS TO SHARE KNOWLEDGE

Finance&Management
Reservoir Engineering
GeoExploration
Drilling
Renewables
BigData

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Inside this issue

SPE President
Dr. Helge Hove Haldorsen
Especially for The First!

SPENORWAY2.0
Many Are Already Standing On Your Broad And Innovative Offshore Shoulders And Now We Need You To Invent Offshore E&P2.0
p.4

Norway and the SPE
Carlos Chalbaud,
SPE Director-North Sea
p.6

News form SPE Ireland Section
Donal Meehan, Chairperson Ireland
p.7

SPE Norway
p.9

SPE Norway Event Calendar
p.50

The First — the SPE Norway Magazine

Editor
Vita V Kalashnikova
vita@pss-geo.com

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The First

Finance&Management

Rules of the game: Take–overs in the Energy Sector on Oslo Børs 12
Per Gunnar Ølstad, Senior Listing Manager and responsible for the energy sector on Oslo Børs

Norwegian Industrial Property Office (NIPO) 15
Kanja Bah, Head of Division NIPO

Norne 2030 – It ain't over till the fat lady sings
The Norne lifetime extension project aims to continue production beyond 2021 16
Audun N. Nyre, Leader Norne Petech RR, Statoil ASA

Reservoir Engineering

iQx™ GEO - Well Data Made Simple 20
Ole-Gunnar Tveiten, Manager Well Operations Support, and Eyvind Aker, Principal Rock Physicist, AGR

tNavigator – breaking reservoir simulation speed limits in Europe! 22
Scott Harrison, Business Development Manager in Europe, Rock Flow Dynamics

NEED FOR SPEED! 25
Jens-Petter Nørgård, Sr Reservoir Engineer, Chairman PL501 Resource Committee

GeoExploration

Seismic Data Attributes — new look at the old techniques 28
Vita Kalashnikova, QI Geophysicist and Juri Muzi, Sr Geophysicist, PSS-Geo AS

CSEM's Influence on Exploration Decisions & Seismic: Examples From the Barents Sea 32
Stein Fanavoll, Exploration Advisor, EMGS

Drilling

Signal processing challenges of measurement and logging while extended reach drilling in the North Sea 36
Peter Shulgin, CEO Axel

Renewables

Enhanced oil recovery powered by nature – a WIN - WIN 38
Johan Sandberg, Service Line Leader Offshore Renewables, Cecilie Kielland, Consultant, and Are Kaspersen, Consultant, DNV GL – Energy

BigData

Big Data *Conference overview* 40
Egor Bokin, SPE Oslo board member, Subsea Production Engineer, Digital Field Support, FMC Technology

Big Value from Big Data: How Oil and Gas can learn from other industries 41
Duncan Irving, Practice Lead, Oil and Gas, EMEA & APAC, Teradata

Software Metering Tools: An Undervalued Source of Increased Efficiency and Savings 44
Signe Marie Stenseth, SMS VP Open iT

E&P competitive advantages from Cognitive decision support 46
Ole Evensen, WW Chemicals & Petroleum, Upstream Leader, IBM

The 10 Million Tag System aka the Enterprise Control Foundation 48
Timo Klingenmeier, General Manager / Software Architect, inmation

SPENORWAY2.0

Many Are Already Standing On Your Broad And Innovative Offshore Shoulders And Now We Need You To Invent Offshore E&P2.0

Dear SPE Colleagues in Norway,

For 40+ years the NCS has demonstrated how offshore E&P can be done safely, sustainably, high-tech and in a highly commercial way in harsh and very demanding North Sea conditions. The incremental and disruptive technological advances and lessons learned that you have delivered to the industry have gallantly been shared with the rest of the global offshore and subsea world in SPE papers, at SPE conferences and at SPE Forums. For all this we salute you! And therefore, your 'CV' is our global heritage!

But Churchill said: 'success is never final' and Darwin: it is only those that adapt that will survive, and at $50/bbl and a 'Rhapsody in Cs' facing the industry (costs up, complexity up, competitiveness and profit margins down, communities expecting more, climate change a real issue, crew change speeding up,…), it is time to re-think what we do and how we do it and to re-base our cost level after sailing along for 4 years at $100/bbl where it seemed like we could afford anything and everything. Now, the buzz words in E&P are: we must not forget that we are manufacturing oil and gas, so we need a manufacturing mind-set: focus on the supply chain and the just-in-time inventory, industrialize, standardize and simplify, draw one – build many, start with the 'minimum kit', don't gold-plate, reduce specifications .. And, find a way to utilize the 'internet of everything`, 'big data` to drive efficiency along with 'integrated operations' and semi-automated drilling (remember that IBM's 'Watson' computer beat two Jeopardy champions so why should he not also drill faster, smarter and safer?) thrown in. Yes, I am talking about E&P2.0 on the NCS that you will help develop – with initiative, creativity and passion constantly 'spying on' and learning new tricks from other industries. In a way, with so many world's first already from the NCS and a new one, subsea compression, coming in 2015, and with average recovery factors already so high that everybody else are envious, it is a hard act to follow your own act! But, you can and you will!

I am confident that the NCS will show the way again with brand new, perhaps risk-sharing business models between the actors, a cheap and safe 'lego-approach' to field developments, with wells drilled 50% quicker with AI assistance, drilling unconventional 10,000 ft unconventional wells in conventional NCS fields with massive reliable down-hole pumps boosting production rates to amazing heights plus drones shooting seismic and new materials making everything in E&P much lighter and cheaper. Should I add 3 -D printers printing well heads when you need them? Just like before, it will take head, heart and guts and a lot of collaboration. Collaboration is called 'Darwin's blind spot'; I think massive cross-discipline, cross company, company-company, E&P business-other business, …., collaboration will give us more value creating inflection points than anything else.

The silver lining in a low oil price period is that the industry is forced to change and adapt to stay competitive. We have seen and mastered low oil prices before and as they say, 'life starts at 50' – so the NCS has good times coming …if you become NCS2.0!

Bottom lines: Thank you for being such a force for good. You get up every morning and help 7.3 billion people get their energy every day. We all love renewables, but solar, wind and bio-fuel only contribute with 2-3% of the global energy needs in 2015 and fossil fuels with >80%. So while we R&D and Moore's law (solar kwh price vs time) our way to not using oil in 85 years (in 2100?) the world will need oil and gas for several more generations of E&P professionals. And with gas substituting for coal in electricity generation, it looks like we can stay < +2degC as well.

On a final note, Professor Th. van Golf-Racht, passed away in February 2015. He was a giant for years in the NCS reservoir engineering community and I want to honor him by saying: Thank You Professor for your massive contributions and for believing in us! And, peace over your memory! And we will never forget your advice: When you forecast, always try to be 'wrong in the right direction' !

I wish you all only the best and thank you again for being an SPE member – we're 143,000 non-profit members in 141 countries ***on a mission to share!***

Dr. Helge Hove Haldorsen
Director General Statoil Mexico
2015 SPE President

Dr. Helge Hove Haldorsen
Director General Statoil Mexico /
2015 SPE President

Dr. Helge Hove Haldorsen holds the position of Director General Statoil Mexico in Mexico City after serving as Vice President Strategy & Portfolio Statoil North America in Houston, Texas. Prior to his tenure at Statoil, Haldorsen worked for Norsk Hydro in various roles including Chief Reservoir Engineer, Vice President Technology and Competence, Vice President Exploration and Research, Senior Vice President International Exploration and Production, and President Hydro Gulf of Mexico.
Helge has also held various engineering positions at British Petroleum, Standard Oil of Ohio (Sohio), and ExxonMobil in Anchorage, London, San Francisco, Stavanger and Houston. He was a Second Lieutenant in the Royal Norwegian Navy and Professor of Industrial Mathematics at the University of Oslo as well as a Lecturer at Stanford University in California.
He has served on the Society of Petroleum Engineer's Board of Directors for three years. He also has been an SPE Distinguished Lecturer and an SPE Distinguished Author. He has authored numerous technical papers and articles on reservoir engineering and other E&P themes.
Haldorsen earned an MS in Petroleum Engineering from the Norwegian Institute of Technology in Trondheim and a PhD in Reservoir Engineering from The University of Texas at Austin. He served on the Offshore Technology Conference Board of Directors for 5 years and currently serves on the 'OTC d5: The Next Big Thing' Advisory Board and on the External Advisory Board for the Cockrell School of Engineering at The University of Texas at Austin. Dr. Haldorsen is the 2015 President of The Society of Petroleum Engineers (SPE) with 143,000 members in 139 countries and he writes his Presidential Columns each month in the Journal of Petroleum Technology (JPT) – www.spe.org/jpt. Haldorsen was awarded the 2013 Rhodes Petroleum Industry Leadership Award by the American Society of Mechanical Engineers (ASME) – see: http://youtu.be/PI7lqnj8b44.


Dr. Helge Hove Haldorsen

Norway and the SPE

SPE is all about sharing knowledge and experience. This sharing happens in our events and through publications like this one, which I feel honoured to have been asked to contribute to.

In Norway we have 5 sections and 5 student chapters that cover the main oil and gas "locations" of the country. These entities are innovative and a clear example of this has been their events. Last February the SPE Oslo organised a seminar of Big Data, which is a critical topic for our industry to improve its profitability in the short and middle term. Another excellent example of quality service to SPE members is the SPE Bergen One day Seminar, an event that has been running for over 20 years and that recently became the first SPE paper event in Norway. These are just two examples of how local sections are a great platform for knowledge sharing and networking for SPE members and non-SPE members in Norway.

The Board of Directors (BoD) of the SPE realises the importance of the Oil and Gas Industry in Norway and it is excited about the possibility to increase and improve its presence in the country. We are working hard to develop our existing events and to create new ones that could help us to achieve our mission that has two key elements: knowledge sharing and professional development. Since I joined the BoD as North Sea Director a bit less than two years ago I have been in Norway eight times with the clear purpose of better understanding our members' expectations, discovering and discussing with the section about their activities; and trying to improve the way we operate in the country. Based on these visits I have been working with other volunteers on the establishment of a National Council in Norway covering the 5 sections (Stavanger, Bergen, Oslo, Northern Norway and Trondheim) with about 3000 professionals members and 700 student members overall. This council will focus on the coordination of the SPE activities at a national level and on the collaboration with SPE International. I am confident that this council would be a great contributor in building a road map for the SPE development in Norway for the next decade and I am looking forward to closely working with it.

These two years as North Sea Director have been a unique experience to meet great people, discover new places and to give back at least a slice of what I have received from other SPE volunteers. I thank all our members for your trust on the Society and want to express my gratitude to volunteers for your time and efforts in serving our members. It is a pleasure and an honour to work with you guys!

Sincerely
Dr. Carlos A. Chalbaud
SPE North Sea Director

Carlos Chalbaud
SPE Director-North Sea /
CNS Non-operated Assets
Subsurface Team Leader, GDF

North Sea SPE officers

2015 Regional Section Officers Conference in Bergen, Norway on the 23rd April 2015. From left to right — Theo Rijper (Amsterdam), Roald Johansen (Harstad), Bjorn Sissener (Bergen), Carlos Chalbaud (SPEI), Donal Meehan (Ireland), Cathrine Eliassen (Stavanger), Kurt Jorgensen (Harstad), Tore Nordenborg (Stavanger), Roberto Chiarotti (SPEI), Jade Abbott (SPEI), Ross Taylor (Aberdeen), Sue Frye (SPEI), Vita Kalashnikova (Oslo)

News from SPE Ireland Section

The SPE Ireland section is the newest section in the North Sea region, having been established in August 2014. Our aim is to build an organisation which will help enhance our members careers in the oil industry by promoting networking and providing a forum for the exchange of technical ideas and information about the industry. Given the challenges the industry has seen since we formed our section, the SPE is more relevant than ever to help our members stay connected to the industry and to each other.

We held a social event soon after establishment, which over 40 of our members attended. This was followed by our inaugural Oil & Gas Industry Event in January 2015. This evening event was attended by over 130 delegates associated with the Irish oil and gas industry, and was a great showcase for our fledgling section. The Irish Government Minister of State for Natural Resources, Joe McHugh, gave an opening address. SPE President Helge Hove Haldorsen gave an inspirational lecture on SPE's role in the future of the oil and gas industry. Tony O'Reilly, CEO of Irish based explorer Providence Resource plc, discussed the status of hydrocarbon exploration offshore Ireland, whilst IHS Cera Vice President Paul Markwell gave a talk about the role of technology in the future of the industry. The event was made possible thanks to the support of our gold sponsor IHS. Photographs of our 2015 Oil & Gas Industry Event are available on our website photo gallery. We are currently looking forward to hosting the event again during the first quarter of 2016. **Of course we would be delighted should any 'The First' readers be interested in attending or supporting the 2016 event!**

Thanks to the support of the SPE International and our 2015 Distinguished Lecture Series sponsor Tullow Oil plc, the distinguished lecture series was brought to Ireland for the first time ever in February 2015 with a lecture from Jim Crafton on "Shale Well Performance Metrics". Our second Distinguished Lecture is scheduled for 12th May 2015 with Terry Matthias delivering his talk "Diamond – A Drillers Best Friend".

UCD Student Chapter

The Ireland section quickly formed links with one of Dublin's major universities, University College Dublin (UCD), to support the formation of a Student Chapter. With graduate employment intakes reduced this year as the industry responds to the macro oil price environment, it is more important than ever that we continue to provide the encouragement and support to our students whilst this industry cycle works itself out. To that end we are encouraged to be able to support the Student Chapter not only through section support with career talks and information, but also through the SPE International Student Scholarship Support Programme and the Enhanced Faculty Travel Programme. Additionally, the UCD Chapter is sending three keen student chapter members to the North Sea Regional Student Development Summit in Aberdeen which takes place in September 2015 coinciding with Offshore Europe. We look forward to continuing our support of the student chapter and to help it increase its links to the international oil and gas industry. If we could help them form new industry links to Norway that would be the icing on the cake for 2015!

Donal Meehan
Providence Resources Plc
Chairperson,
Membership Chairperson
Ireland

SPE International

January 2015 Event

Left to Right: Helge Hove Haldorsen (SPE President); Tony O'Reilly (CEO Providence Resources plc); Joe McHugh (Minister of State for Natural Resources); Paul Markwell (IHS Cera Vice President); Conor Ryan (SPE Ireland Programming Co -Chair); Carlos Chalbaud (SPE North Sea Regional Director); JJ Madudu (SPE Ireland Programming Co-Chair)

January 2015 Event

Paul Markwell (IHS Cera) presenting to the attendees

January 2015 Event

Attendees at the event

Follow the SPE Ireland Section

Web: http://connect.spe.org/ireland/home

LinkedIn: https://www.linkedin.com/groups/SPE-Ireland-Section-6759109

Email: spe-ireland@spemail.org

SPE Norway

SPE Northern Norway

The 2015 SPE Workshop in Arctic Norway was held 11-12 March with 75 delegates attending. The presentations authorized to be published can be down-loaded here:

http://www.speworkshop.no/presentations/

SPE Northern Norway Section is delighted to congratulate **Kurt Jørgensen** for winning SPE 2015 North Sea Service Award! Congratulation on this outstanding achievement!

SPE Oslo Section is delighted to congratulate **Karl Ludvig Heskestad** for winning SPE 2015 Regional Service Award! Congratulation on this outstanding achievement!

SPE Norway

Find your section!

The Society of Petroleum Engineers (SPE) is a professional association whose 100,000-plus members worldwide are engaged in energy resources development and production.

Local sections of the SPE are established around E&P communities all over the world. In Norway, there are five local sections. Each section maintains its own individual website. Visit, and learn more!

- **STAVANGER** SECTION
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Rules of the game: Take–overs in the Energy Sector on Oslo Børs

by Per Gunnar Ølstad, Senior Listing Manager and responsible for the energy sector on Oslo Børs

Per Gunnar Ølstad
Senior Listing Manager and responsible for the energy sector on Oslo Børs

The energy sector on Oslo Børs has three main subsectors; Drilling, Oil service and Exploration & Production. The price of the energy companies has fallen steeply after the drop in oil price from USD 110 to 55 per barrel since July 2014. Investors now have access to world class companies and assets to low prices in a historical perspective. Consolidation, mergers and acquisitions is expected and Oslo Børs plays a key role.

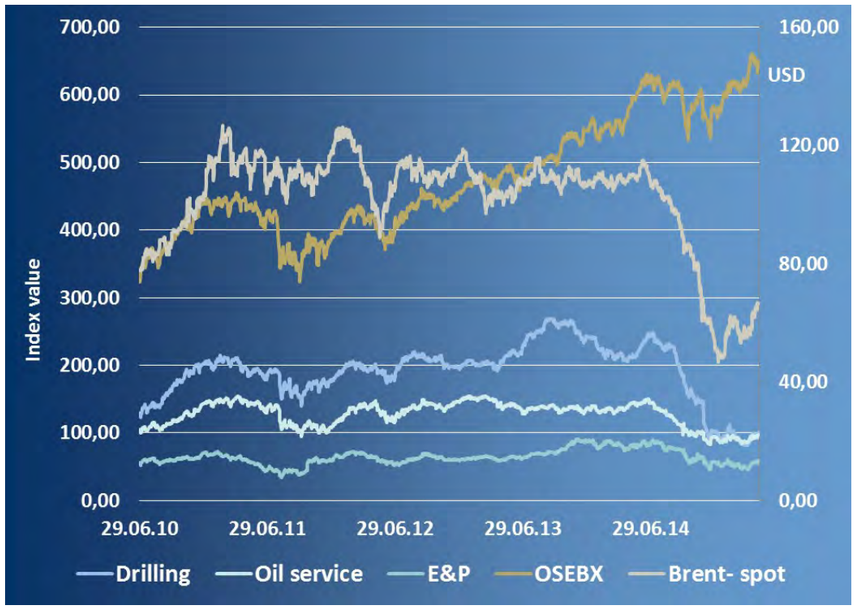
Background: Companies move from private to public ownership through stock exchange listings when the owners can obtain a favorable pricing of their business in the market. A stock exchange listing allows the Company to raise capital to fund further business expansion and to make the shares of the company an acquisition currency for later deals. However the financial marketplace is dynamic and companies can become subject to takeovers from others with the same motivation for growth that initiated the Target's[1] stock exchange listing in the first place.

A takeover of a publicly traded company is a strictly regulated and concerns large amounts of money in exchange for transfers of ownership and control of valuable assets for many shareholders[2]. Oslo Børs holds the role as the Norwegian supervisory authority on takeovers and plays a key role when any company listed in Oslo is attempted acquired by another party.

Oslo Børs energy sector: The energy sector on Oslo Børs consists of three main subsectors; Drilling, Oil service and Exploration & Production (E&P). The market market value of these sectors is obviously strongly correlated with the development in the underlying oil price, as illustrated in Graph 1.

The group of E&P companies on Oslo Børs is internationally attractive with Statoil as the largest company with exploration and production activities. In total 14 E&P companies are listed in Oslo with a total market capitalisation of NOK 535 bn and together the companies have exploration and/or production activities on five continents.

The energy sector is still the largest sector on Oslo Børs in terms of market capitalisation despite of the drop in oil price since July 2014 with correspondingly low share prices for energy companies. With oil prices of USD 110 per barrel the total market capitalisation of Oslo Børs, across all sectors, used to be approximately 50% energy related. Today, with an oil price of around USD 60 per barrel the total market capitalisation of Oslo Børs is only 1/3 relat-



Graph 1: OSEBX, Brent Oil and Oslo Energy Drilling, E&P and Oilservice indices 2010 – 2015. All data downloadable from www.oslobors.no free of charge. When using the images the source must be credited

[1] *The company subject to a takeover is normally referred to as "Target".*
[2] *EU takeover directive implemented in the Norwegian Securities Trading Act and Securities Trading regulation*

2015	2014	2013	2012	2011	2010
Interoil E&P	Rocksource	Bridge Energy	Fairstar	Aker Drilling	Scorpio Offshore
	Flex LNG	Sevan Drilling	Reach Subsea	Reservoir Exploration Technology	Interoil E&P
	Prospector Offshore Drilling	Fred Olsen Production	Asia Offshore Drilling		Prosafe Production
		Dockwise			
		Discovery Offshore			

Table 1: Selection of targeted energy companies on Oslo Børs and Oslo Axes

ed to the energy sector.

