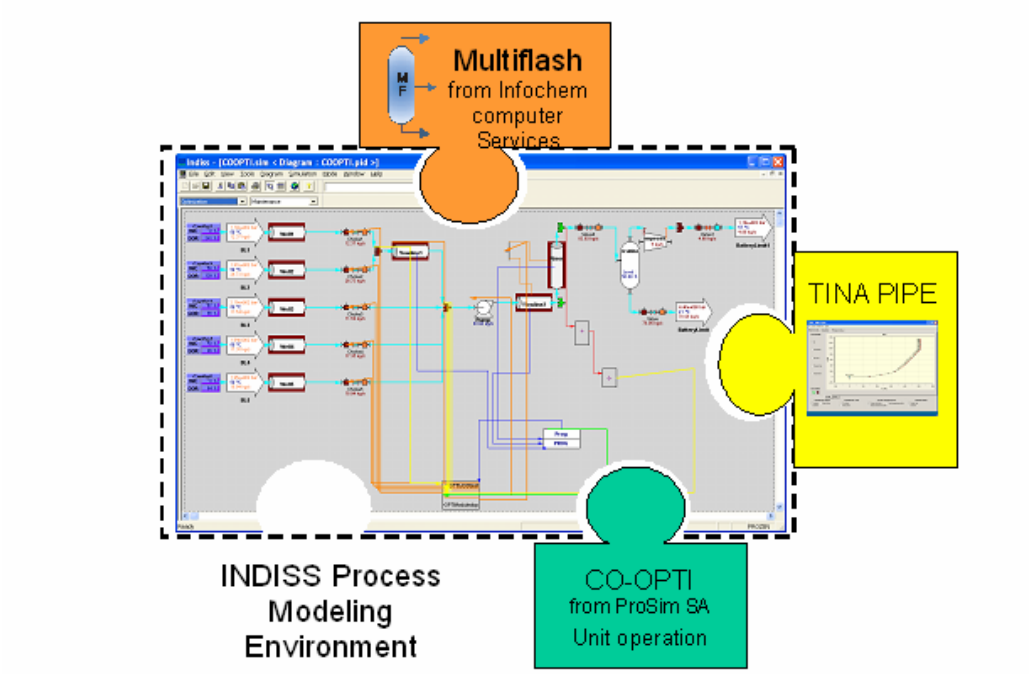
Society of Petroleum Engineers (SPE) ATCE, Anaheim 2007



CAPE-OPEN – software 'Lego' for the digital oilfield[1]

The Society of Petroleum Engineers 2007 Annual Technical Conference and Exhibition (ATCE) claimed an 8,000 plus attendance with 380 papers presented and 400 exhibitors. On the 'digital oilfield' front, Landmark introduced 'AssetConnect' a production optimization platform that uses a modeling package from the automotive industry. The French Petroleum Institute (IFP) presented the results of a joint industry project (with Total) using a modeling standard (CAPE-OPEN) from the process industry, to simulate from wellbore to facility. Schlumberger's Avocet Integrated Asset Management package was featured in a paper about a revamp of Pemex' San Manuel complex. Petroleum Experts has added an API to its Integrated Field Management package so that it too can be used in customized optimization workflows. TNO was showing some modeling technology that couples multi scale (time and space) models for studying production instabilities such as slugging and gas coning.

Uncertainty and decision making continues to be a hot topic at the SPE. A presentation from Texas A&M called for a re-evaluation of current commercial offerings, with more focus on decision support as opposed to 'uncertainty' analysis. Global warming was featured in the SPE 'Carbon' Forum session where USC's George Chillingar's iconoclastic views were enthusiastically greeted by a large audience. This dwindled considerably for the more politically correct presentations from EnCana and ONGC.

In our report from the 2003 SPE, we cited an operator who, referring to the increasing sophistication of downhole monitoring and control systems said, 'I don't want jewelry in my wells!' Judging from the 2007 edition of the SPE's ATCE, 'jewelry' is, if not everywhere, at least getting good traction. The obvious targets for sophisticated downhole control valves and real time monitoring are the newer offshore developments and the supergiants of the Middle East. But there are applications for the high-end technology in 'cost sensitive' brown fields too.