Also note the development of the Oslo Børs benchmark index (OSEBX) relative to the development in the oil price (Brent) and the three energy indices in graph 1. The drilling, oil service and E&P index appear at relatively seen much lower levels than the record levels of OSEBX index which consists of companies from all sectors in addition to energy.

Takeovers in the energy sector: Several commentators in the media have recently speculated in a period of consolidation and high level of M&A activity in the energy sector ahead. Based on relatively low share prices in a historical perspective this seems reasonable, however it should be noted that such transactions do take place throughout the entire business cycle. Attractive companies are acquired at attractive terms throughout the cycle and we have seen several examples on Oslo Børs over the years. A selection of targeted energy companies over the past five years is shown in Table 1.

We have seen attempted takeovers of companies in all subsectors over the past few years, which is an indication of the attractiveness of the companies in these sectors. The majority of the transactions have been initiated by the private equity sector or other established industrial players.

Even when an offer is placed with the intention of acquiring the entire company, the necessary level of acceptances may not be reached. Sometimes an offer is successful, and the parties initiating the takeover end up as the sole owner of the Company. If so, the basis for the stock exchange listing is no longer in place and the company is delisted. Sometimes a mandatory offer is launched without the intention of acquiring the entire company, just a controlling stake. Some offers are just unsuccessful in receiving the desired level of acceptances from the shareholders of the Target. For the two latter scenarios, the stock exchange listing is maintained for the benefit of all shareholders.

The role of Oslo Børs in takeovers: The Norwegian rules on takeover bids are stipulated in the Norwegian Securities Trading Act (STA) and its regulation and implements the EU takeover directive in Norwegian legislation. Oslo Børs is the takeover supervisory authority for all companies subject to Norwegian takeover rules, i.e. both Norwegian ASA companies and most international companies listed in Oslo.

Corporate takeovers are strictly regulated in the STA and most transactions trigger complex discussions e.g:

- Passing of ownership thresholds for bid obligations
- Consolidation of shareholdings
- Exemptions
- Minimum price requirement
- Amendments to ongoing offers
- Duties of the board of directors of the Target

This is not an exhaustive list, just a few examples of legal areas where high level of takeover competence is required among those involved.

The legal framework of corporate takeovers is too extensive for the scope and format of a brief article. The main rule says:

> *"Any person who through acquisition becomes the owner of shares representing more than 1/3 of the voting rights in a Norwegian company(…) quoted on a Norwegian regulated market is obliged to make a bid for the (…) the remaining shares in the company".*
>
> *Extract from Securities Trading Act § 6-1*

Besides the main rule, three out of many essential topics are:

- Mandatory vs voluntary offers
- Offer document
- Offer price

In principle anyone can make bilateral offers to shareholders for up until 1/3 of the voting rights of a publicly traded company without triggering the Norwegian takeover rules. Such offers can be referred to as unregulated offers. However, if a sufficient number of acceptances are received, disclosure of acquisitions of large shareholdings must be made in accordance with the STA, chapter 4.

Alternatively a multilateral offer can be made to a larger group or all shareholders of a company. Such offers are referred to as voluntary offers and are regulated differently than mandatory offers and appear as more flexible for the bidder in terms of deadlines. Voluntary offers also lack a regulative minimum price requirement and a requirement for cash settlement. If a voluntary offer receives acceptances for more than 1/3 of the voting rights in the Target, the mandatory bid obligation is triggered with more detailed regulation.

The mandatory bid obligation on all outstanding shares in a company is triggered once anyone becomes the owner of shares representing more than 1/3 of the vot-

[3] *Securities Trading Act § 6-13 for an exhaustive list of all content requirements.*

ing rights in the company. The same obligation is repeated on the 40% and 50% thresholds. The mandatory bid obligation ceases to apply if sale is undertaken from any of the thresholds within a certain timeframe. The regulation of mandatory bids is more detailed than on voluntary bids. Mandatory bids should always be presented on an unconditional basis, with at least optional settlement in cash and the entire takeover process has several milestones with strict deadlines in comparison to voluntary bids. Also, in a mandatory bid the offer price is subject to minimum requirements: The offer price should be at least as high as the highest payment made or agreed to by the Offeror or its consolidated parties in the six months period prior to the point where the mandatory bid obligation was triggered. If it is clear that the market price at the point when the mandatory bid obligation is triggered the bid price should be as high as the market price.

All mandatory offers are documented in separate Offer documents which are subject to approval by Oslo Børs. The offer document is normally prepared by the legal advisors of the Offeror and should reproduce the bid and give correct and complete information about matters of significance for evaluating the bid. The offer document is distributed to all shareholders in the Target, and is very important in the sense that it serves as the formal basis for the shareholders to accept or not accept the offer upon. Its content is subject to formal legislative requirements e.g. offer price, valuation, settlement and guarantees, conditions, financing of the offer and consequences for the employees.[3]

Conclusion: The market conditions have changed dramatically for the global energy sector on over the past year. This is also seen clearly in the energy sector in Oslo. Consequently the center of attention has gravitated from high listing activity towards anticipated high level of activity within consolidation and mergers and acquisitions. It is difficult to predict if the anticipated high consolidation and M&A activity will be realized. Regardless, takeovers are an integrated part of the financial market dynamic. This is also the case in Oslo where many attractive energy companies are listed. Oslo Børs plays a key role in this respect, both as the market place where the shares of the company are listed and as the Supervisory authority for takeovers for all companies subject to Norwegian takeover rules.

Oslo Børs ASA
Photo by Stein Henningsen

Visiting address: Tollbugata 2

Postal address: Box 460 Sentrum, 0105 Oslo

Phone: +47 22 34 17 00

Norwegian Industrial Property Office (NIPO)

by Kanja Bah, Head of Division NIPO

Kanja Bah
Head of Division
Petroleum and marine division
The Norwegian Industrial Property Office (NIPO)

Short on what NIPO is?
NIPO (Norwegian Industrial Property Office) is the Norwegian National Authority for the handling, processing and granting of applications on intellectual property rights, which is normally abbreviated as (IPR). Intellectual property is an umbrella term for all values a company owns, which is not of physical substance. A prime example is patents, trademarks and designs. NIPO is a government authority organized under the Ministry of Trade, Industry and Fisheries, and was established in 1911. NIPO has approximately 260 employees working with technology and science, legal issues, marketing services, public information on IPR, support and administration.
NIPO is a partner in Nordic Patent Institute, and as such, acts as International Searching Authority for patent applications within the international PCT (Patent Cooperation Treaty) system. Nordic Patent Institute also carries out various patent searches and analysis for foreign companies.

Functions of the Norwegian Industrial Property Office
The primary role of the Norwegian Industrial Property Office (NIPO) is to promote innovation and value creation, both as national intellectual property rights authority and as a guide and knowledge provider. NIPO contributes to competitiveness and helps to strengthen Norwegian trade and industry in various ways. We are a national centre for IPR. We provide knowledge and expertise concerning intellectual property rights. NIPOs value chain enables businesses to secure their investments, their competitive market position and as such generate economic growth in Norwegian society.

Products and services
As aforementioned, we process and grant applications on patent, design and trademarks. Nevertheless, what are these products?
Patent: In order for an invention to lead to a patent, it must constitute a practical solution to a technical problem. The invention must have a technical character. In order to be granted a patent, the invention must be novel, not obvious for a person skilled in the arts to anticipate, and it must be possible to mass-produce the product of your invention. A patent application must explicitly disclose the embodiment of the invention with examples describing or showing how the solution works in practice.
Trademarks: a trademark registration is an approved symbol, words or combination of words, letters, numbers, slogans, sound and even moving images that distinguishes your goods or services from others.
Design: design concerns the shape and appearance of an article or part of a product. A design that also serves a technical function should be protected by patent, for example an outer construction of a ship hull that has dynamic functions on sea.
Information services: We provide our customers with information on technological developments within a specific technical field, and we give prior assessments of ideas for patenting, trademarks and designs. Moreover, we do offer a wide variety of courses and seminars in both Norwegian and English.

Why should you bother?
A patent can give you an important competitive advantage because you will enjoy exclusive rights to use your invention commercially in a period of 20 years. During this time, you can prevent others from manufacturing, importing or selling the invention you have patented. A patent protection gives a sound basis for entering into sales and licensing agreements, if you do not want to produce and market your product yourself. Patent, trademark and design protection can be used as a means of safeguarding your investments and the assets created in the development of your invention.

IPR resource heterogeneity
NIPOs knowledge base within IPR constitutes our greatest competitive advantage. The patent department in NIPO has four technical divisions comprising of 82 engineers within the fields of oil, gas, shipping engineering, fisheries, biotechnology, polymers organic- and non-organic chemistry, mechanical engineering, electronics, physics, electricity and computer science. We have extensive experience with this expertise from 1911. In addition to our legal practitioners. In order for example to process and grant a patent application, it requires at least a minimum of a master's degree in the technical field concerned. In addition to your technical qualification, a training of a period of 1.5 years in industrial property rights is required to acquire the necessary skills and experience to make decisions in patent cases (that is to say, process a patent application independently). In other words, not an expertise that a company can buy from the market.

Norne 2030 – It ain't over till the fat lady sings

The Norne lifetime extension project aims to continue production beyond 2021[1]

by Audun N. Nyre – Leader Norne Petech RR, Statoil ASA

Audun N. Nyre
Leader Norne Petech RR, Statoil ASA[2]

The Norne field has been producing since 1997, and in the original plans Norne FPSO was scheduled for shut down in 2014. Since then, the licenses in the area have developed several satellites fields which are tied in to the Norne FPSO. The production license has been extended to 2021 and the recovery factor on Norne main field is steadily approaching 60%. Two important factors to ensure life-time extension beyond 2021 are: sufficient remaining reserves and technical integrity of the Norne FPSO.

Norne Main Field

The Norne main field is at the tail of its production. In Figure 1 the production estimate from the first year of production is plotted together with the numbers from the revised national budget (RNB 2015).

The economical cut off was historically estimated to be in 2014. The main field is included in the plans for extending the Norne area life time, but without the satellite fields there would not be a sufficient volume base.

Satellites

The Norne FPSO is producing from four satellite developments in addition to the main field. Two oil and gas fields; Urd (2005) and Skuld (2013), and two gas/ condensate fields Alve (2009) and Marulk (2012). These satellites have contributed to the prolonged production from the Norne FPSO. From Figure 2 we see that volumes equivalent to the original reserves of the Norne field has already been produced.

The lifetime of Norne is extended through tie-ins, and the search for new tie-in candidates is an important activity to strengthen the business case for continued production beyond 2021.

Lifetime of FPSO

The design lifetime of the Norne FPSO is 25 years; hence prolonging the production license beyond the economical cut off of 2014 was achievable without major modifications to the vessel. In order to continue production beyond 2021 a reassessment of the FPSO's integrity is required. The Norne 2030 project has investigated several options for prolonging the life time of the FPSO.

1. Bring the FPSO to shore - upgrade and refurbish
2. Do all required upgrades offshore
3. Disconnect FPSO and produce remaining gas through sub-sea installations

The condition of the hull will dictate if the FPSO must be brought to shore (option 1). If the remaining reserves are mainly gas, then option 3 could be considered.

Volume base

Estimating reserves for a lifetime extension project involves different approaches. The work spans from developing tie-in candidates and IOR projects to estimating lifetime of existing wells. Oil volumes are particularly dependent on lifetime of existing wells.

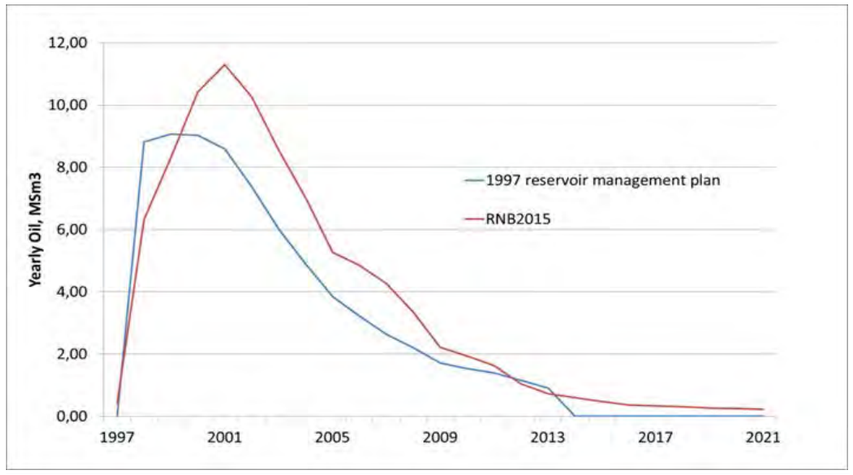


Figure 1: Production profiles showing predicted and actual production towards 2014 and predicted production from 2015

[1] This abstract was presented at the 2015 SPE Workshop in Arctic Norway, Harstad, 11-12 March 2015

[2] *Audun N. Nyre is the leader for the Reserve Replacement group in Norne/ Snøhvit Petech (Statoil). He has a PhD in reservoir physics from the University of Bergen. He has been working on IOR processes and techniques, both as a reservoir engineer in Statoil and as a researcher at the University of Bergen.*

The First

The Future

Looking towards 2030, the aim is to reach 60% recovery on the main field. The field is already well into the tail production phase. The ambition of 60% recovery must be reached through implementation of new technology and new ideas. Currently Norne Petech is investigating the potential for subsea IOR e.g. subsea pumps, subsea separation and artificial lift.

In addition, Statoil has an ambition to develop competence and new technology to produce tight reservoirs. This development will be beneficial for Norne producing the last remaining reserves.

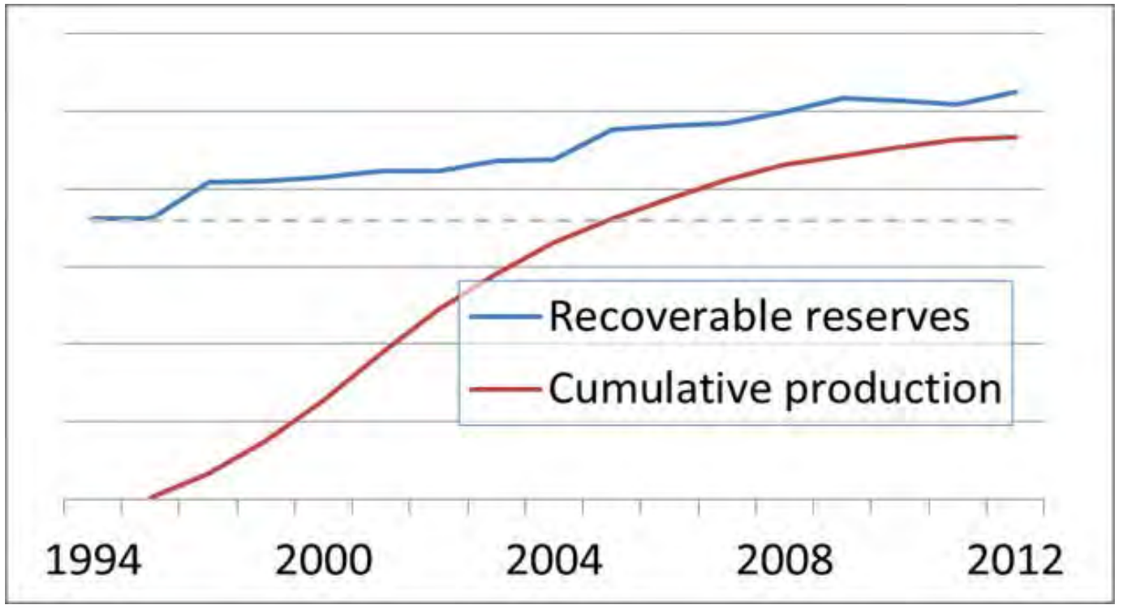


Figure 2: Increase in Norne reserves due to tie in of satellite fields

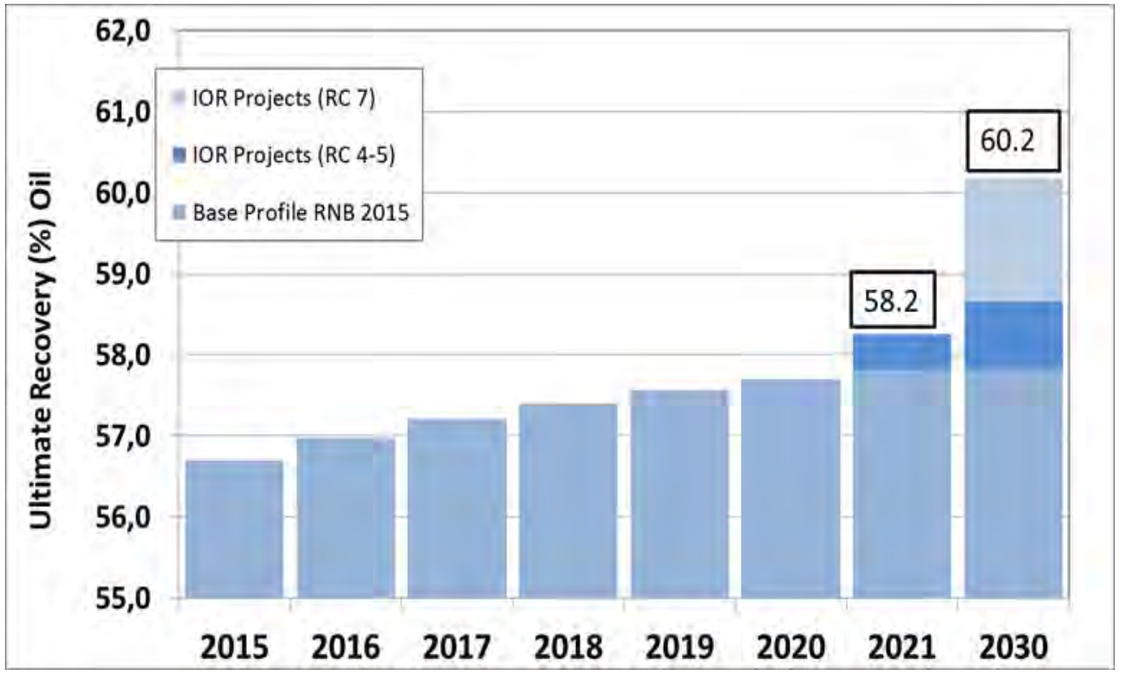


Figure 3: Recovery factor for Norne Main Field

Lundin
Norway

Bygget på erfaring
Drevet av ambisjon

Edvard Grieg var vår første letebrønn, vårt første funn, og blir nå vår første egenopererte oljeplattform.

Det er hittil det største utbyggingsprosjektet Lundin Norway har gjennomført. Plattformen er også det ferskeste eksempelet på at norsk leverandørindustri kan levere det ypperste av design og kvalitet som de tøffe forholdene i Nordsjøen krever.

Med Edvard Grieg i drift vil vi vår daglige oljeproduksjon nå et nivå på 75.000 fat hver dag. Og når Johan Sverdrup kommer i produksjon i 2019 vil vår produksjon dobles.

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MERKET FOR GOD DESIGN

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iQx™ GEO - Well Data Made Simple

by Ole-Gunnar Tveiten and Eyvind Aker, AGR

Gunnar Tveiten
Manager Well Operations Support, AGR

Eyvind Aker
Principal Rock Physicist, AGR

Following the success of iQx™ Experience and Offset modules for drillers in well planning and skills transfer process, AGR recently launched a new application, iQx™ GEO for petroleum engineers and geoscientists.

iQx™ for drillers

The iQx™ platform was developed by and for drilling engineers tired of browsing historical well reports in search for well data, equipment selection and not least, the good and bad experiences to take into consideration when planning the next well. Usually, going through previous End of Well Reports requires spending the majority of time doing offset analysis, searching for data and reformatting findings in order to make data comparable.

AGR has drilled more than 500 well projects globally on behalf of their clients and using iQx™ internally has helped them capture experiences and data from previous projects improving the company's operating performance.

The development of iQx™ began four years ago and today it is used by several companies mainly in Norway.

iQx™ GEO for geoscientists and petroleum engineers

The development of iQx™ GEO module started a year ago by subsurface professionals at AGR. In essence, iQx™ GEO makes thousands of Petrobank files available for instant analysis without the need to browse multiple file formats.

Most subsurface engineers spend time loading data from files, converting file formats to readable formats and importing to interpretation software. This is an exercise, which can be tedious and time consuming. A "Petrobank" usually means safe storage of data files, with a huge variety in formats and codes. Adding up to the complexity of data files is the difference in mnemonic characteristics that suppliers use for their data acquisition tools, despite the fact that the tools are similar.

iQx™ is online and has the benefit of processing vast amounts of data in a very short time. iQx™ stores data and facilitates direct analysis, graphical display and generates export files for interpretation. **"The iQx™ philosophy is – Big Data made simple".** Instead of storing files, numbers are referenced directly for spatial analysis.

As subsurface specialists, we can see huge benefits in terms of data capture from the Petrobank. The Petrobank is a secure storage facility, but usually requires Project Data Managers to download and streamline data for interpretation work. **"AGR's iQx™ GEO ambition is to enable the end user (geoscientists and engineers) to be able to capture data directly and not relying on Project Data Manager anytime, anywhere with the only requirement being an internet connection".**

AGR's Reservoir Management team has used iQx™ GEO for a year now testing feasibility and adapting the programme to subsurface needs. After a year of testing, the software makes a significant impact on data capture efficiency. This is good news since most of us want to work on the analysis, not data management.

Working across disciplines

The oil and gas industry has been struggling with the data management volume, complexities and multiple copies of everything – since day one! When a well is logged, real time data is followed by rush data; then followed by end of section data; then followed by end of well report and finally followed by blue book reports. The well results become a "truck load" of paper, films, files, reports and experiences in people's heads.

Different sub-surface professionals use well data for a huge variety of purposes:

1. Petrophysicists use raw logs for computer processed interpretations of hydrocarbon content.
2. Rock-physicists use logs for describing mechanical properties.
3. Geologists use logs for correlation, dating of sequences, interpretation of depositional environment, reservoir characterization, fault seal analysis, trap integrity.
4. Geophysicists use logs for tying wells to seismic, processing of seismic, depth conversion, fluid substitution and AVO analysis.
5. Reservoir engineers use logs for characterizing reservoir and flow properties, barrier identification and to make production profile estimates.
6. Basin analysts use temperature, pressure, porosity versus depth, maturity measurements, HC characteristics to understand petroleum systems.
7. Drilling Engineers use experiences from previous wells which are crucial to success in the next.
8. Drilling Supervisors can efficiently find answers to actual problems during operations by browsing iQx™ for data or experiences.
9. Drilling Managers can supervise all drilling teams effortlessly making sure that data and experiences are being captured and comparing performance between operations or development over time.
10. Drilling Optimization Engineer can compare several well designs, drilling parameters and experiences to continuously improve on performance.

iQx™ serves as a tool facilitating co-operation across disciplines.

Across professional disciplines, drilling incidents may also be important to others than just the drilling engineer:

- Losses and shows could indicate hydrocarbon filled fractured reservoir not detected by conventional logs.
- Obviously gains and shows are important indications that a discovery could be demonstrated.
- Spalling shale, tight hole, bit balling, dog-leg, hole instability, over-pull, drill break, pump pressure, lost circulation material, mud additives, rate of penetration, torque, weight on bit, temperature, gas readings are all incidents relevant for different reasons and interpretations to different professionals.

iQx™ is constantly being adapted to meet requests and wishes of different professionals in terms of data capture and display function. The basic paradigm shift is that data are stored as numbers rather than files. **"Imagine numbers and values from 6,000 wells at your fingertips".**

iQx™ International Launch

AGR's iQx™ has been launched outside Norway, primarily towards international companies working across borders and basins as a tool for cooperation between offices and disciplines. Other countries utilising similar facilities to the Norwegian Petrobank (Diskos) are equally suited for iQx™ within their organisations.

Large companies may have challenges in their own "data vault". iQx™ technology enables huge databases to be structured geographically with values rather than files. Proprietary data is honoured and each company retains full ownership and integrity of their concessional rights. In terms of mergers and acquisitions iQx™ is well suited to capture company data.

iQx™ can be tailor-made with solutions that will incorporate company-specific approved interpretations and raw data. In this way, iQx™ can become a very simple solution to a complex challenge of how to share data and interpretations.

To date, this scale of data capture and organisation has not been done before, simply because the technology is new. In terms of the iQx™ Experience and iQx™ Offset modules, working across borders, basins and offices means that; **"one incident or experience is described in a system; with a reference, a cause and remedial action and is kept for future reference independent on who was there at the time".** The reference can be formation (rock), equipment (rig, bit, mud etc) or basin (geography), thus lessons learned can be used independently of which engineer did the work originally.

Data capture efficiency

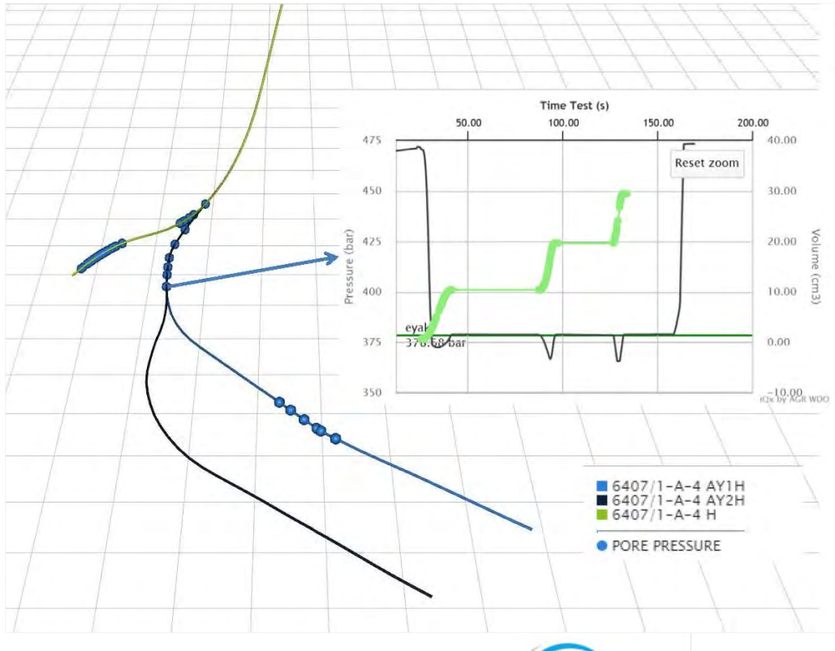
In large companies professionals tend to depend on a project data manager (PDM), which will secure available data to do the work, the work station is populated with data before project starts and during the course of the work. Big Data has become a buzz word, with a number of people being kept busy organizing project data input and output.

In an industry where people move frequently between companies and between departments, important knowledge often leaves the organisation or the company with the people. With iQx™ it is possible to make sure that data and experiences are not only retained but are made accessible to the end user, independent of experience with the company or the specific operation. AGR's iQx™ solution is user driven, where the end-user is empowered to capture data directly - this is a key to retaining organisational knowledge.

ENDS

About AGR

Global service company AGR delivers well construction and engineering project management, HSEQ, reservoir and facilities engineering solutions to the upstream oil and gas industry. AGR also offers rig access management, consultancy manpower, software technologies and tailored training. AGR has managed over 500 well projects and delivered more than 1,000 reservoir studies in all major basins and reservoir types. AGR has offices in Norway, UK, Australia, USA, Colombia, UAE and CIS.



Investigation of pressure points in production wells

**The authors of the article are SPE members and work at AGR's Oslo office. To contact the authors, please send an e-mail to ole.gunnar.tveiten@agr.com or eyvind.aker@agr.com*

tNavigator – breaking reservoir simulation speed limits in Europe!

by Scott Harrison, Rock Flow Dynamics

Scott Harrison
Business Development Manager in Europe
RFD

For many years now reservoir simulation has been a practical and accepted practice within oil and gas recovery, adopted by nearly all petroleum companies today. Running dynamic models of an asset, or a specified sector of the field, using numerical engines to predict fluid flow behaviour and quantify oil and gas recovery is seen as a best practice solution to de-risk each drilled well and ultimately optimise the overall recovery when creating a field development plan.

Over recent years we have witnessed a surge in static modelling capabilities. Huge full field models are created with high resolution of associated field data that can now be constructed to create a representation of the subsurface, allowing for better understanding of the asset. Added to this the industry also faces very challenging (and not to mention, costly!) wells, therefore making time-dependent predictions for field optimisation is of paramount importance. Around 30 years ago, standard reservoir simulation technologies made enterprising developments for tying in applied physics to a numerical simulation. However, many of these standard simulation packages are unable to optimise the modern supercomputer hardware platforms to take full advantage of parallel scalability performance, thus leading to some frustrating workarounds for reservoir engineers, constantly confronted with a difficult comprise between time of simulation; resolution and active cell count of the model; and monetary budget for software licences and available hardware capacity.

With these bottlenecks in mind, Rock Flow Dynamics have created a reservoir simulation technology that tackles these compromises in order to hand the advantage back to the reservoir engineer. tNavigator is a fully parallel hydrodynamic simulation technology that can run models at the geological scale within reasonable simulation time. A highly intuitive graphical user interface that works on the fly during simulation also saves reservoir engineers a lot of time, as they do not have to wait until the simulation is finished to analyse the results.

tNavigator technology has expanded worldwide due to some key features that are changing the way companies view reservoir simulation. Intel Capital also invested into Rock Flow Dynamics with a co-marketing agreement in 2010, recognising the potential of this product for the petroleum industry.

Towards the tail end of 2014 an office was set up in Europe to promote tNavigator and provision all client interactions with front line support. Since this milestone moment there has been a number of evaluations taken up within the UK, Norway, Germany, Spain, France, Italy, Austria and Holland. There are now many new clients added to the growing list with future sales forecasts looking extremely positive.

In order to achieve such success there are some fundamental values aligned with the technology in order to simplify the perceived constraints of moving from tried and trusted methods to something that is now commonly being described in the industry as a "game changer".

The first point of call is that tNavigator is vendor neutral. It recognises standard industry formats so there is limited, or in most cases, zero format conversion that is required. Embedded convertors in tNavigator will seamlessly 'read' the current model and bring it to life in a 2d and 3d visual representation. For many reservoir engineers, this will be the first time that they have seen their dynamic model displayed in something that is not lines of outdated text scripts. Visually, it is a very impressive start….

The design and layout of the graphical user interface has been fully led by the reservoir engineering community. In order to reduce mouse clicks and ensure that all functionality is within logical proximity to one another the guidance of simulation experts was utilised in order to develop the product. Being able to interact with your model before, during and after a simulation run adds tremendous benefit that permits the reservoir engineer to fully explore all kinds of data that were once not thought possible (or practical) for analysis. A distinct benefit about the interface is that there is so little training required in order to get up and running. For an experienced reservoir engineer, picking up tNavigator is simple. By utilising the pdf tutorials and simple guidance from the RFD local support team, it takes almost no time to begin using the software to great effect.

Now that the reservoir engineer is in control and able to work with the model more fluently, the logical next step is to actually run the simulation. Every line of tNavigator code is fully parallel giving unrivalled scalability for acceleration performance improvements. So regardless of the size and complexity of the model it is always possible to reduce simulation time by adding more hardware. The vision of Rock Flow Dynamics is to ensure that high resolution simulations and huge history matching and uncertainty studies are not so much a dream but a reality, therefore the licensing policy is to include full parallel performance of all available cores within the workstation or cluster node per standard simulation engine. The high-end desktops, such as HP z840 currently have up to 36 computational cores. With proper implementation of the software this hardware allows for up to 25-30 times speed-up compared to simulations on the single core. This means the simulation time for a challenging model can be reduced from 1 day to 1 hour on a workstation. As for high-performance clusters, there is no limit really. The recent studies show up to 100+ and even 1000+ times speed up for large models. With the capabilities and price effective rates of modern hardware it is now possible to improve acceleration performance by almost limitless means. Meaning, if you need a faster reservoir simulation, it is now scalable on tNavigator and at a cost permitting solution.

Quotations:

"Occasionally someone comes along with a truly new approach. And is usually met with disbelief, because the status quo is always more comfortable. With over 35 years' experience in reservoir simulation, I would like to say, that tNavigator have created this Eureka moment and have taken simulation into the 21st century. Superfast processing comes with synchronised GUI for maps, line graphs and well displays; it allows for immediate timestep by timestep analysis of the history match in progress. Stop/Retrace/Start technology allows for ad hoc intervention during a run, alleviating the need to wait to the last timestep; effectively conducting multiple runs in one. Interrogation of the results is so improved, that one now considers whole new data, which were previously left untouched. Truly a game changer!"

- Bruce Stevens, Reservoir Engineering Consultant, EnQuest

"We were initially looking for a cost effective solution to our simulation needs. tNavigator provided much more than that. Its impressive muti-core capabilities, coupled with intuitive and reservoir engineering oriented features provided a step change in some of our simulation studies. Simulation runs that would take days, now can be run, analyzed and fully exploited within hours. Its user friendly design made it possible for our engineers to switch from other simulators to TNavigator in a matter of a few hours. What RFD has achieved in the space of a few years is an impressive technical achievement which, coupled with a competitive price strategy, provides real and tangible value to our organisation."

- Xavier Lopez, Senior Reservoir Engineer, VERMILION REP

"The tNavigator technology represents a game-changer for us compared to other reservoir simulation software in our organization. We not only can tackle far more complex reservoir models with the software, but we are also able to fully exploit the exceptional speed of tNavigator in combination with our assisted history matching software to significantly reduce project cycle times. This in turn has made reservoir simulation a much more valuable tool to our organization."

- Larry Murray. Manager, Waterflood Modeling, Occidental Oil and Gas California Operations

"Having been a user of reservoir simulation for over 30 years, I was looking for the next step change in technology that allowed us to do the things we wanted to do, at the resolution we wanted, in an acceptable timeframe and at reasonable cost. RFD achieved this, and I'm sure will achieve a significant part of the reservoir simulation marketplace as others realise that this is a step change in the performance/price value driver."

- Steve Flew. Technical Director, Petrofac Malaysia

"I've used the tNavigator for a while now for our polymer study, but also other simulations since it's so fast and it fits nicely into our Petrel workflow. It's so intuitive that none of us had to attend any training course."

- Geir–Magnus Sæternes. Reservoir Engineer. Lundin Petroleum Norway.

NEED FOR SPEED!

by Jens-Petter Nørgård, Lundin Norway AS

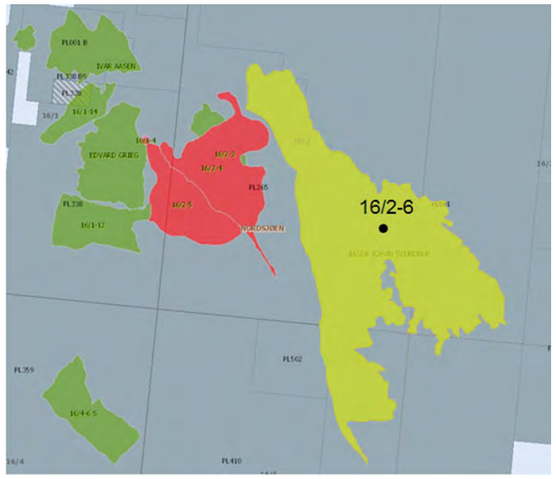
One of the larges oil discoveries ever made offshore Norway, the Johan Sverdrup Field, was discovered by Lundin Norway in 2010. Described in the media as 'World Class Reservoir' with 'Champagne oil' expectations are high. Even though the reservoir is fantastic, it doesn't drain itself and various IOR methods had to be evaluated. One method that was studied, and still being considered, is polymer flooding. Lundin Norway carried out a polymer evaluation project with TIORCO to find a polymer suitable for Johan Sverdrup, obtain polymer characteristics for dynamic simulations and do initial evaluations. Polymer flooding cases with alternating gas injections are very calculation intensive and simulation time increased far beyond the time available in the project. This show stopper had to be eliminated in order to complete the study on time.

Jens-Petter Nørgård
Sr Reservoir Engineer
Chairman PL501
Resource Committee

Lundin Norway

The Johan Sverdrup Field

Johan Sverdrup was discovered with the well 16/2-6 drilled by Lundin Norway. The field is situated about 140 km West of Stavanger and cover some 200 km2 stretching into 3 licenses. The reservoir is relatively homogeneous with high to very high permeability. Reservoir pay is 70m in the thickest parts. The oil is strongly undersaturated and has a moderate viscosity. On February 13th 2015 the PDO was submitted by the partnership Statoil (Operator), Petoro, DetNorske, Maersk and Lundin Norway. This mega development is estimated to cost 170-220 bNOK and total income from sales products 1.350 bNOK. In the first development stage a field centre consisting of 4 platforms will be ready in Q4 2019. Water will be injected via 3 subsea templates for pressure support. Concept for the following development stages is still being evaluated. Even a small percent increase in recovery on this large field can generate significant extra revenue to the part-



The Johan Sverdrup field was discovered in 2010 when Lundin Norway drilled the well 16/2-6. Later appraisal drilling by PL265 operator Statoil and PL501 operator Lundin Norway revealed this large field extending some 200 km2.(Picture: NPD factmaps)

Johan Sverdrup Field Centre in phase 1 with riser platform, drilling platform, process platform and living quarters (Picture: Johan Sverdrup konsekvensutredning)

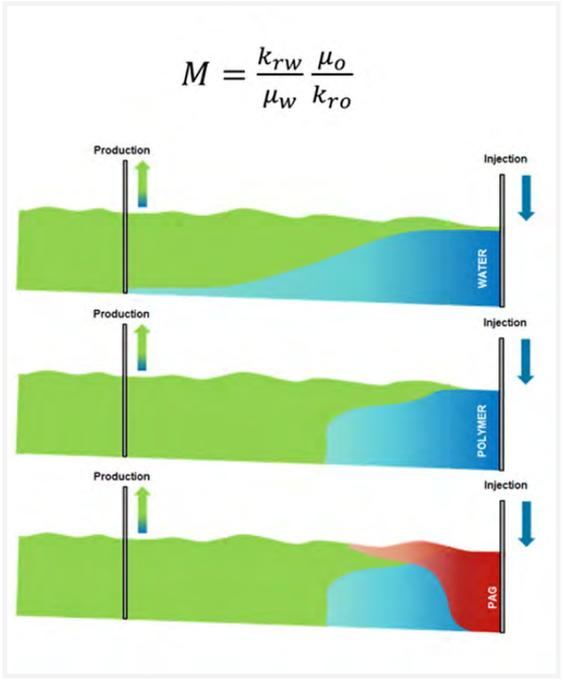
ners, the Norwegian government and people.