The first deployment of Baker Hughes' 'Intellipipe' drill string 'Ethernet' was reported by StatoilHydro's Henrik Wolter. Tests on the Troll supergiant gas field in a 2700m lateral proved very successful in high frequency geosteering around large calcite nodules in the reservoir. Today's data rates are 9,600 bps compared with 20 bps for conventional mud pulse transmission.

Microsoft's Windows Compute Cluster Server (WCCS) 2003[2] was introduced on the Schlumberger booth with rather more razzmatazz than science. The idea is that WCCS will be easier to deploy in smaller organizations' all-Windows environments. Schlumberger provided an underwhelming benchmark, stating that Eclipse on WCCS offers 'similar performance to a Linux machine, at least for up to 8 processors.'

[1] *Image courtesy French Petroleum Institute – IFP.*

[2] *Just as the 2008 WCCS edition was being unveiled at SuperComputing 07.*

Highlights

Contents

TW0715_1 Introductory note – SPE paper references

We have taken some liberties with our references to SPE papers. First, we sometimes change the titles to give a more succinct and relevant quick view of what we feel is of prime interest in the paper. Second, again for brevity, we only credit the speaker or first author. The website links to the SPE may not contain the full paper or even a very complete abstract. Full papers can be ordered from the Society of Petroleum Engineers on www.spe.org. Alternatively, a CD of the proceedings of the 2007 ATCE is available from the same source.

TW0715_2 Presidential addresses – Jaleel Al-Khalifa (2007) and Bill Cobb (2008)

Outgoing president Jaleel Al-Khalifa (Saudi Aramco) hailed the publication of the Petroleum Resources Management System (PRMS) earlier this year as a 'milestone' for the SPE. PRMS was presented at the reserves 'convergence' conference[3] sponsored by SPE, AAPG, WPC, and SPEE. SPE now has some 75,000 members and a lot of cash! The Canadian Petroleum Society is to merge with the SPE.

2008 president Bill Cobb (William M. Cobb & Associates) announced a plan to 'connect' the industry with the general public. This involves initiatives to promote world wide acceptance of the PRMS reserves definitions and to take a lead role in carbon capture and storage. On the education front, SPE continues to support young professionals and will take a 'proactive' role in education from elementary to high school. 'We need to let youngsters know of the growth and high tech in the industry.' 'To achieve 125 million bopd in the next 25 years, we need more young talent.' The SPE is also to build bridges with other professional societies which are currently working independently on reaching pre-college students. The SPE reserves will fund a world-wide scholarship in PE. To address faculty staff shortages, companies are to lend staff as adjunct professors and the SPE is seeking experienced members and retirees to contribute. SPE is to appoint a 'professional development ambassador.'

TW0715_3 'Carbon' session

Attendance was moderate for the 'conventional' ONGC and EnCana presentations but Chillingar's controversial denying the human origin of global warming paper was given to a packed room and what seemed like a receptive audience.

0715_3.1 Carbon management for the oil industry[4] – A.B. Chakraborty (ONGC)

This paper investigated how to account for and assure sustainability of anthropogenic greenhouse gas emissions. Companies need a risk management strategy to prepare for climate change to satisfy environmentally conscious stakeholders. Suggestions include increased insurance premiums and the implementation of 'apparently infeasible' projects with long term benefits as discussed in Kyoto's Clean Development Mechanisms (CDM). The strategy includes quantification, ISO 14064[5] certification and transparency. Competitive pressures and the shift in the centre of gravity of global energy demand need to be addressed with a greenhouse gas (GHG) accounting system. This will identify emissions sources and implement measurement procedures ('you can't manage what you can't measure'), tools, site assessments and a 'tentative' monitoring protocol. Eventually, carbon will be a matter of disclosure in the company balance sheet, moving the emphasis from environment to financial – with regulation in the offing. All new oil and gas developments will be carbon neutral.

Q&A

Who is to pay?

[3] *http://www.spe.org/spe-app/spe/jpt/2007/08/ReservesConf.htm.*

[4] *SPE 110239 - http://spe.org/atce/2007/tech_prog/documents/spe1102391.pdf.*

[5] *See for instance http://www.ceu.hu/envsci/aleg/research/ISO-EnvFinance110503.pdf.*

The effects of global warming (GW) will be so serious, especially for developing countries like India, that food, growth and public health will be impacted. Of course development is tied to economic growth, so companies need to look at mitigation. The question of who pays remains to be addressed, but companies need to lead the way.

What is ONGC doing regarding measurement and mitigation?

ONGC is a state owned company. We have several mitigation projects ongoing in the fields of reducing gas flaring, efficiency and fluid substitution. ONGC is working on each and every possibility so that we will be in a position to act.

0715_3.2 Humans are nor responsible for global warming – George Chilingar[6], USC

Chilingar (a petroleum engineer by trade) began by complaining of the difficulty of 'scientific debate' in the current climate. His thesis is that variations in solar radiation are responsible for global warming. The increase in C02 is due to 'mantle outgassing and possibly microbial activity.' Current thinking fails to account for heat transfer to the upper atmosphere. Here, Chilingar offers his own upper atmosphere physical explanation of convection, water vapor condensation, radiation, intra molecular vibrations ... to conclude that a 1% change in solar energy results in a 1° change in the earth's temperature. 'Solar is the major factor.' Anthropogenic CO2 is less than 0.00022% of total CO2 naturally degassed from the mantle and so is negligible. Moreover, an increase in CO2 causes global cooling! Are we living in a time of global warming or global cooling? The last 150 years have been warming because of rising solar energy and increased tectonic activity. Solar is a 'persuasive explanation of the currently observed global warming'. Looking at the longer term, there is a global cooling trend over last 3 millennia, the earth's temperature has fallen by 2° since 3000 BP[7]. A plot of CO2 and solar irradiation shows a good correlation with solar preceding CO2. For any remaining doubters, Chilingar offers a council of despair in so far as all attempts to change are doomed to failure because of the magnitude of natural processes.

Q&A

Comment from the chair - This is an emotional and politically motivated topic. Cause and effect is reversed in the mind of scientists. There is warming on Mars – are Martians responsible?

Michel le Blanc – Houston Geol Soc. CO2 has increased so much in the last 200 years – how can you be sure humans are not responsible?

This is a childish question. Here are some facts; take all our gas reserves and burn them, now take all oil reserves and burn them too – there will be no significant increase in the Earth's temperature.

Economides (University of Houston) – We much appreciate a paper like this even though it may be meaningless to the world outside where facts do not seem to matter any more. This is primarily a political issue – science has been emasculated by political correctness.

EPA Dallas[8] –I also have a graph that shows that the correlation is with solar activity which is increasing through 2010 and will subsequently decline. I support the author's point of view.

0715_3.3 Can we reduce C02 to safe levels? – Subodh Gupta, EnCana

Biomass has been proposed as a mechanism for CO2 sequestration, but decay releases CO2 back into the atmosphere. Biomass has a storage 'period' from a few years to a few decades. 'Bioharvesting' models of land acquisition and ramp up to a productivity peak need to include decay. After a while, decay matches storage rates. Current biomass limit is a couple of decades. This needs to be increased to over 200 years to bring down CO2 to pre industrial levels. One approach is to turn woody material to charcoal which is stable for hundreds of years. The approach is 'permanent, measurable and verifiable' and a ready source of energy stashed away for posterity[9]. Charcoal sequestration will be costly, a land mass 'about the size of Africa' will be required. But the cost is 'comparable to geological sequestration.' A fix will take around 150 years – so Gupta advocates combining this approach with geologic storage. This would bring the time frame down to 100 years. A three way approach, combining energy economies bring this down to 50 years.