Polymer project

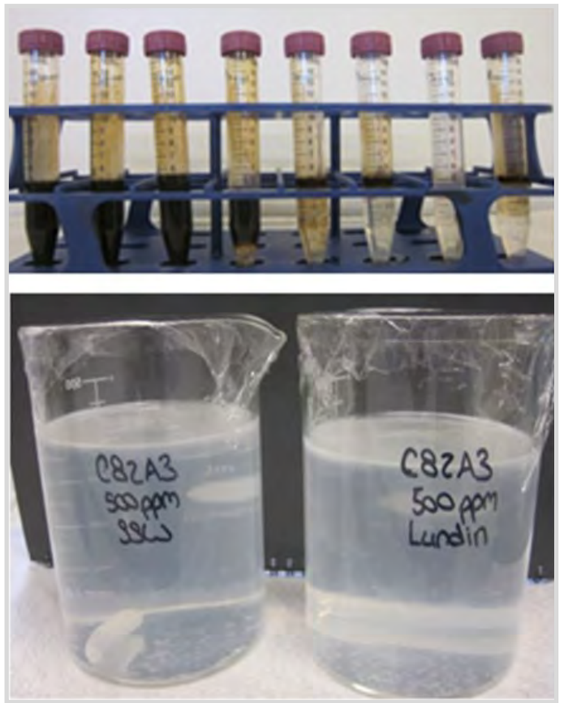
Given the moderate viscosity in this field, the water-oil mobility ratio suggests that polymer flooding may have an effect. By adding polymer to the injected water it will become more viscous, hence, the water-oil mobility ratio more favourable resulting in less fingering and a more piston like water front with lower oil saturation behind the front. Several polymers were screened based on their properties. Lab experiments were done on five selected polymers to investigate thermal stability, viscosity at different polymer concentrations, screen factors and compatibility with formation and injection water. Finally, one polymer was selected for core flood experiments with both sea water and low salinity water. A numerical model of the flooding experiments was history matched with lab results providing a set of keywords describing polymer-rock properties, adsorption and degradation. This characterization is used in the full field simulation and enables calculation of polymer concentration and water viscosity of each grid cell.

Implementation of lab results in simulation model

The bumpy ceiling of the reservoir implies that there may be attic oil not swept by the water or polymer flooding. Polymer Alternating Gas (PAG) was therefore considered in the study. Full field simulations with polymer flooding took long time, but alternating with gas dramatically increased the simulation time. It would be impossible to complete the study on time with full field simulations taking almost one week. An alternative plan to speed up simulations was needed. Rock Flow Dynamics (RFD) had earlier demonstrated their fast simulator, tNavigator, and was contacted regarding this challenge. Polymer functionality was not supported at the time. However, RFD saw this as a natural development and entered a project with Lundin Norway to develop the required functionality. Within a couple of months a version was ready, tested and verified. Simulation time



Conceptual illustration showing average saturation when water flooding, polymer flooding and flooding polymer alternating gas. Notice the delayed water break through for polymer and the recovery of attic oil when alternating with gas



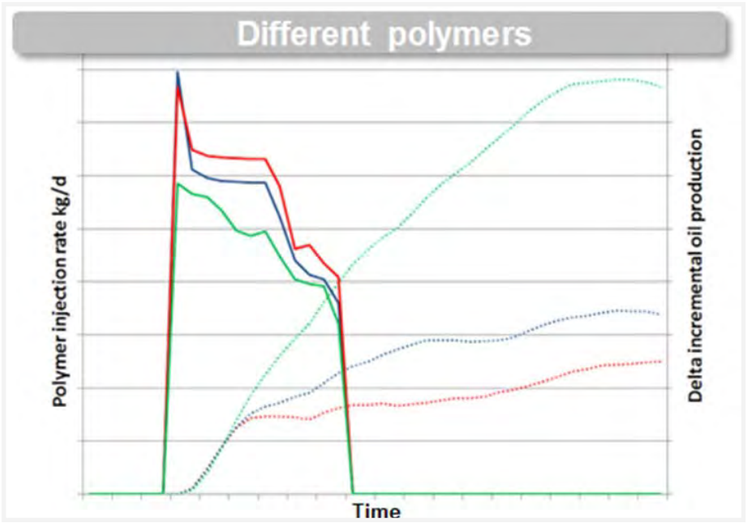
Testing of polymers was done by TIORCO

was reduced by astonishing 75-85% on a regular dual CPU workstation with 16 cores on board. The key advantage of tNavigator is the simulation speed. The technology is designed to maximize the parallel performance on the modern multicore hardware. The license price does not depend on the number of cores in the workstation, so the available computational resource could be utilized efficiently. tNavigator supports the conventional simulation model formats. Therefore, the project team did not loose any time on input data conversion as the existing model could be loaded as is. With the new simulator in place multiple sensitivities were run in order to quantify the effect of polymer. Sensitivities covering polymer injection in selected injectors vs all, selected areas vs all field, timing of polymer injection, variation in polymer concentration and polymer injection vs polymer alternating gas. Economical evaluation of the cases was done to gain some insight to what would be a good polymer strategy.

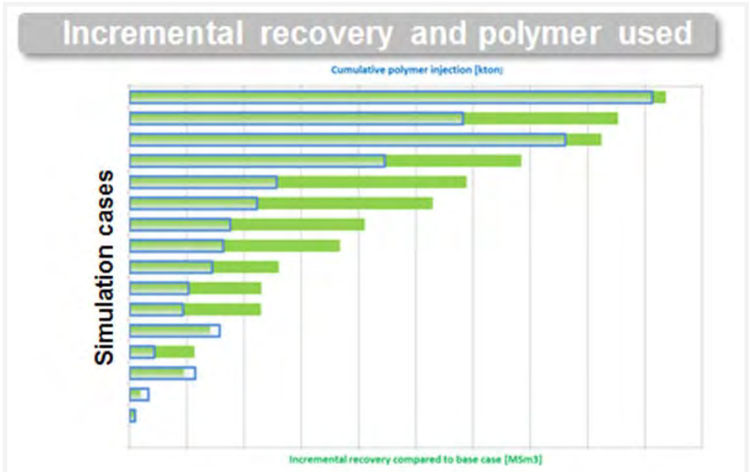
Summary and observations

The polymer experiments performed by TIORCO provided input to the simulation model. Changing the simulation platform to tNavigator reduced simulation time with up to 85% on a workstation enabling simulations to be completed within the given timeframe. This initial study proved useful and more detailed IOR studies are ongoing and managed by the Working Operator. It is premature to conclude, however some observations are worth mentioning. Polymer flooding had a positive effect in all cases. No sensitivity was done on the polymer properties; hence, results could change if e.g. polymer were to degrade faster in the reservoir than anticipated. The study showed that production increase comes several years after polymer injection starts. Rough estimates for operating cost and capital investment where available at the time of the study, so any conclusion regarding project economics is premature. However, observations suggest it may be challenging to make it economically attractive in some cases since the additional revenue from polymer flooding comes late. The study shows that the gain is not equal in all parts of the field. Incremental recovery vs polymer used suggest that polymer injection in selected areas only is more economically favourable than polymer injection in all injectors. Polymer alternating gas also indicated an upside potential, but this complex scenario needs further studying and optimization before any conclusions can be made. Prior to any investment decisions more detailed reservoir studies are required in addition to studies covering polymer type and properties, logistics, operations, handling of produced polymer and HSE aspects.

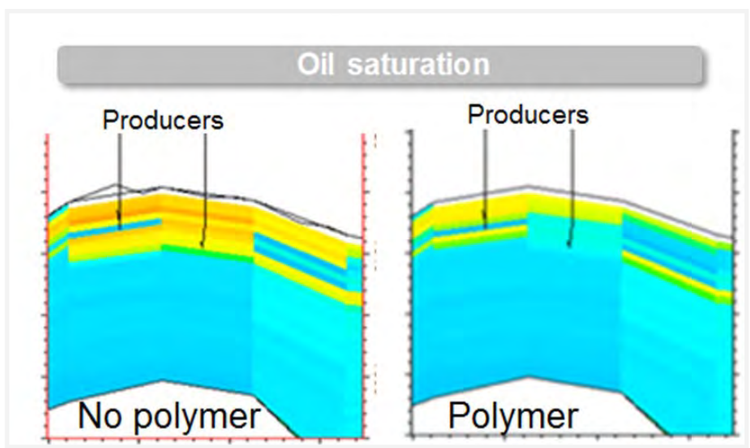
The First



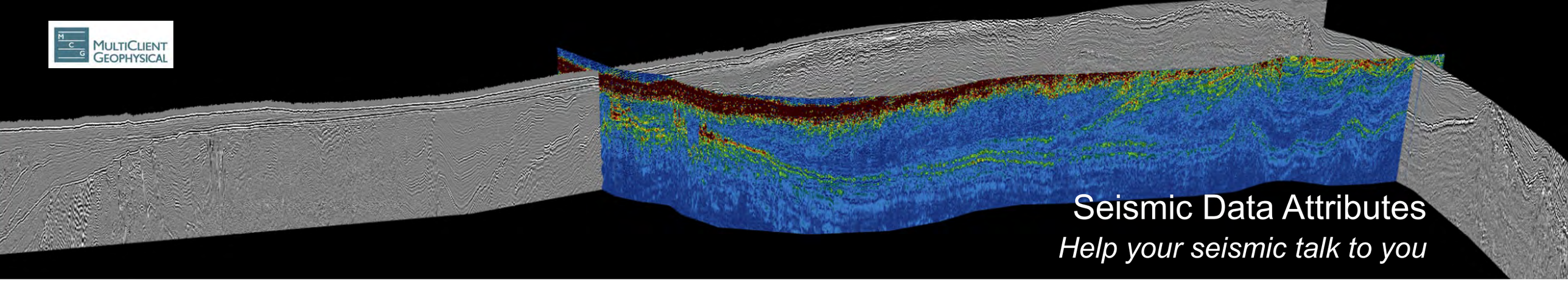
Varying polymer injection rate and resulting increase in production is shown above. Notice the delay in production increase



The figure shows the ratio of polymer used and incremental recovery for various cases. Cases are made anonymous, but the figure illustrates the wide range in polymer flooding efficiency



A cross section showing oil saturation with water flooding and polymer flooding. Notice there is some attic oil left that could be drained with gas



Seismic Data Attributes — new look at the old techniques

by Vita Kalashnikova and Juri Muzi, PSS-Geo AS

Vita Kalashnikova
QI Geophysicist
PSS-Geo AS /
YP SPE Chair Oslo /
vita@pss-geo.com

Juri Muzi
Senior Geophysicist
PSS-Geo AS/
OSEG Board member

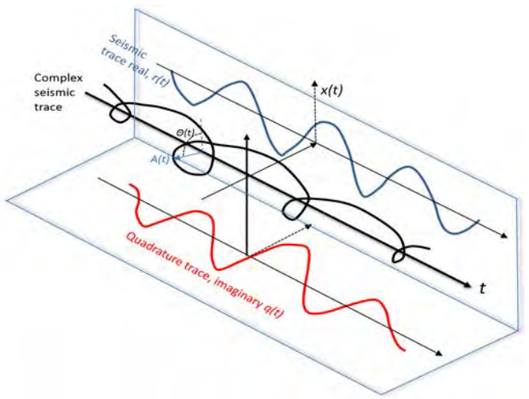
Seismic Data Attributes processing are well know techniques, but not many companies use them for exploration needs. Most on the G&G departments limit their research to AVO or to some simple "screening attributes scan" analysis. Modern software packages include attribute modules which can be applied directly to the seismic section, while more sophisticated lithology and fluid based attributes are typically handed down to other expensive software/module and required external geophysicist expertise, even though they are actually of simple computation.

This article is simplified explanation of several Seismic Data Attributes, which PSS-Geo AS normally compute as a part of fully quantitative data interpretation and deliver separately a product package of attributes with color codes and manual.

Some of the attributes that were computed for the MCG Barents Sea Well Tie Survey are shown here.

Seismic data attributes

The traditional interpretation of seismic data is based on the temporal and spatial variations of fundamental seismic data properties: reflection amplitudes, reflection phase and wavelet frequency. Quantitative parameters of seismic data can be very precious to get more information and reduce the ambiguity of the results of traditional seismic interpretation. Analysis of seismic data attributes gives structural and stratigraphic understanding of geologic conditions. Different approaches extract and display various amplitudes, phases and frequencies in convenient, understandable format.



Picture 1. Complex seismic trace

The basis of attributes computation is modified Aki-Richards equation (Intercept/ Gradient/ Curvature) [1], Geostack method described by Fatti et al. (1994) [2], and decomposition of complex seismic trace followed by Hilbert transform, see Pic. 1.

Attributes physics and Interpretation

Several attributes were chosen to highlight Lithology and Fluid. The list and description of the attributes are presented below. Some of these attributes are shown on Pictures 3,4,5.

– ***Envelope*** $A(t)=(q^2(t)+r^2(t))^{½}$, $q(t)$ - quadrature trace (Imaginary), $r(t)$ –seismic trace, see Pic. 1. It is a magnitude of the complex trace, defined by the trace and its Hilbert transform. Also known as instantaneous amplitude. In literature, also can be called as instantaneous energy of signal or reflection strength. It shows lithology changes, bright spots, and thin-bed tuning effects.

– ***Fluid Factor*** (FFr) - $FFr=Rp(t)-g(t)\cdot Rs(t)$, $g(t)=M\cdot(Vs/Vp)$, where M is a slope of liner approximation on Vp vs Vs plot. In the examples shown in this article, to calculate $g(t)$ Castagna sandstone mudrock line* is taken for simplification.

Avseth et al (2010) [3] made a short good and concise description of all the principles for Fluid Factor computation. He summarised that brine-saturated siliciclastic rocks have low reflector amplitudes, and gas rocks will be brightening up even more, because reflection amplitudes will lie off the mudrock line. Carbonates, igneous rocks, and several other lithologies should be carefully studied on this attribute because they may also show brightened up.

The strongest negative events in sandstone layers can be considered as hydrocarbon saturated rocks. When $Rp(t)-g(t)\cdot Rs(t)=0$, it corresponds to brine saturated rocks, with $Rp(t)-g(t)\cdot Rs(t)<0$, it can be considered as hydrocarbon saturated rocks. Finally, when $Rp(t)-g(t)\cdot Rs(t)>0$ this is considered as a hard event.

$g(t)$ *is* the most important coefficient which can be calculated using available well logs data. When properly calculating $g(t)$ coefficient along the well path, its application to the seismic section gives *the most accurate lithology based fluid indicator.*

– Lithology based fluid indicator

****Instantaneous frequency***

$\omega(t)=d(\theta)/dt$ — instantaneous frequency is the time derivative of the instantaneous phase $\theta(t)$, see Pic. 1. This attribute shows the lower frequencies often seen below gas sands in bright spots: *shadows*. The low-frequencies *shadows* effect is described by Taner et al (1979) [4]. It often occurs only on reflectors which lie just below the hydrocarbons layer: gas sand, condensate, and oil. The frequency character of reflections slowly changes according to changes in lithology or thickness. Furthermore the instantaneous frequencies change more rapidly at the edges and wedges. Low-frequency shadows can also indicate fractured fragile rocks.

The instantaneous parameters are associated with the point in time on the seismic pulse; they are not affected by the reflection strength.

– Lithology based fluid indicator

****amplitude weighted frequencies***

Amplitude weighted frequencies is a product of the amplitude envelope (reflection strength) and the instantaneous frequency. Amplitude weighted frequencies of the lithology based fluid indicator section highlights the lowest impedance layers in a more accurate way, see Pic. 3 [4].

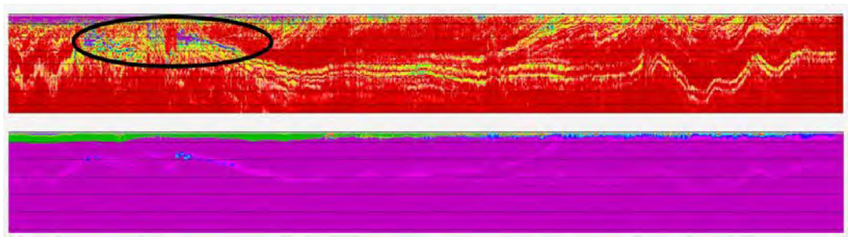
– ***Poisson's ration*** (pseudo-Poisson's, introduced by Smith and Gildow as ratio reflectivity [5]). The pseudo-Poison's ratio reflectivity of fractional Vp/Vs can be directly calculated from the estimation of P- and S- waves reflectivity and fractional changes in density. This attribute is the calculation of normalised changes in Vp/Vs ratio, which can be directly correlated to lithology and/or pore fluid content changes.

– ***Density section*** (delta Rho) - $\rho=2\cdot(A(t)-C(t))$. $A(t)$ is the ideal zero-offset (intercept) trace and $C(t)$ is the curvature term [1]. It can be interpreted as an indicator of density similarities over a seismic section. This attribute is only significant at higher offsets.

– ***IGT*** (Intercept multiplied on Gradient) section (required spatially calculated color code) – shows seismic section colored by AVO classes, see Pic. 4. ***Intercept*** is the amplitude at zero-offset, and ***Gradient*** is the slopes of the line on amplitudes vs angles of incident plots.

– ***Pay zone*** – the angle of crossover, indicates a polarity reversal effect. Absolute amplitudes decreases with offset until one reaches the crossover angle, flips polarity, and subsequently increases. Events with this response typically appear weak on the stacked section. Nevertheless, this polarity reversal effect has been known to indicate rock properties consistent with pay zone, see Pic. 5.

Picture 2. The MCG Barents Sea Well Tie Survey. (Data of MultiClient Geophysical ASA).



Picture 3. A MCG Barents Sea Well Tie line that crosses the Wisting discovery. Two Seismic Data Fluid Factor based Attributes. Wisting discovery is shown in black oval

Examples

The examples below are some attributes displays of the 2D MCG Barents Sea Well Tie line (Data of MultiClient Geophysical ASA, processed by PSS-Geo AS), see Pic. 2. A long East West oriented line was chosen for

** Mudrock line is an empirical linear relation between seismic P-wave velocity (Vp) and S-wave velocity (Vs). Introduced by Castagna, J. P.; Batzle, M. L.; Eastwood, R. L. (1985). "Relationships between compressional-wave and shear-wave velocities in clastic silicate rocks". Geophysics 50: 571–581.*

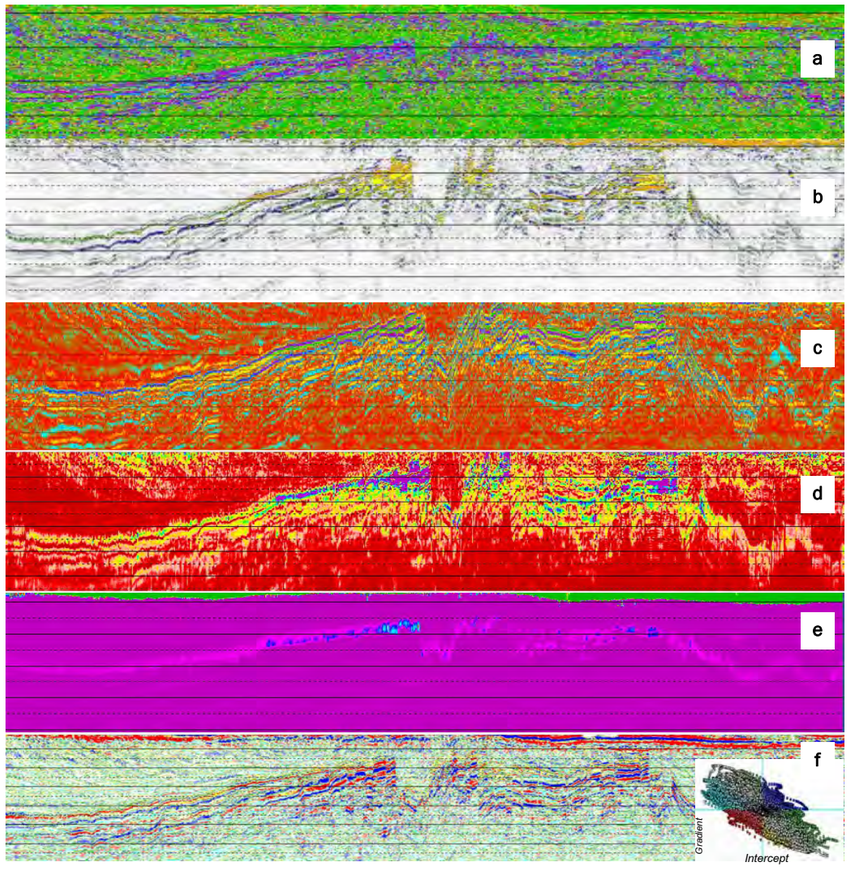
Seismic Data Attributes

MCG Barents Sea Well Tie Survey

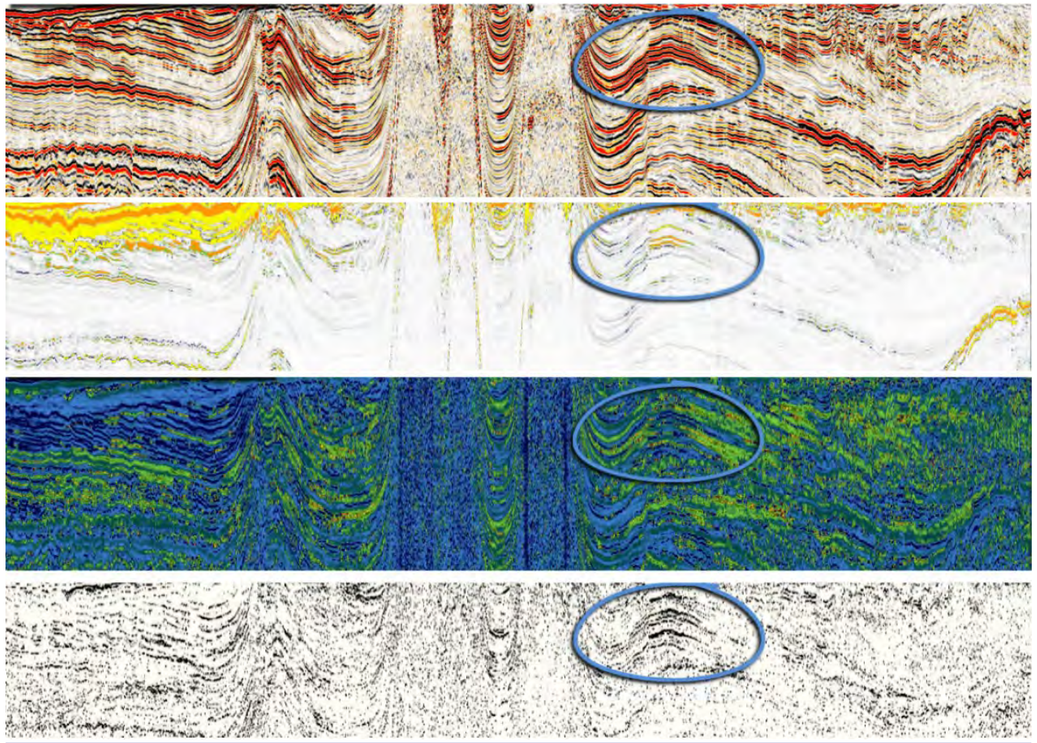
crossing the Wisting discovery.
Seismic Data Attributes, described in this article, were calculated for the entire MCG Barents Sea Well Tie Survey. Several reservoirs were highlighted on the Fluid Factor related attributes which were confirmed by other attributes. The reservoirs which were not highlighted on some of the Seismic Data Attributes were postponed from the analysis, see Pic 5. This quick seismic "scan" allowed to define similarity in the rock properties, and possible pores fill.
On Picture 3, amplitude weighted frequencies of Lithology based fluid indicator attribute shows hydrocarbons in purple color. The section below is the integration of the section above. The easiest anomalies that are theoretically supposed to be related to hydrocarbons are in blue.
On Picture 4, several Seismic Data Attributes are shown for a particular area of the Wisting discovery. The top picture *(a)* is Rp (additional attributes, reflection coefficients), showing similarity in reflectivity across the structure. The second picture *(b)* is pure Fluid Factor calculated for Castagna sandstone, as described in *the Attributes physics and Interpretation* paragraph. Negative amplitudes indicate possible hydrocarbons in orange color. Picture *c* is the Density section. Pictures *d* and *e* are amplitude weighted frequencies of Lithology based fluid indicator attribute and its integration. The last picture *(f)* is the IGT section, clearly showing both top and base of the reservoir.
Picture 5 shows a succession of Full Stack and Seismic Data Attributes of another East line from the MCG Barents Sea Well Tie Survey. It is easy to observe "anomalies" matches and mismatches on the presented Attributes.

Summary

Calculated Seismic Data Attributes are the fast scan of seismic data. Most known reservoirs that the MCG Barents Sea Well Tie Survey is crossing in the Barents Sea are nicely mapped.
The attributes are developed to minimize time and risk for exploration, though they should not be used as a final prospect conclusion.
It is important to know that the attributes sections are not scaled sections. The color scale should be adjusted to the working time window (except for the IGT section). Conclusion about possible hydrocarbons reservoirs can only be done when all hydrocarbon related attributes indicate hydrocarbon at the same event.



Picture 4. Wisting Discovery. From top to bottom: Reflection strength, Fluid Factor, Density, Two Fluid Factor related attributes and IGT section



Picture 5. The MCG Barents Sea Well Tie Survey, East line. From top to bottom: Full Stack, Fluid Factor, Fluid Factor related attribute, Pay Zone

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MULTICLIENT GEOPHYSICAL

Stasjonsveien 18 1396
Billingstad, Norway
Phone: +47 66 98 41 10
Email: mcg@mcg.no

PSS-Geo

Solligata 2, 0254 Oslo, Norway
Phone: +47 225 60 715
Email vita@pss-geo.com

CSEM's Influence on Exploration Decisions & Seismic: Examples From the Barents Sea

by By Stein Fanavoll, EMGS

Stein Fanavoll
Exploration Advisor
EMGS

While the Barents Sea has long been a source of frustration for E&P operators with only one field in production and one under development after 30 years of exploration, there has recently been more optimism with oil discoveries in Skrugard, Alta and Wisting.
Historically, exploration wells in the Barents Sea have been drilled on the basis of seismic data and geologic structures. Since 2008, however, EMGS has begun acquiring 3D controlled-source electromagnetic (CSEM) data to provide additional geophysical information in the last three licensing rounds. Over 40,000 km2 of multi-client data has been acquired to date and is being used as an interpretation tool alongside seismic.
This article will provide an update on 3D CSEM activity in the Barents Sea and through using case studies examples, will demonstrate: i) How 3D CSEM supports play models and generates valuable information on a license application phase as well as in drilling decisions; and ii) How 3D CSEM provides crucial input to prospect ranking and drill-or-drop decisions.

CSEM – Method, Survey Design & Inversion Methodology

Electrical resistivity of the subsurface is a physical property that strongly correlates with the fluid content and saturation of hydrocarbon reservoirs. 3D Controlled Source Electromagnetic (CSEM) data maps resistive anomalies in the subsurface, where the larger the resistive body, the greater the response.
All multi-client 3D CSEM data acquired in the Barents Sea is 3D wide-azimuth data and is acquired through grids of receivers (all with multi-component electric and magnetic sensors) along with a 3 km receiver and line distance.
In the case examples, the 3D CSEM data was inverted into 3D earth resistivity models.

CSEM in the Barents Sea

Most of the wells in the Barents Sea are concentrated in the Hammerfest Basin, the Loppa High, Hoop area and the Polheim Subplatform. Here, the geology is variable, ranging from Tertiary basins in the west, Jurassic basins (e.g., Hammerfest Basin) in the middle part, and Triassic and Permian platforms (e.g., Bjarmeland Platform and Finnmark Platform, respectively) in the east.
Major uncertainties remain, however, in regard to the prospectivity of some areas. This is mainly related to the reservoir quality of Triassic reservoirs and high seal risk. New ideas and technologies are therefore needed to increase future success rates.
Between 2008 and 2013, EMGS

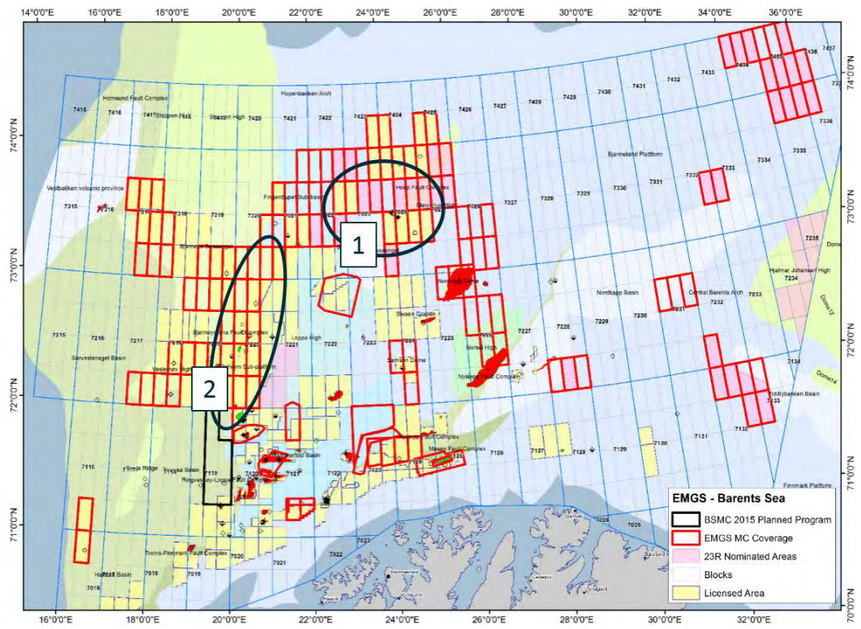

Figure 1. An overview of EM acquisition in the Barents Sea. The case study examples are shown 1-2; red rectangles indicate blocks where CSEM was acquired

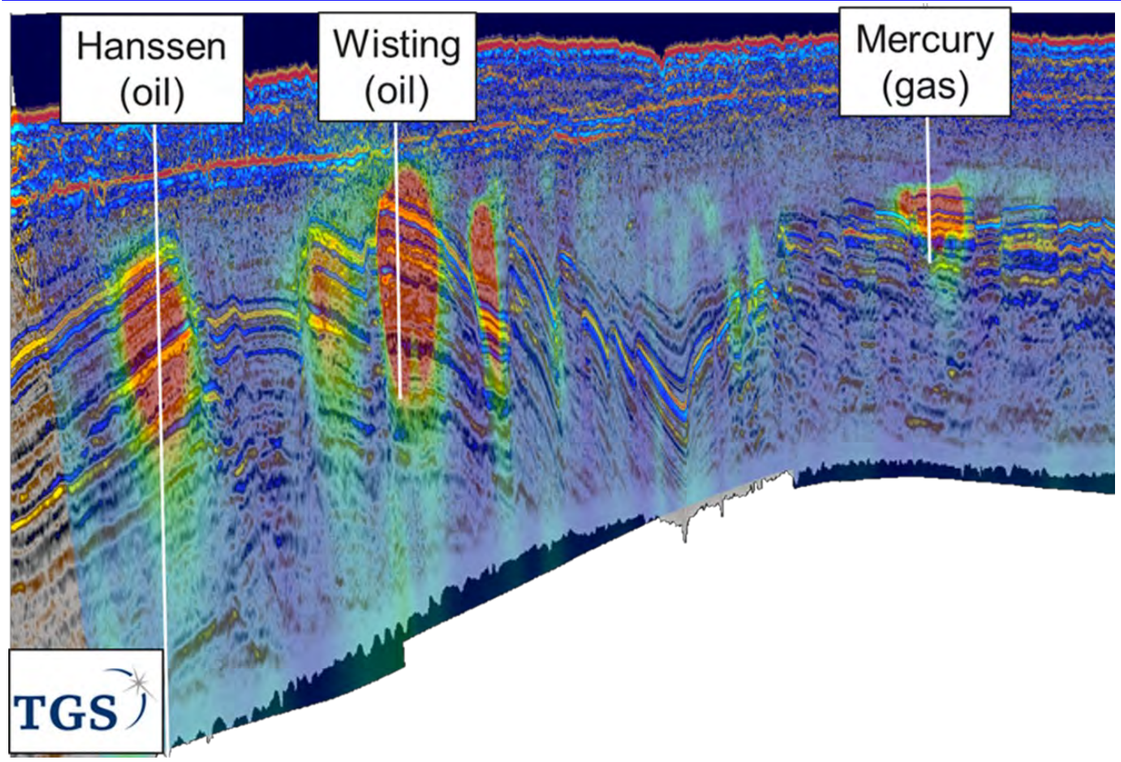

Figure 2. The Wisting, Hanssen and Mercury Discoveries where the white lines indicate wells and where the very high resistive anomalies represent hydrocarbons and show an excellent conformity to structure

built up a substantial 3D EM multi-client library, as shown in Figure 1 where the red rectangles illustrate acquired blocks and the case study examples are shown – 1 and 2.

Case Study 1: The Hoop Area

One key discovery in the Hoop is the Wisting prospect in Lower Jurassic reservoir rocks. In September 2013, the Austrian oil company OMV announced an oil discovery in license PL537 on the Wisting prospect with an oil column of 50–60 m and potentially recoverable reserves of 60–130 MMboe. The following year a new oil discovery - Hanssen - was announced in the same license. In the neighboring license there was a gas discovery, Mercury, the same year.
All discoveries are associated with a significant EM anomaly as can be seen in Figure 2. The illustration shows a 3D CSEM inversion overlaying high resolution seismic for the Hanssen, Wisting and Mercury wells – all of which

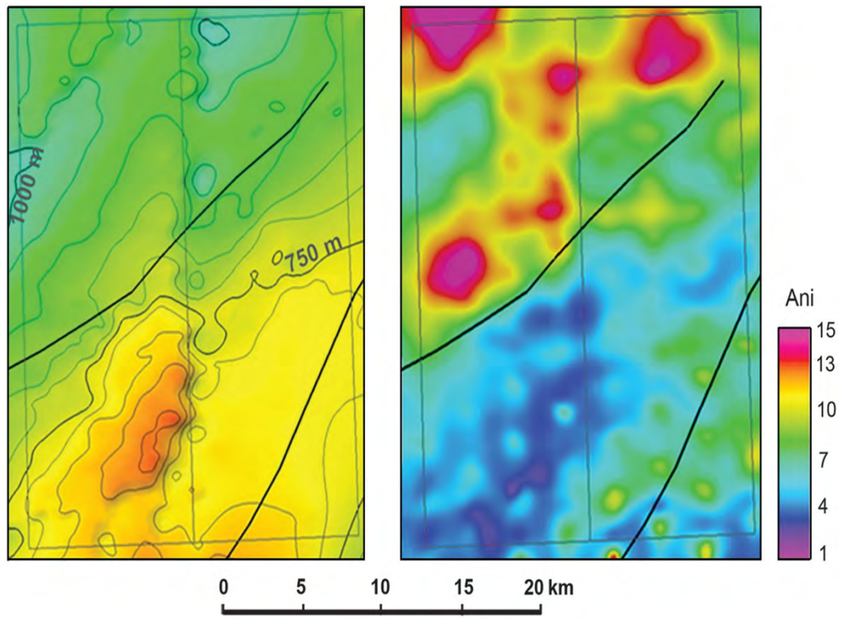

Figure 3. A structure map and CSEM Results two blocks Northwest of the Wisting Discovery. The depth structure map (left) indicates a large, shallow structural closure (contour interval 50 m), whereas the CSEM anisotropy anomaly map (right) shows resistive anomalies in the northern part

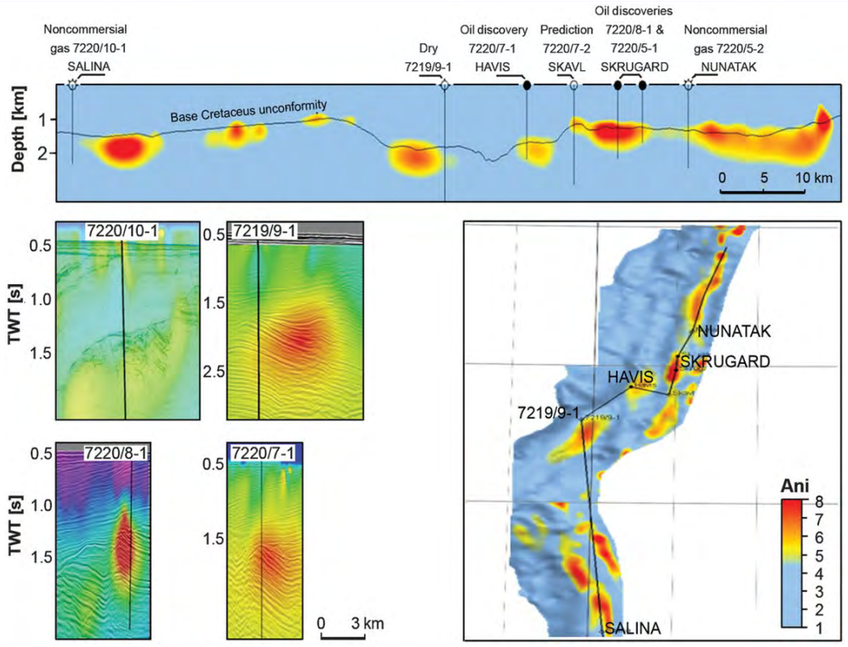

Figure 4. Seven wells where CSEM provided a correct prediction for the Lower to Middle Jurassic and Lower Cretaceous plays along the Bjørnøyrenna Fault Complex

were successful. The high resistivity (highlighted in red) indicates hydrocarbon charged reservoirs.

However, there are also examples where seismic amplitude anomalies are not associated with high resistivity, severely limiting the possible outcome of such a target.

Different Play Models Requiring Further Investigation

These discoveries also open up additional oil discoveries in the area with the CSEM data revealing large anomalies for further investigation.

Some have argued recently, for example, the case for an increased focus on a different depositional environment in the upper Triassic *(Kjølhamar, 2012)*. This idea is supported by the inversion results from the CSEM data, where CSEM anomalies are present in the area where these Triassic reservoirs are assumed to be present *(Fanavoll et al., 2013)*. This also raises fundamental questions as to which play models should be pursued: the resistive Triassic target or the Jurassic target even though there might be a mismatch between seismic and CSEM?

When studying the map for two of the blocks in the area (see Figure 3), it can be seen that there is little correlation between the shallow Jurassic structure and CSEM anomalies. This suggests that if the anomalies are caused by hydrocarbons, the traps will partly need stratigraphic closure and/or fault seal. In addition, these resistive anomalies seem to represent a deeper source for resistivity than the Wisting Discovery.

Making the right decisions between Triassic and Jurassic targets will be of enormous value to the industry, especially as the same question applies for many of the other Hoop area licenses. An integrated approach that includes CSEM, seismic AVO and inversion, well results, and other geologic information will be crucial in achieving this.

Case Study 2: The Polheim Subplatform and Bjørnøyrenna Fault Complex - Looking for Analogs

The Polheim subplatform and the Bjørnøyrenna fault complex separate the Loppa High to the east from the Bjørnøya Basin to the west. Skrugard and Havis were discovered on the Polheim subplatform in 2011 and 2012.

Figure 4 shows seven wells in the area where CSEM provided a correct prediction for the Lower to Middle Jurassic and Lower Cretaceous plays along the Bjørnøyrenna Fault Complex.

Three of the wells are significant discoveries (Havis 7220/7-1, Skrugard 7220/8-1, and 7220/5-1). Skavl (7220/7-2) also revealed oil and gas predicted by CSEM, although it was a small discovery. Together these discoveries form the Johan Castberg field development.