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[6] *http://en.wikipedia.org/wiki/George_V._Chilingar. Rebuttal on blog http://n3xus6.blogspot.com/2006/12/denialist-hopes-dashed.html.*

[7] *Before present.*

[8] *We contacted the EPA to learn that 1) there was no official representative present and 2) the EPA's position is that* 'Human activities are changing the composition of Earth's atmosphere. Increasing levels of greenhouse gases like carbon dioxide (CO2) in the atmosphere since pre-industrial times are well-documented and understood. The atmospheric build-up of CO2 and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels.' *More from http://www.epa.gov/climatechange/science/stateofknowledge.html.*

[9] *Presumably when 'posterity' has found a better way of dealing with the CO2 this will generate!*

Q&A

Economides – we need to be sure! 9 billion tonnes of CO2 is 1 trillion dollars of opcosts per year – that is bigger than the oil industry. We will need to drill and operate more wells than have been drilled in the history of oil and gas. We need to position work in the operational context.

My study is on options. If you give credence to GW, we need to look at this.

What are we going to do with all this charcoal?

Keep it safe on surface and use as future source of energy.

Pollution, leaching?

Charcoal is a purifier.

TW0715_4 Drilling Automation special session

0715_4.1 History of drilling automation[10] – Bill Eustes, Colorado School of Mines

Automation has evolved from techniques to increase human strength, through semi-automation to total automation of some activities. Motivations include safety, harsh environments, efficiencies, complex operations, etc. A seminal work by Brantley describes the early history of oil well drilling[11]. Electrical systems were tried in the 1920s but weight-based systems won out. Computer controls were introduced in 1971 (Baroid) and later were used to automate tripping, reaming etc. The driller now can use a joystick, touch screen and a 'comfy chair.' Automated rotary systems date back to the power swivel (1955), top drives and today's pipe handling systems. The rig floor has evolved from 'spinning chains and tongs' to Varco's Iron Roughneck (first introduced in 1975). Transocean now has a full column racking system in its latest rigs with pipe pick up. A 1966 symposium debated the question 'Why not automate the whole rig?' Bandera Drilling introduced full automation with its 'incredible' 1970 system. Remote control was introduced in 2004, with a project that demonstrated monitoring and control of weight on bit from a continent away. Automation effort continues today on mud, cement, BHA assembly and rotary steering systems.

Q&A

How do you distinguish automation from mechanization?

Automation implies some programming.

BP – Technology only really sticks when we can demonstrate both safety and operating improvements.

What advancements really stand out?

The WOB indicator, tongs etc. for the rig floor and the computer – that's when things really started flying.

Baker Hughes – where will we be in 5 years?

I'm a historian.

Has automation been driven by corporate R&D or entrepreneurial activity?

A bit of both – company R&D, entrepreneurship but there has been little academic research.

0715_4.2 Extra terrestrial drilling[12] – Chris Zacny, Honeybee Robotics

Planetary drilling began with Russia's 1970 Lunokhod robotic moon shot. Black and Decker designed the first US lunar drill – the technology was recycled in the ubiquitous portable hand tool. Drilling on Mars was achieved in 1997 with Pathfinder. This will be followed in 2009 with the Mars Science Lab, an 850 kg robot powered by a radioactive thermal generator – this provides 100 watts for drilling. Other projects of note include DAME[13] (drilling automation for Martian exploration) and MARTE[14] – with an automated assembly of drillstring and 10m of penetration.

Q&A

How do you handle the unexpected?

Redundancy – avoid single point of failure.

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[10] *SPE 111125 - http://spe.org/atce/2007/tech_prog/documents/spe1111251.pdf.*

[11] *http://www.gulfpub.com/default.asp?page=14&productID=6364&VS=.*

[12] *SPE 111126 - http://spe.org/atce/2007/tech_prog/documents/spe1111261.pdf.*

[13] *http://www.marsonearth.org/reports/dame.html.*

[14] *http://marte.arc.nasa.gov/.*

0715_4.3 Panel discussion

National Oilwell Varco – The automation 'dream' has not yet come true for instance we still have workers at risk on the rig floor. But we are moving closer to automation, we shipped 500 Iron Roughnecks in 2007, this has growth from 10 or so in 2002. Pipehandling systems have likewise risen from 5 per year in the 70s to 35 now. Safety and reliability are the drivers (see also NOV's 'RapidRig'). Do we need autonomous drilling? Safety, quality and speed are the prizes, reliability and affordability the challenges. We also need risk taking game changers who want to make (drilling) history.