Three wells are non-commercial or dry (7219/9-1, Salina 7220/10-1, and Nunatak 7220/5-2), demonstrating CSEM's ability to distinguish between commercial and non-commercial hydrocarbon bearing reservoirs. Recently, two more wells have been drilled on the Polheim Subplatform: the Kramsnø (7220/4-1) and Drivis (7220/7-3). Both wells reported small amounts of hydrocarbons below the sensitivity range of the CSEM technology.

Figure 5 shows three leads on the Polheim subplatform along the Bjørnøyrenna Fault Complex where multi-client 3D CSEM and 2D seismic data are integrated. Two of the leads are interpreted to be analogs with the Lower to Middle Jurassic reservoirs penetrated by the wells (Figure 5a and 5b). The third lead is located east of well 7219/9-1 (Figures 4 and 5c) and is interpreted to be associated with the Lower Cretaceous–Upper Jurassic section.

Through the integration of geophysical, seismic and CSEM data (see figure 5a), an interpretation of the deltaic Lower to Middle Jurassic sand is shown in yellow and Lower Cretaceous fans are shown in green.

Structural closure is identified for the deltaic sand whereas the Lower Cretaceous fans need a combined structural-stratigraphic trap. CSEM data (anomalous vertical resistivity) overlays the seismic data to the right in Figure 5a. This CSEM attribute emphasizes anomalous resistivity values and is calculated by subtracting a background resistivity model from the vertical resistivity model obtained from inversion *(Gabrielsen et al., 2013)*.

In Figure 5b, a possible flat spot is identified on 2D seismic data in a rotated fault block. The flat spot is interpreted to be in the Middle Jurassic. The CSEM attribute apparent anisotropy overlays the seismic data to the right. Apparent anisotropy is calculated by dividing the inverted vertical resistivity model by the horizontal resistivity model.

This attribute emphasizes thin resistors because thin resistors are only imaged in the vertical resistivity model and not in the horizontal resistivity model in an unconstrained inversion *(Alcocer et al., 2013; Gabrielsen et al., 2013)*. The apparent anisotropy shows an anomaly located in the same position as the flat spot on the seismic.

The last example is within Upper Jurassic to Lower Cretaceous syn-rift sediments southeast of the dry well 7219/9-1 (Figures 4 and 5c). Sand is predicted to be present in the syn-rift sediments by seismic inversion *(Carstens, 2009 and Gabrielsen, 1994)* and a vertical resistivity anomaly is identified to be located in these syn-rift sediments (Figures 4 and 5c right). The depth of this resistive anomaly is uncertain.

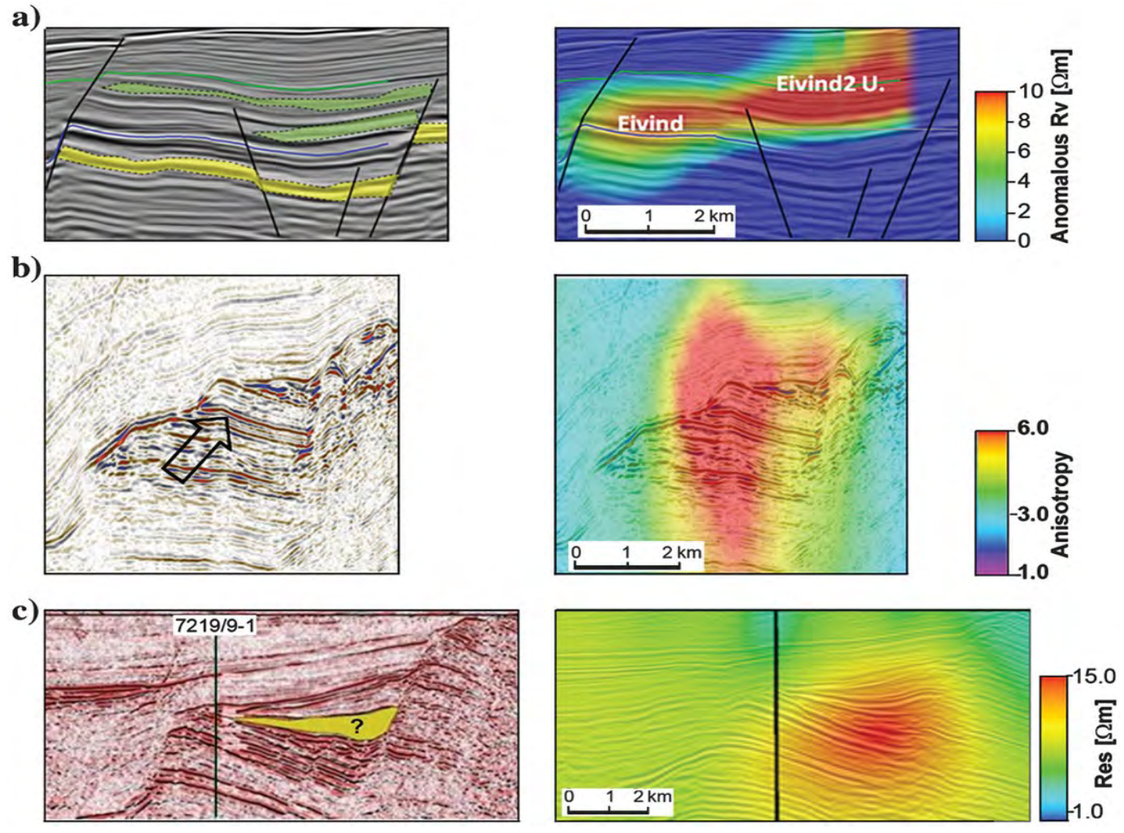

Figure 5 - Three leads on the Polheim subplatform along the Bjørnøyrenna Fault Complex where multi-client 3D CSEM and 2D seismic data are integrated

The two first leads in Figure 5 also show resistive anomalies in Lower to Middle Jurassic sands located in a rotated fault block. One of them also shows indications of a flat spot on the 2D seismic data. These leads are interesting because they can be regarded as analogs to the Havis and Skrugard discoveries.

The result of combining CSEM with marine seismic is the identification of a number of new leads and vital information for prospect ranking and drill-or-drop decisions.

Conclusion

While exploration history in the Barents Sea cannot be considered successful to date, the emergence of CSEM data as a complimentary tool to seismic raises reasons for optimism, especially as there are large unexplored areas (in the range of 100,000 km2).

With the coverage of 3D multi-client CSEM data allowing for the calibration of more than 20 wells - some drilled before and some after CSEM acquisition - for all these wells CSEM accurately predicted the outcome of drilling. This knowledge can in turn be used to better de-risk new prospects.

Based on this convincing track record to date in the Barents Sea, CSEM data when interpreted alongside other geophysical and geologic information can have a crucial influence on exploration decisions - where to and where not to drill, license applications, prospect ranking, drill-drop decisions, and farm-in–farm-out decisions

Acknowledgments

The authors would like to thank the Society of Exploration Geophysicists and Interpretation for permission to re-publish some of the material in this article (found in Interpretation, 'CSEM as A Tool for Better Exploration Decisions', August 2014) and the European Association of Geoscientists and Engineers for re-publishing material found in Firs Break Magazine ('The Impact of CSEM on Exploration Decisions & Seismic, November 2014).

Some examples are also taken from the joint project between EMGS and MultiClient Geophysical ASA for seismic and CSEM integration and cooperation between EMGS and TGS.

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Signal processing challenges of measurement and logging while extended reach drilling in the North Sea

by Peter Shulgin, CEO Axel

Peter Shulgin
CEO Axel
peter.shulgin@axelmwd.com

Today the vast majority of drilling companies use mud-pulse telemetry for transmitting measurements and logging while drilling (MWD/LWD) data to the surface in real time. However, external conditions like pumps, mud consistency, and drill string movements reduce the quality of data received at the surface. Obstacles that decrease the percentage of decoding include sporadic noises caused by drill string movements and mud motor operation, as well as ongoing noises created by pumps and electric systems on the rig. In addition, the signal level from MWD systems decreases as depth increases, making the transmission channel less reliable as drilling progresses. Transmark EDS, one of the most experienced directional drilling companies in the North Sea region, operates in extremely challenging conditions. They often are forced to place mud pulse MWD systems below the motor or use them in conjunction with rotary steerable systems. Such workarounds create significant decoding challenges. Based on the recommendations of other drilling contractors, Transmark EDS decided to try the recently developed Axel Surface Unit to reduce the effects of pump noises and high torques on their operations as shown in Figure 1.

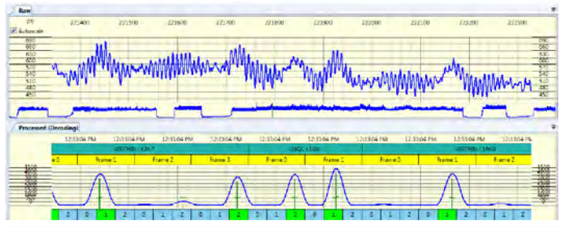


Figure 1. High torques processed by Axel Decoder

Axel is an independent MWD manufacturer founded in 2012 in response to a market need for standardized communications for MWD/LWD systems operating in extreme environments. Axel's first major goal was to improve decoding quality in mud pulse telemetry by developing a universal surface solution. Their solution, the Axel Surface Unit, offers hardware and software compatible with different types of MWD downhole tools. Axel's team successfully implemented advanced signal processing algorithms and cutting-edge machine learning techniques to take decoding systems to the next level. When Transmark EDS started drilling with Axel in 2014, the unit was quickly developing a reputation as the best surface system available on the international market.

Initially, Transmark EDS ran the Axel Surface Unit in parallel with their previous surface solutions. Comparative performance testing showed that Axel outperformed competitors during drilling in the North Sea region. The Axel Surface Unit consistently decoded sections for which other systems showed poor decoding or no decoding at all.

Axel's superior performance is based on a combination of features for noise reduction, including specially designed smoothing and correlation filters as shown in Figure 2. A manual toolkit allows MWD engineers freedom to manage the decoding process in real time and manually decode the most problematic signal intervals. This significantly improves decoding quality and resolves many decoding issues.

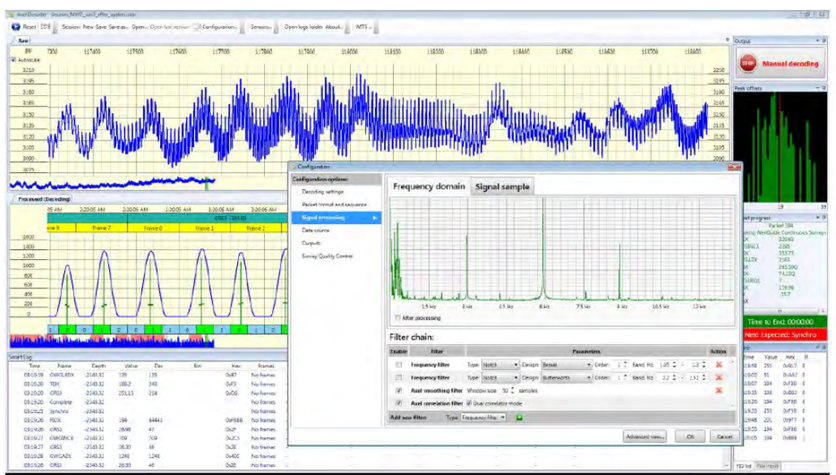


Figure 2. The combination of Axel Smoothing Filter and Axel Correlation Filter helps to remove spikes from the frequency domain

Axel's technical team is very responsive to client requests. The flexible and scalable architecture of each unit makes it possible to quickly build case-specific improvements and push software updates to operating surface units while drilling is in progress. Based on data provided by Transmark EDS, Axel was able to start work on a universal filter solution for noises caused by rotary steerable systems. The Axel technical team will be glad to present the results when the work is complete.

Enhanced oil recovery powered by nature – a WIN - WIN

by Johan Sandberg, Service Line Leader Offshore Renewables, Cecilie Kielland, Consultant, and Are Kaspersen, Consultant, DNV GL – Energy

Johan Sandberg
Service Line Leader, Offshore Renewables, DNV GL - Energy

Cecilie Kielland
Consultant, DNV GL – Oil & Gas

Are Kaspersen
Consultant, DNV GL – Oil & Gas

DNV GL has just kicked off a Joint Industry Project (JIP) called 'WIN – WIN – WINd powered Water Injection' to assess the technical and economic feasibility of using floating offshore wind turbines for powering subsea water injection systems for increased oil recovery (IOR)

Smarter and greener

The oil business is currently challenged by a low oil price, increasing cost and a demand for more sustainable operations. If the industry is to become more efficient and if renewables are to be proved in a commercial setting, it is a need for collaboration.

While wind intermittency may be a challenge for many oil and gas applications, the water injection process can handle some degree of intermittency as long as a specific volume of water is injected over a given time period. This power supply can be combined with relevant water injection technologies to provide water of required quality to the reservoir.

The upstream industry has for many decades injected water into oil reservoirs to increase recovery. Traditional solutions using processed injection water are impacted by the necessity for long power cables and water injection flowlines, which are significant cost drivers. The systems are energy-intensive and space consuming.

Floating wind turbines have in recent years emerged as a promising technology for large scale renewable power production. Several full-scale offshore pilot turbines have delivered promising results which builds on the knowledge from both the offshore oil and gas industry and the wind power industry.

Initial DNV GL studies suggest there are opportunities for a new generation of wind-powered water injection systems used to increase reservoir pressure. There are several advantages, such as extending the life of marginal and mature fields, and reduction of both costs and emissions from offshore oil and gas installations. The system could be installed without costly retro-fittings on the platform, it could provide access to systems normally located subsea and increase the flexibility of the injection location and reduce the installation time. It could also be possible to move the system and use it at new locations after the closure of a well or field.

The Concept

The WIN WIN concept is based on a floating wind turbine system that is separated and at a distance from the production platform. The power for the water treatment systems, injection pumps, and the auxiliary systems will be supplied by the wind turbine generator itself

The economic rationale is dependent on the characteristics of the field. The best business cases are typically applications with marginal fields where associated gas for fuel is limited and tie-back to other production hosts or import of fuel are the main alternatives.

Technical considerations

High level studies indicate that the stand-alone wind powered system is technically feasible and potentially cost-competitive to alternative solutions. To deepen the knowledge and develop a more detailed understanding of the system with its opportunities and challenges, the JIP will take a detailed approach through analysis of a number of technical and economic case studies reflecting the operators needs and real-life experience.

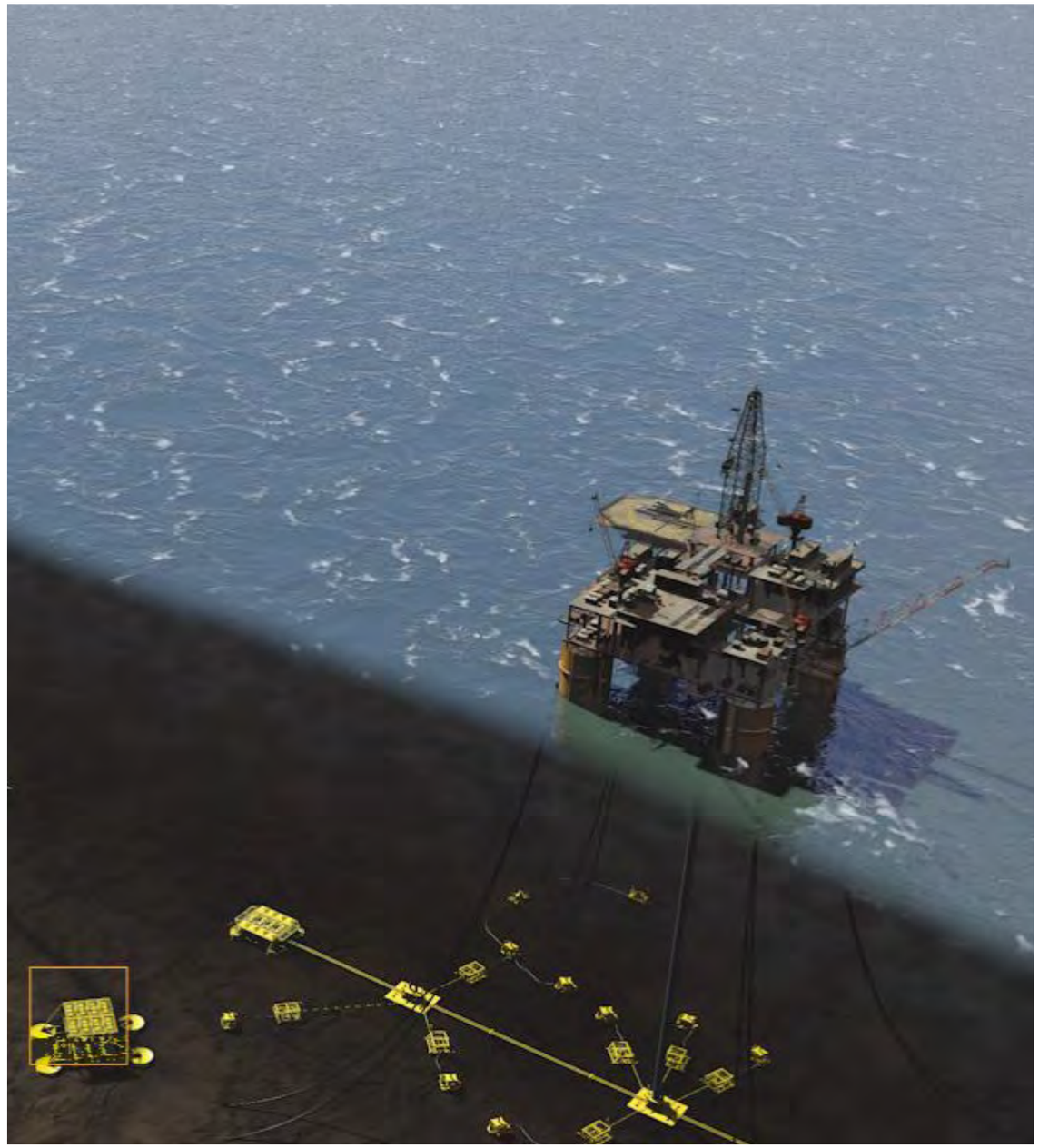
Building on the results obtained from an earlier study by DNV GL, some of the critical issues to be addressed by the JIP are:

* Reservoir characteristics and well system
* Floating wind turbine system design and selection of wind turbine
* Operational challenges and pump intermittency
* System stability and availability
* Power outages and black start capability
* Economic and regulatory aspects

Conclusion

The aim of the JIP is provide enough information to give the industry confidence to develop the WIN WIN concept into an actual project. Participants in the project now include a handful of operators from several countries.

A successful integration of offshore wind power with offshore oil and gas operations could provide the oil and gas industry with a new and cost-efficient means to develop marginal reservoirs and increase production in mature fields with long step-out distances. It could reduce costs for certain activities while also offering a new niche market for offshore wind technology, creating momentum for both industries. It's a WIN WIN!



The First

BIG DATA and Analytics in Upstream Oil and Gas Industry

From Idea to Realization

On 10th of February, the representatives of various companies from oil and gas and IT industry met together at the event dedicated to Big Data solutions and analytics and claimed to be the first of its kind in Norway. The one day conference and exhibition was hold at Radisson Blu Scandinavia Hotel in Oslo and attracted around 100 people from operating companies, oil service providers, IT vendors, management consultancies and academia.

Among them there were Statoil, Schlumberger, SAS Institute, Teradata, IBM, Microsoft, Oracle, McKinsey & Co, Bain & Co, SINTEF, NTNU and others.