John Thorogood – Global Drilling Consultant (ex BP). Automation is required to optimize the drilling performance loop. This is still at the mercy of the well site leader and driller who may have 'momentary slips of attention.' We are working on the 'drill to the technical limit' concept – one supermajor's technology 'refresh' program. Here we need to 'close the loop' with computer control. But we are still stuck in a manual control paradigm. Here drilling is completely out of line with other industries like aviation (autopilot) and chemical (process control). A step change is required similar to the move to a two crew airplane. We need just one man and dog in the doghouse – the dog is there to see the man doesn't touch anything. Intellipipe, WITSML got a mention on a very busy slide.

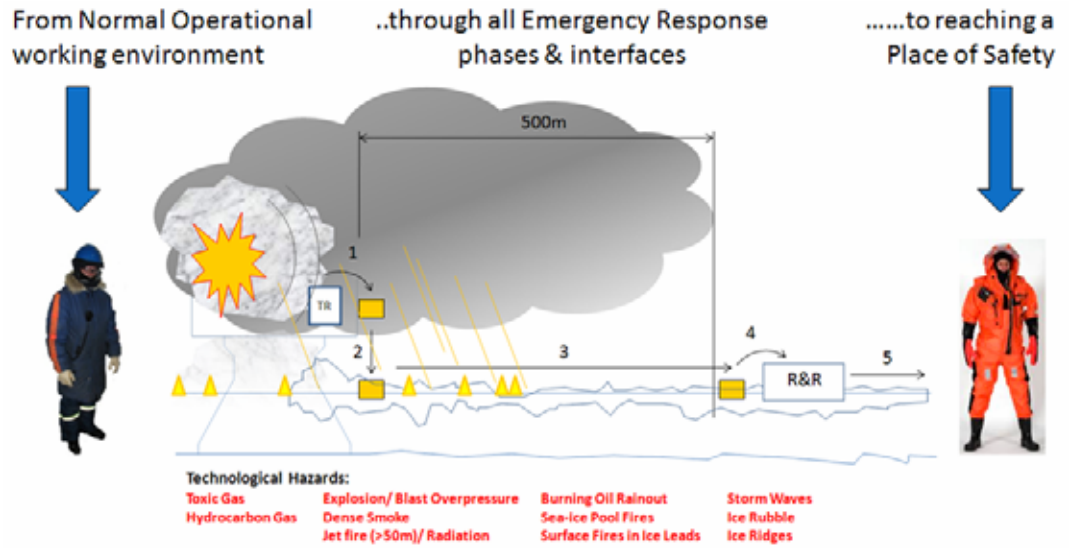
IRIS (Norwegian R&D body) – We are working on automatic drilling in our Drilltronics[15] project.

TW0715_5 Attended Papers

0715_5.1 Decision Making in Oil & Gas[16] – Eric Bickel, Texas A&M

The talk, subtitled 'from blissful ignorance to uncertainty-induced confusion,' noted a 'dramatic' increase in use of probabilistic methods in the last decade. But of the six SPE-sponsored 'uncertainty' Forums held in 2007, only one has 'decision' in the title. The focus today is on risk, not decision making – leading the authors to question whether decision making has actually improved. An online 'SurveyMonkey' survey got 494 responses, 62% from oil and gas companies. 50% of large companies reported 'significant use' of probabilistic uncertainty analysis (less for smaller companies). Companies reported some improvement in uncertainty analysis. Unfortunately, lack of management understanding, inter alia, means that such analyses are not reflected in improved decision making. The goal is not to 'reduce uncertainty' but to make the right decision. This may involve no more uncertainty analysis. The authors state categorically, 'We often hear people in the industry speak of reducing uncertainty by building a model. Modeling uncertainty does not reduce it. [..] Uncertainty can only be reduced or altered by our choices [actions].' The authors advocate more application of 'value of information' studies and a process that identifies the key uncertainties which are modeled for decision support. This process has to be 'simple enough to keep it understandable.' To which end, there is a need for 'nimbler models' from the software developers.

0715_5.2 Personnel protection JIP[17] – Stephen Knight, Gardin-Haag



Arctic example of complex environmental emergency response phase[18].

[15] http://www.iris.no/Internet/petroleum.nsf/ps/E52AA51D9DDA0136C1257229002B30A1.

[16] SPE 109610 - http://spe.org/atce/2007/tech_prog/documents/spe1096101.pdf.

[17] SPE 109177 - http://spe.org/atce/2007/tech_prog/documents/spe1091771.pdf.

Knight introduced a joint industry project on personnel protective equipment (PPE) and 'informatics integrity.' The JIP kicked-off in 2006 to investigate and reduce oil and gas workforce exposure risks. The issue is that today's PPE is not designed as a system. Gas masks may be kept in the wrong place and can prove hard to don. Improvements are made piecemeal, to hard hat, goggles or breathing equipment but there are 'gaps and duplication.' Emergency response and communications during a disaster are likewise problematical—and are addressed in the JIP with a 'hazard identification' (HAZID) approach and i-HAZ software. Situational awareness can be enhanced with real time data and high reliability PPE systems with data sensors and communications embedded in clothing. Knight invited interested parties to join the JIP's next phase to kick off, under the auspices of the Oil and Gas Producers Association in London next February. The JIP budget will be of the order of $90k over 3 years. More from www.gardinhaag.com.

Q&A

PPE is a boon in an emergency but how does such equipment impact day to day activity?

Yes this is a consideration. Like military headgear, the industry needs modular kit that does not affect dexterity.

Is there an IT component of the JIP?

Yes. For instance we want to track people, monitor pulse rates, orientation (whether lying down etc.) Such systems do exist.

0715_5.3 Operations centers and real time data[19] – Lars Olav Grøvik, StatoilHydro

StatoilHydro according to Lars Olav Grøvik strongly believes in integrated operations with real time data links enabling users to see the same data and geomodel on and offshore – notably between the West Venture Operations Support Centre at Sandsli and the multilateral snake wells of the Troll field. Everything is in real time. Data transfers are enabled by WITSML but there have been 'challenges,' with infrastructure, with WITSML dialects, and in implementing the new work processes.

Note that the OSCs provide operations support, 'you do not activate a BOP from onshore.' The idea is to help the offshore folks with a better understanding of what's going on. 'Fragile' data stream from downhole remove some human intervention – but still require QC by humans. The Intellipipe[20] wired drillstring has been acceptance tested. This brings problems with increased data rates. Grøvik asks, 'Why is today's software not ready for RT?' Too much software is 'static' not RT – and 'this is 2007.' Data management is a prerequisite – but most focus is on tools and less on organization and process. You can't solve DM problems just with 'tools.' Vendors do not always understand this – one told Grøvik recently, 'Our software use depends on well behaved users.' Grøvik ironized 'Have you ever seen a well behaved user?' We need a fit for purpose data model, middleware and a master data store for raw data. StatoilHydro is testing a version of Google Earth which is showing potential – even over 'vendor solutions.'

0715_5.4 Real time information architecture for drilling and completions[21] – Julian Pickering, BP

BP's proposed standard real time information architecture for drilling and completions involves developing WITSML to the point where it has 'the same kind of authority' as OPC in process control. For Pickering, 'openness delivers discipline health.' BP's real time architecture currently relies on data management by third parties in proprietary systems and formats. Ultimately this is to evolve to the extent that contractors will be managing data inside BP's systems in WITSML. This is considered key to the 'field of the future' initiative. According to Pickering, operator hosted data 'gives a sense of ownership.' A new skill base will be required with digital project managers, security consultants, network architects, automation engineers, application managers, remote visualization and data management consultants. BP expects that standardization will bring challenges and may require 'geeks on rigs.' BP will talk more about the initiative next year when the architecture is in place.