It can be said that Norway is a right place for such kind of an event in order to tap into Big Data within oil and gas industry taking into account not only data-heavy seismic services activity in the country, but also its vast offshore operational activity and status of being a leader in subsea technology applications. The latter implies remote and integrated operations during drilling and production and lots of subsea instrumentation and sensors. Regarding the global status of data usage, it should be emphasized that today the need to collect more data for competitive and informed decision-making is driving the industry to thoroughly address Big Data within E&P and Drilling. The desire to better understand subsurface has driven oil and gas companies to collect different types of even more data at higher frequencies. Thanks to real-time data collection, the amount of data being gathered from seismic activity, drilling process, logging activity, production activities, subsea equipment, downhole sensors, etc. has dramatically increased over the past years. At the same time, data analytics becomes the key to the success of the business in today's competitive environment. Hence, the industry deals with huge quantities and varieties of data on one hand, and ever-bigger expectations for analytics on the other.

The event therefore provided a unique opportunity for the industry experts to address the challenges, status and emerging technologies in Big Data within E&P and Drilling domain. Well-known professionals from such companies and institutions as SAS Institute, IBM, Teradata, Microsoft, Oracle, Bain & Co, NTNU and University of Oslo presented their vision and best practices about the main issue, i.e. how to exploit data as a strategic asset in a better way. They were all well welcomed by the audience, and the common interest in the topic seemed to have sparked communication and establishing business contacts.

To summarize, the conference received a lot of positive feedback from the participants. It was discovered that such kind of the event if made annual would be highly appreciated by the industry professionals who expressed their opinion after the event that they were lacking it. The organizing team in turn will take into consideration all inputs with respect to possible improvements in order to hopefully make this conference even a bigger success next year.

Egor Bokin
SPE Oslo board member/
Subsea Production Engineer/
Digital Field Support, FMC Technology

The First

Big Value from Big Data : How Oil and Gas can learn from other industries

by Duncan Irving, Practice Lead, Oil and Gas, EMEA & APAC, Teradata

Dr Duncan Irving
Principal Consultant,
Oil & Gas, EMEA & APAC

The downward trend in oil prices has marked the longest decline since the US travel and leisure organization, the AAA, started tracking retail gasoline prices 15 years ago.

But for oil and gas companies, that recent stabilisation is hardly any comfort. The current price still represents a nearly six-year low and, considering the geopolitical landscape driving the price of oil – ever-downward at the moment – it's clear that gasoline prices simply aren't going to bump back up substantially anytime in the foreseeable future.

So, what does big data and analytics have to do with the price of gasoline? For the oil and gas industry, a whole lot. Simply put, to weather this storm of deflated prices and uncertainty, the oil and gas industry must undergo a fundamental shift in how it collects, shares and analyzes data. I've dubbed this new approach the "Connected Well" and truly believe it is a fundamental framework that oil and gas companies – which account for hundreds of billions of dollars in transactions and employ hundreds of thousands of people globally – will adopt to deal with today's uncertainty.

The Secret is in Shared, (Big) Data-Driven Insights

What is the "Connected Well?" At its core, it's built on the same conceptual framework as the Quantified Self and the Connected Car paradigms – a conceptual framework by which an industry can understand the value of bringing stakeholders together around a particular ecosystem.

Already, the manufacturing, aerospace and automotive industries have employed such a framework to bounce back from industry upheaval. Just like oil and gas, these industries invested heavily in sensor technology over the last decade. But, the idea of using this kind of data to make better business decisions isn't (or at least shouldn't be) new. The key is that, when things got tough, these industries took the important next step of integrating and analyzing that high-volume data (like data from sensors) in conjunction with financial, logistics, equipment condition and usage data across their organization and across their industries.

Consider what could happen in the oil and gas industry if we brought this concept to operations, reservoir, production and maintenance domains, integrating them under a 'Connected Well' approach. For example, decision-makers in the oil and gas industry must know full lifecycle costs of any given well, from exploration to abandonment, in order to have a true picture of what is most cost effective in terms of avoiding non-productive time, scheduling maintenance against overall productivity based on recorded equipment usage, and when to buy, sell, develop or defer. This is always the case, but the stakes are even higher now, considering the state of the industry and price of oil.

This "true picture" requires more than integrating data spread out across various business units – it requires accessing and integrating data that's across an ecosystem of contractors, partners and stakeholders. In this example, decision-makers must look at costs in the context of all wells and equipment on the same – and similar – fields. (Note: analytics will tell you what "similar" means here.) Then, they must integrate this with all available equipment information from drilling contractors, plant providers and engineering inspection and service companies to develop an understanding of what works and what doesn't. This is how the aerospace industry transformed through the 1990s and 2000s, whereby aircraft operators and owners, and the engine manufacturers shared data in the new service-level rather than product-driven business model.

Realizing the Vision of the "Connected Well"

How do we make the "Connected Well" a reality? Well, like most mega-trends, it takes more than one. The movement can't happen without the right technology and, more importantly, the leaders willing to forge new lines of communication and new pan-organizational and intra-industry relationships. With regard to technology, companies need a platform that can grow with the increasing data demands, and enable analytics that is fast, easy, accurate and ready to put into production. Lots of oil companies have already worked to integrate their own data into one data warehouse, but that's not the same as bringing together outside data and making sure it can actually be analyzed.

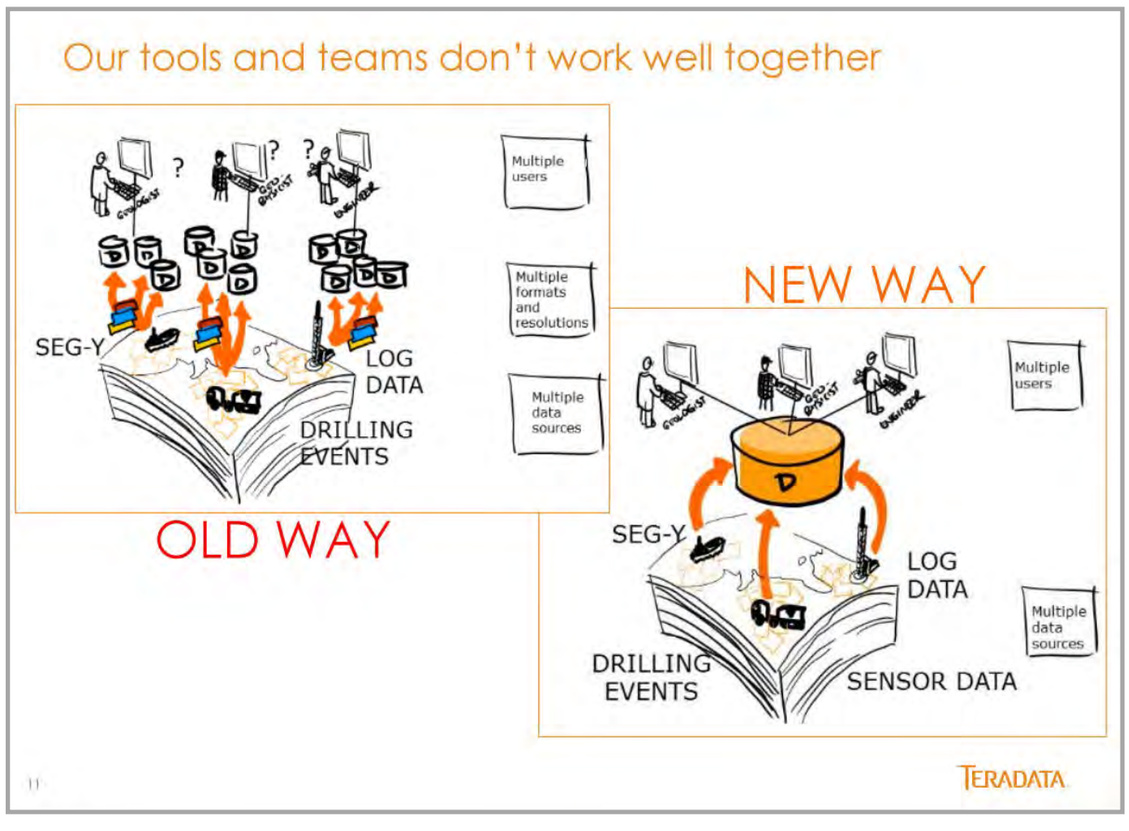
Data warehousing has long been the scale-out solution for integrating large amounts of data to quantify well-defined relationships for immediate business use. However, the disruptive explosion of massive amounts of time series data from sensors and loggers means that a refining process must be applied before newly generated data can be placed in the context of a wider knowledge pool. The emergent and vibrant Hadoop ecosystem has all of the components to ingest and process such data at the scale and pace necessary and pass it to the operational data warehouse for contextualization and decision support. Crucially this ecosystem is already realizing its potential in other science-driven and engineering-driven workflows such as the biopharmaceutical, aerospace, and petrochemical industries where data describing complex systems and operations is captured and integrated into operational business processes.

As has been seen in these other industries, the biggest challenge is often leadership and organizational culture. This type of industry-wide integration requires lots of different groups talking to each

other. You need to actually put people in the same room and bring disparate teams together – until you can do that efficiently, you aren't doing it right. So why isn't this happening in Oil and Gas? The gaps in understanding between what technology companies have to offer and what the oil industry requires for this digital transition need closing. It doesn't suffice for tech companies to namecheck Big Data and Cloud and hope that it will do the trick – there are a lot of gotchas in this industry: from the high science; to the fact that the data often outlives the applications and even the people who work on an oilfield. Domain expertise is a fundamental prerequisite but there also needs to be an investment in a data-driven and analytical mindset on the part of the oil companies and the service companies to understand how this new connected world will function. Any organization that can bridge this gap will be highly valued – from the analytically-minded scientific consultancies, to analytics and data science teams working as centers of excellence in the service companies and operating companies. The transition will be more about people and processes than technology, and it will require much closer cooperation between the operating companies, the service companies and the technology companies to make it work.

The bottom line is that there is a storm raging in the oil and gas industry – thanks to myriad factors – that's not going to go away for foreseeable future. On a philosophical level, that means companies need to really focus on what they can control in order to survive. On a practical level, a large part of that means putting the right technology and communication processes in place to make more out of the big data that's out there, beyond the four walls of the business units, and ultimately beyond the business.

Just like the manufacturing, aerospace and automotive industries, oil and gas will learn and evolve in the face of adversity. And, ultimately, I have no doubt that it will become a model for other sectors to follow. In a data-rich world, this quantified and connected evolution is an inevitable one that will spread like wildfire across industries.



Dr. Duncan Irving presented ''Big Value from Big Data" at the Conference "Big Data Solutions & Analytics in Upstream Oil and Gas Industry" in Oslo, on February 10th. All the presentation from the Conference are posted on the web site at http://oslo.spe.org/bigdata

Software Metering Tools: An Undervalued Source of Increased Efficiency and Savings

by Signe Marie Stenseth, SMS VP Open iT

Signe Marie Stenseth
Vice President
Open iT, Inc.
smstenseth@openit.com

The volatility of today's global economy has led to an increased awareness and focus on the surplus cost of underutilized IT assets. By metering the usage of software applications and other IT assets, companies stand to gain a lot in cost optimization, asset efficiency and user efficiency.

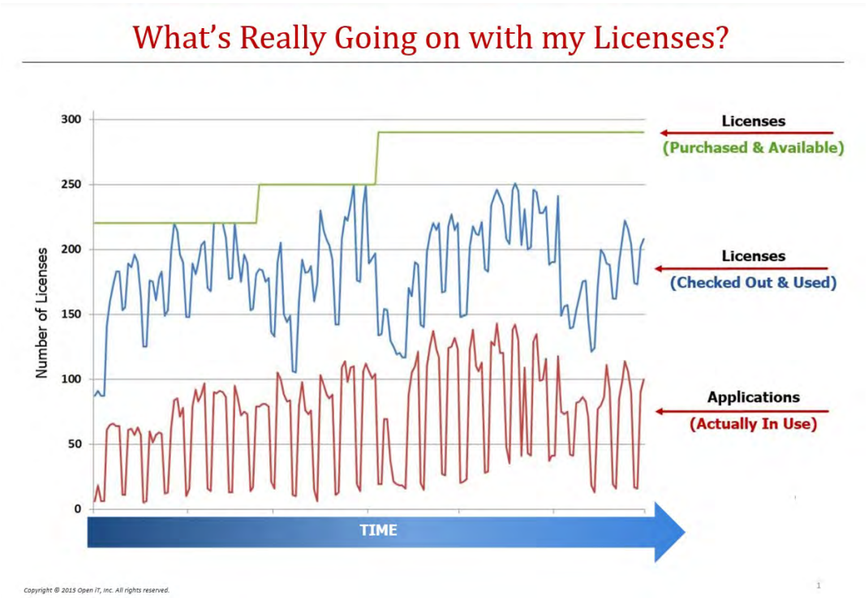
Software metering tools: An Undervalued Source of Increased Efficiency and Savings

In today's business environment, software applications are essential to running our companies, connecting with our customers, generating new business, differentiating us from our competitors, and even inventing our products. Almost every major company relies on general business applications, specialized or scientific applications, and extensive systems tools that operate in the background to make the company perform. We are all aware that software is not an optional asset, yet surprisingly few companies manage their software portfolios with an enterprise perspective or a long-term view of the investment.

Software is often unmanaged in the sense that there is little knowledge about who is using which applications when, for what purposes, or how efficiently—including how the frequency of use compares to the number of software licenses purchased. The relevant IT management questions remain: Are we utilizing our most expensive IT assets efficiently? Have we aligned our licensing of software assets with the goals of our organization?

Such lack of management can be due to a variety of reasons, including technical or organizational complexity and a dismal track record of consulting projects trying to address IT Asset Management. Whatever the reasons, the volatility of today's global economy has led to an increased awareness and focus on the surplus cost of unmanaged IT assets, as well as improved technical solutions to manage such assets. Companies wanting more responsive IT management, reductions in the total cost of ownership, and improved user efficiency can implement technical solutions to achieve this. This article will identify the benefits of software usage metering and optimization, based on first-hand experience from working with companies implementing processes and systems for cost optimization and asset efficiency. After a decade-and-a-half of work with Global 1000 organizations, we have found:

1. The more expensive the software applications are, and the greater the dependency on these applications for profit growth, the more likely companies are to value solutions that can help them with cost optimization, asset efficiency and user efficiency.
2. By tracking software purchased against what is actually used, and applying this information in contract negotiations with key vendors, companies are able to cut the cost of software ownership by at least 25%.
3. An overview showing how extensively certain applications are used throughout the organization is valuable information for the application support team, for directing efforts of user training and support. When applications or features are not fully used, and



when this underutilization can be identified by metering software, the team can then use this information for user training and support, to fully realize the potential of the application. Alternatively, the application may not be relevant and could be retired. This is the type of decision made best when based on real asset usage data.

4. Software usage metering enhances the IT team's ability to participate in corporate compliance. Compliance requirements are on the rise, forcing companies to keep track of contracts, data and other corporate assets and processes. Software and IT asset management provides the basic tracking and monitoring of hardware, applications and services that enable the regulated data to be audited. Good compliance programs incorporate metering and optimization of IT assets.
5. A successful Software Asset Management program includes repository, inventory and usage metering. All this can take time to implement, but savings can begin immediately when the customer implements a software usage metering and optimization component that can be 100% automated. Our experience shows that a company can expect a return on investment within six months of implementing a usage metering system, depending on when contracts are up for negotiations.
6. Collaboration between an independent software vendor and the software vendors delivering business and systems applications can also be highly instrumental in delivering value to companies that buy software. For example, Open iT is a partner with both Schlumberger and Halliburton (Landmark), two software vendors for the oil and gas E&P market. As customers increasingly demanded flexible license agreements, these partners saw the value of a partner offering tracking usage of their tools, and chose Open iT to deliver this capability. End-users can now follow the full life cycle of applications – from the uptake of new technology to the retirement of old versions and features. Insights into the usage of applications and features, while helpful to managers at end-user sites, can also aid the software provider in getting precise customer feedback on products and features valued most, to funnel this feedback back to R&D.
7. Another advanced approach to optimize software licenses is harvesting under-utilized or inactive software licenses. High-end software applications are often licensed on a concurrent usage basis, where there is a limited number of licenses available at any one time for the user community. Many end-users therefore access software licenses in the morning, just in case they need it throughout the day. Users that "stake-out" their licenses are expensive for the company. With limited administrative and management resources, it is costly to follow up and correct this behavior in a manual way. A best practice in this area is to harvest inactive licenses automatically: inactive software licenses are automatically freed up and reclaimed back to the license pool to be used by more active users. The definition of "inactive usage" can be set independently for each application: for example, inactivity could be determined by lack of keystroke or mouse movements within an application for a certain time period, or by CPU usage, or a combination of these two methods. The user will receive a warning, and if the software remains unused then the license is freed up and given back to the pool. If needed later the user can reclaim the license with one click, without losing the work he was doing when the license was taken from him. This gives a high ROI for companies that are running close to capacity on their applications, or are approaching renewals of the agreements and can cut back on licenses not in active use. We see a cost improvement of 10% for companies that implement this functionality.

As a solution provider in this niche, we are seeing increased opportunities to work with clients who appreciate the competitive advantage they gain by managing costs while protecting their long-term investment in critical IT assets.

To illustrate these points, consider the case of one Global 100 Company, having about 35,000 employees worldwide and nearly $80 billion of assets. While software is not their most expensive asset overall, it is a large part of their IT expenditure. Therefore, the asset management team decided to use a tool to automate tracking of software assets, and to use the data collected to charge regions and departments for the usage of valuable application licenses. In addition to meeting regulatory financial reporting requirements, internal chargeback (internal pay-per-use) created greater awareness of which assets are in use and what they cost, resulting in conscious planning and fiscal stewardship. In the long run, reducing waste delivered significant cost savings, especially in such a large and complex environment. According to one of the company's Global Application Portfolio Managers, "Data collected by Open iT tools are being used to communicate with our software vendors and to create flexible licensing contracts that reflect the real license needs of the company." He explained that, "We have been able to recover the cost of the tools immediately by identifying licenses no longer needed from a vendor whose contract was up for renegotiation. Even before the first year was over we had a 10fold return on investment."

The focus for IT Asset Management (ITAM) solutions has changed considerably in the last few years. Instead of creating an all-encompassing IT Asset Management solution that requires the whole IT organization to adopt all ITAM processes and solutions, with the risk of not being able to carry through with such a grand change of focus, many companies sees the benefit of 'harvesting low hanging fruit' by focusing on heavily used, high-end, core applications first. This will give an immediate ROI – as well as give the IT organization experience in working with an ITAM solution.

E&P competitive advantages from Cognitive decision support

by Ole Evensen, WW Chemicals & Petroleum, Upstream Leader, IBM

Ole Evensen
*WW Chemical & Petroleum Upstream Lead, IBM**

The E&P industry has always been "data driven", willing to invest in new technology to improve data acquisition, interpretation, simulations and analysis. While still necessary, the historical approach to insight and decision-making is no longer sufficient. New technology may change the playing field.

Exploration success sometimes seem arbitrary, even lucky. Major discoveries in previously explored areas leaves us with questions like "why did not previous license holders succeed?" The simple answer may be – the data available, and the insight made possible – at the time of decision making. When we make different decisions today, to drill, drop - or decide a new location - we have the advantage of additional insight from new data – as well as the results from previous efforts. We have the potential to think outside the box - of previous assumptions and outcomes. This potential will depend on the organizations ability to explore and exploit new internal or external sources of information. This capability may be difference between failure, success and how we will perceive industry leadership.

Improving the basics is not enough

Most companies adopt the "basics"; like improved seismic acquisition, more sophisticated geoscience applications and cross-functional collaborative work flows. They try to cope with the increasing amounts of "big" data, from wells, drilling, digitized facilities as well as studies, internal and external reports. All intended to improve exploration decision making, operational excellence and compliance.

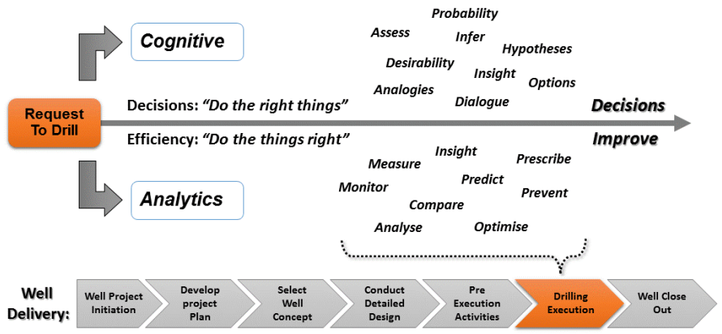
Doing an inventory of data in a typical E&P company today would show that about 75% of the data is unstructured, and growing exponentially. A paradox is that an increase in data does not necessarily result in an increase of insight and quality decisions. Multiplying data may even reduce insight, if "information overload" – leaves us without knowledge of what data we have, or means to locate and use the information. Improved exploration decisions requires more than just new or higher resolution data. It requires data to be available, timely, accurate, in your context – and "explorable".

An example: Today we can analyze historical sensory and operational data to identify patterns or "analytical signatures" that precedes undesired events in areas such as drilling, artificial lift or facility operation. These signatures may be used to predict events and prescribe the next best actions to avoid them, or minimize their impact. Improved drilling efficiency by avoiding stuck pipe is an example of benefits from this approach. While this is a high impact improvement, it still is not enough. Improved drilling efficiency is a moot point if the well should not have been drilled in the first place, or in a different location.

The *illustrated below* (high level) Well Delivery process may highlight the different types of insight and decision making required when planning and executing a well delivery.

While there is a lot of effort invested in the execution part, where real-time analytics drives improvement, there is a lack of decision support in the preceding phases, where major and critical decisions are made.

Concept selection, locations, trajectories, rig selection etc. depends on our ability to understand

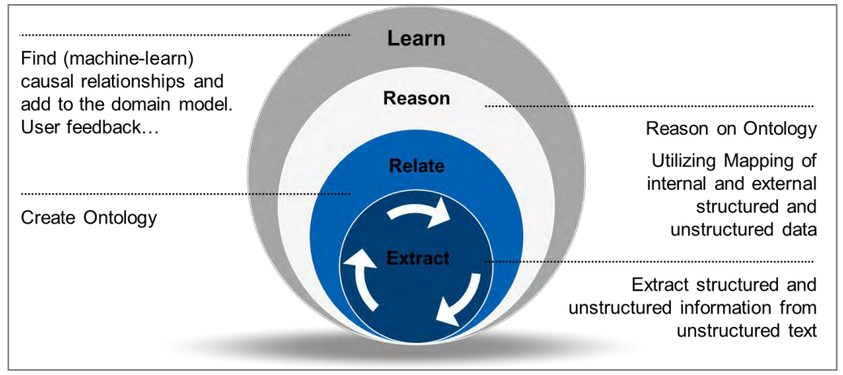


Analytics approaches as complementary support to drilling

Ole Evensen *is Upstream Leader in IBM WW Chemical & Petroleum unit. He has more than 20 years international experience working with Oil & Gas and Services companies, where he has worked as strategic advisor and program manager for operational improvement initiatives. As a consulting partner he served National and International Oil Companies in Europe, Middle East and Africa. His current focus is E&P operational improvement, utilizing new technology to obtain rea-time insight for optimization and decision support. His academic background is from Harvard Business School, MBA degree from Henley Management College, a Bachelor's Degree from UiS and a Diploma of International Management. Ole Evensen is a regular speaker at industry events, writer in industry journals and host a blog in IBM Insight on Business – WW Chemical and Petroleum.*

Mail: ole.evensen@no.ibm.com

the request to drill, the objectives and best options. The decisions made will influence time, commercial terms, cost, HSE – and the probability of success. We categorize these decisions as "doing the right things" – and they can be improved by insight from a number of domains, such as previous projects, well reports, studies, newsfeeds, market analysis, external data providers and even open information sources. Most of these sources contain unstructured data, partial information, with little quality assurance – and requires a new approach to analysis.



Cognitive Analytics – Conceptual view

Welcome your Cognitive advisor

There is no lack of ambitions to organize, store, govern and make data available to users. Progress has however been slow and lagging. Current technology is helping us address some of the basic issues, but the main challenge is to enable users to interact with, and exploit, the growing volumes and types data in a more intuitive and supportive dialogue.

Superfast response to a web search may be impressive, resulting in millions of hits. The problem is that you are still left with a haystack where you searched for a needle. This is where new "Cognitive systems" seek to remedy the situation. The first cognitive pilot, named "Watson" managed to outperform the incumbent Jeopardy TV champions in 2011. The technology that understood and managed to answer questions better than human experts has evolved into todays "Cognitive systems". They help experts by processing huge volumes of data to provide best insight and hypothesizes in areas such as patient diagnostic, competitive intelligence and research. Today's system is capable of processing the equivalent of a million books per seconds, extracting relevant information – and present answers as hypotheses to questions asked in a natural human language. The Oil & Gas industry is conservative in some respects, and is late to follow the cognitive technology adoption already well underway in other industries. So, what would a true cognitive system offer the E&P industry? You should expect an "advisor" to:

1. *Understand your inquiries in natural language*, with a human style of communication. This includes understanding of industry "lingo" – the semantics and ontology. Searching for "wildcats in the North Sea" will narrow search to exploration drilling, and return – among other results - data from Johan Sverdrup, as the system would know that this field is part of the North Sea area, even if it was not stored or stated in one database or document.
2. *Generate and evaluate evidence-based hypothesis*. A cognitive system goes far beyond "search" – which may return scored hits. A Cognitive system responds to an inquiry with its best understanding of what the user is looking for. It will show its "confidence" to different responses or hypothesis. "Show me basins with similar characteristics as …?" Or in medicine: "What could cause nausea..?". Each hypothesis may be explored to see what data has been considered, analyzed and inferred from.
3. *Adapts and learns from training, interaction, and outcomes.* Building on the characteristics, the system will use feedback from users to improve understanding of relationships, semantics and credibility of source data.

See illustration above, of conceptual architecture.

Cognitive decision support in E&P

In an exploration context critical decisions are based on geoscientists understanding of basins and fields - and their assessment of presence, type and volumes of hydrocarbons in a prospect. Developing good models of basins and petroleum systems requires not only access to quality data, but understanding of how to interpret the regions data. E.g. how to address ambiguities. The geoscientists experience is key, and usually supported by good practices of cross discipline collaboration and peer reviews. However – a relevant questions may be posed: Are the results influenced by individuals "bias" - or based on a too narrow experience or knowledge base? Would a different team produce different results, valuations and recommendations? This can be considered as a prospects intrinsic uncertainty, which cognitive systems may address.

Imagine a situation where you could expand your decision platform, where the basis of your geological understanding, value assessment and recommended way forward could be based on:

- Insight from *all existing internal data* (unstructured and structured) from all fields considered *relevant or analogous*, previously developed – with lessons learned.
- Relevant data and insight from *external data sources accessible* through open sources or subscriptions, like IHS, AAPG, Tellus, NPD, Elsevier, GSL etc.
- The *collective insight* – and *best hypothesis* – that can be derived from all above.
- A documented *"audit trail"* of what data was used in the hypothesis you based your decision on, for future use – and review – in case new data would be made available.

This is what IBM would categorize as a *"Cognitive Exploration Decision Advisor"*. Leading E&P companies are already exploring the potential of Cognitive Advisors, developing internal capabilities to get a competitive edge in situations where an "advantage of insight" may influence drill/drop, buy/decline – or the perception of "right price". Most of these ongoing projects are confidential, while some – like Repsol – have announced their intent. The success in other – faster adopting – industries are impressive, and we believe the potential business impact within E&P is enormous. While these projects are comprehensive, the payback is immediate – when considering the business value of improved appraisal, better understanding of what to expect during drilling – or even a "drop" decision that saves the cost of a dry well.

While exploration is a hot area, other disciplines are also adopting cognitive technology to obtain new and better insight. Operations are following suit with a timely focus on production efficiency. Similarly, production – considering reserves growth opportunities from better understanding of concepts proven elsewhere, to enhance oil recovery. As crude prices threaten profitability, or even economic feasibility, of fields - the time is overdue to demonstrate some "exploration boldness" to make a step change in decision support. Challenges should be a motivator to move, not an excuse to stand still - or risk being left behind.

The 10 Million Tag System aka the Enterprise Control Foundation

by Timo Klingenmeier, General Manager / Software Architect, inmation

Timo Klingenmeier
General Manager
Software Architect,
inmation

Today, we want to talk about scale. Scale matters in the real-time information world. Scale matters with process data. Scale matters for large enterprises.

For the ones of you, who have not spent the last years close to automated production and control systems: The term "Tag" refers to a named item or object in this domain – usually associated to some moving data properties and classified by a certain designation system. Designation systems in industry can be compared to stock market tickers. Everybody understands that MSFT.NAS refers to the share price of Microsoft at the NASDAQ stock exchange. Similarly, a control engineer understands that TC40101.PV is the current process value of the controlled temperature of tank 10 in area 40 of a distinct production plant. Or so. Unfortunately, industrial designation systems are not finally regulated on a global scale, as stock ticker symbols are. Money always wins.

So basically, if you would centrally collect all your worldwide operations measurements and controlled objects data *in one system*, you end up having to organize millions of tags and their associated data. This was merely impossible in the past. For three main reasons.

First, full data historization for readings out of control systems started in the early years to be a discipline executed on the production floor, close to the control systems. Plant engineers added a plant historian to their plant control system. Fine, this enabled the local workforce to better understand complex processes, debottleneck and improve. Data has always been the key to efficiency.

Second, the network bandwidth which is required to transport loads of real-time data from production sites to the corporate headquarter and the analysis applications back in form of SaaS, which is also centrally managed for dozens and hundreds of remote sites has either not been available or was to costly to consider. This has changed.

Third, software systems which are able to scale to the true enterprise level were not available. Multiple servers had to be installed even on medium size production sites. They had to be individually managed. Today, they are actually individually managed, usually by different system integrators, depending on the geographic region. Data protection and QoS are by nature not so well handled as it could be in a central Data Center, managed by the central IT group of the corporation. This situation also led to a certain gap between the local engineers and central IT – the two 'domains' which could generate so much additional value on the basis of an integrated, global, corporate data store… are never getting there.

Costly individual maintenance of on-site dinosaur software systems simply goes on, and the precious gains from a potential corp-wide integration are left on the plate. Which CEO or CIO would not dream of a unified, fully-integrated real-time spinal chord of the entire enterprise? Including better management and 100%-secure access control based on corporate standards. Creating a single source for all Business Intelligence processes? New fields for advanced process automation, steered directly from the ERP/SupplyChain backbone? Does anyone not smell untapped profit here?

The new trends of Big Data, Industry 4.0 and the (Industrial) Internet of Things are giving industries a wake-up call. But what really can add to the bottom line is the unleashed potential of 360° Real-time Enterprise Control.

It is time for Enterprise Control comprising all operational assets and secondary processes, even integrating different control domains. The process and the buildings, the smoke detectors, the energy management systems. External price information and control loops. Seismic and meteorological warnings from thousand miles away. Whatever data, if it is tag-based, or to be turned into a tagged information we can use it in our infinite world of Enterprise Control. The only ingredient missing is the software system which holds it all together in a uniform manner.

What does it take to create an Enterprise Control system of any size?

The enterprise control system operates on a uniform, but highly distributed real-time/near-time data acquisition system plus a 100%-waterproof communication infrastructure plus an unlimited size data store plus the intelligence it takes to serve this huge address space of information to the corporate workforce. Plus a flexible layer which routes information access to the right source, given a sustained security context from top to bottom, from Rio to Shanghai.

First, we must be able to connect to any real-time, near-time and sporadic data source. For control systems, this all translates to OPC (either COM-based "classic" servers of Unified Architecture servers), but includes all interfaces (such as real-time data, alarms and events plus time-series history). For realtional databases, it mostly means OleDB/ODBC, plus JSON for the more modern ones. We need to connect Web-Services in order to collect data from external sources. And anything else can be taken from structured files (structured text, XML or JSON). The system must support to connect to such sources in an unlimited fashion. And, most important to be a true Enterprise Control system, no local configuration may be ever invoked at data source level. We need to integrate existing systems as they are. Eventually adding an off-the-shelf interface to it is the most we want to accept. Any interface configuration must be central. Dropping an executable to a remote hardware is all what we want to do. No compromise here! Not even a license-key we want to apply.

Next. We need to be able to transport the real-time data in bidirectional fashion. We want our system to be able to issue remote control sequences. Obviously, it is not intended to start an exothermic chemical reaction from thousands of miles away by a junior fellow playing with the system in the headquarter cantina. Sure, the StuxNet demon appears on stage, once someone starts to mention remote control. But, it must be possible to initiate certain processes automatically from remote. Without downlink writing, there is no Enterprise Control. The answer is uncompromised security whenever a wire leaves the controlled space on its way to the remote controller. This includes a lot of checklists, but – it must only be standardized and maintained once. Not to forget No-Spy agreements with all involved parties and periodic penetration team missions on hire.

And inside the system (including all interfaces it supplies for the integration on Enterprise IT level), per-object security control must be implemented. Each user accessing the system in whatsoever fashion must be authenticated against the Enterprise AD. No compromise here!

The system must be built not making any assumptions that remote links are always available. It must provide easy-to-maintain, self-monitored and multi-strategy redundancy. It must buffer collected data which can not be routed upwards. It must reject control commands which can not be forwarded downwards.

All events of our Enterprise Control system must be collected centrally and also serve as a single source for any emergency notifications. No, dear vendor, a text file on the harddisk is not considered a log.

In a similar fashion all other data has to be stored centrally. Time-series, alarms, events, aggregates, forecasted values, structural data, metadata… It must all be stored using the same database system. Guess, this is not SQL-based. We want to cluster to the infinite, quickly and easy to maintain. Horicontally scaled, using multiple instances of moderately muscled machines. We want to add to it as required. An Enterprise Control system is not built at one shot and then handed over. An Enterprise Control system evolves every day. The database system can only be a document-oriented, modern NoSQL database, able to flexibly store all kinds of data types and formats. Built for scalability, clustering and sharding. MongoDB is such a product.

Using MongoDB, the backbone of the Enterprise Control system is a sharded database, eventually consisting of dozens or even hundreds of instances, but forming one logical database. It can be distributed over multiple data centers in different world regions to be disaster-proof. Backups? We do not want to do backups. We use replicated storage for the on-premise data and hybrid storage for long-term storage. Old data is encrypted, anonymized and stored in the cloud. Or, in case even this is not wanted, in a private cloud instead.

Halt! Our Enterprise Control system evolves. How can it do so, if only highly specialized staff can ever tame the beast? It is true, the internal corporate IT and their partners must be the owner and skilled personnel from operations, engineering, finance and administration must be the stakeholders. And yes, a good, super-regional system-integrator may still be a good option. But finally, the system must – as central and large it internally is – also allow for partial administration by division, site, branch or department. Definable at object level, again. It must be able to control security to the finest grain, but open and extensible to the infinite.

The developers at inmation have been in industrial system integration business for more than two decades. We have learned from global real-time data infrastructure projects on behalf of industry leaders. Fueled by this spirit, system:inmation, our own new product is designed to enable Enterprise Control in a much simpler way than this was ever possible before.

SPE Norway Event Calendar 2015-2016

May 18, 2015 Harstad **May 19, 2015 Oslo**	**Distinguished Lecturer Klaus Potsch, Formerly OMV E&P** ***Understanding and Checking the Validity of PVT-reports*** Society of Petroleum Engineers Distinguished Lecturer 2014-15 Lecture Season Klaus Potsch Senior Expert from OMV and a Consultant for Fluid Studies Abstract: Information about fluid properties is a required input for every stage in the oil and gas industry, from the reservoir to the refin-ery. It is, therefore, of utmost importance for reservoir, facility, and corro-sion engineers to understand the volumetric behavior and the transport properties of the produced fluid. These fluid proper-ties can be obtained from pressure/volume/temperature (PVT) reports generated either in-house or in external labs. In both cases, engineers should be able to perform a consistency check on the data before including it in their respective tasks. This presentation provides an overview of tools for verifying the consistency of PVT data. Biography: Klaus Potsch is a retired senior expert from OMV and a consultant for fluid studies. For the past 4 years, he has been a guest lecturer in reservoir fluids and their modeling at the Mining University of Leoben, Austria. Potsch holds BS and MS degrees in physics and a PhD degree in mechanical engineering from the Technical University of Vienna.
May 26, 2015 Stavanger	**SPE YP Lysefjord Cruise** SPE Young Professional invites you to the summer event of 2015, our traditional Lysefjord Cruise Trip!
May 27, 2015 Oslo	**Risks and Rewards in Oil and Gas: Navigating in a Volatile Oil Price Market** Society of Petroleum Engineers (SPE) Oslo Section in partnership with Oslo Børs and PwC for the third consecutive year has gathered some of the key people in the industry to discuss the status of the oil indus-try in the volatile oil price market on May 27th 2015. Building on the successes of the previous years' semi-nars, this time we focus on the volatility of the oil and gas industry and the implications to the E&P compa-nies. NPD will share with us their view on the NCS. With the current re-pricing of the oil sector, cash is king and cash-strapped companies might be subject to take-overs. Oslo Børs will present the rules of the game for this activity. Detnor will share their views on its take-over of Marathon. ABG Sundal Collier will share their insight to what the future might hold of mergers and acquisitions in the oil sector and more. Next Rystad Energy will present their view on the oil price; will we ever see 100 USD again? By the end of the seminar a panel will discuss the challenges that the industry faces. You should not forget the social dimension of this seminar. As always, we treat you with a great lunch at the top of the PwC building with a grand view of Oslo. Here you can mingle at the top of Oslo. After the panel debate, a reception is held at Oslo Børs. All this makes the seminar a good place to meet old acquaintances and make new ones. The event is in English and is sponsored and hosted by Oslo Børs and PwC.
May 28, 2015 Harstad	**Young Energy Breakfast at Det norske**
May 28, 2015 Bergen	**SPE Bergen Sailing** Every May, we host the SPE Bergen Sailing with Statsraad Lehmkuhl. The annual sailing is always a sell-out, and 350 participants including students enjoy a full evening at sea with excellent food, drinks and networking.
June 5, 2015 Stavanger	**SPE BBQ**
Jun 11, 20105 Stavanger	**ICoTA Well Intervention Seminar** **Keynote speaker: Jarle Haga, Manager, Drilling and Wells, Talisman Energy Norge AS** One day seminar of technical presentations sharing experience, innovations and case studies focused on well intervention. An exhibition of the latest services and technologies in the intervention market and opportunities for networking complete this valuable day.
26. November 2015	**SPE Bergen Lutefisk** Another steady tradition is our annual Lutefisk dinner in November. Some 150 participants enjoy the Lutefisk with its proper add-ons. This is Norwegian pre-Christmas culture at its best, and always a great success.
20. April 2016	**SPE Bergen One Day Seminar** The annual SPE Bergen One Day Seminar is our largest event during the year. The international combined technical con-ference and exhbition is held in Bergen, every spring and is visited by roughly 500 delegates. The conference offers multiple full-day parallel sessions of technical presentations. The exhibition covers some 2000 m2, and some 40 companies are represented with exhibition stands.

Thank you!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Idemitsu Petroleum Norge
SPE International
senergy
MAERSK OIL
core energy
AkerSolutions
agr
DOMINION GAS
EXPRO
ALTUS Intervention
BAKER HUGHES
Schlumberger
Huisman
interwell
nexen
concedo
add energy
Tracerco
Providing Insight Onsite
RWE
The energy to lead
twma
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KONGSBERG
DNO
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RaMEX a.s
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