0715_5.5 AssetConnect, automating workflows for production[22] – Michael Szatny, Landmark

Production optimization is challenging because an estimated 7,000 technical applications are in use, along with almost as many data sources with different structures, lack of common definitions and other incompatibility. Typical production workflows embed multiple commercial applications and data. Excel models can link to anything – but are 'fragile.' A flexible commercial framework is required to support best

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[18] *Image courtesy Gardin-Haag.*

[19] *SPE 110399 - http://spe.org/atce/2007/tech_prog/documents/spe1103991.pdf.*

[20] *See below.*

[21] *SPE 110388 - http://spe.org/atce/2007/tech_prog/documents/spe1103881.pdf.*

[22] *SPE 109859 - http://spe.org/atce/2007/tech_prog/documents/spe1098591.pdf.*

of breed applications. Such a framework exists in other industries like aerospace and automotive, for CAD/CAM, stress analysis, CFD[23]. One tool that has been used to connect modeling applications in the automobile industry is Engenious. For instance, Corus uses multiple third party applications like iSight, FD to do Monte Carlo analysis and reduce design and development time. This is applicable to oil and gas, for example in frac job design. Here LAS, Petrophysics, Geographix combine with frac tools like PinnacleFrac, ProPT, Evakuate, Corelab Predict-K. A typical workflow links these tools to optimize NPV[24] by iterating across multiple runs. This can take 8-16 hours of an experienced engineer's time. Ad hoc workflows can be created by dragging applications onto the automation canvas. When tested these can be deploy to users via desktop or a 'web top' client. An expert designs the workflow – which can be deployeded to many engineers, cutting design time down to 4-6 hours. Component applications can be selected to suit a given locality. More from www.lgc.com.

Q&A

Limitations due to incompatibility of data models?

Sometimes there is little or no common ground – connection can be hard.

0715_5.6 First offshore use of Intellipipe[25] – Henrik Wolter, StatoilHydro

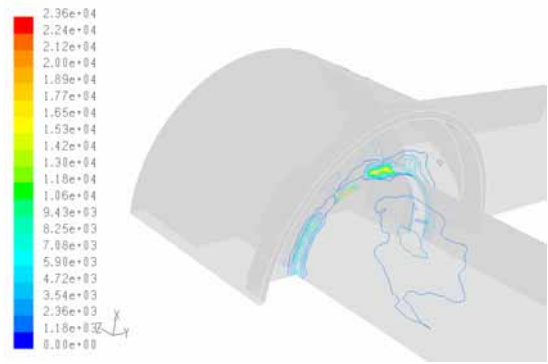
Baker-Huges' IntelliPipe drillstring 'Ethernet' was tested on StatoilHydro's Troll West gas field in two laterals – one of 2700m. The system was used to aid drilling in an unconsolidated sand with calcite nodules that deflect wells. The test was conducted on floater, with automated pipe handling. IntelliServ communications and the pipe handling system required considerable adaptation for the test with rubber mats to protect the wired drillpipe connectors. The whole complex bottomhole assembly is equipped with cable. Data streams to surface at 9600 bps[26] compared with around 20 bps for mud pulse. Intellipipe has the potential to go to 56kbps. Despite some teething troubles, the test was successful and offered considerable time savings. RSS and CoPilot tools were used to reduce directional steering lag time negotiating calcite nodules (micro dog legs). The system still needs to be combined with mud pulse technology to assure 100% up time. More from

Q&A

Halliburton – What are the economics, the ROI?

For geosteering and managed pressure drilling, this is a 'no brainer.'

0715_5.7 CFD erosion study of choke[27] – S. Peri, MI-SWACO



Erosion patterns in choke[28].

Knowledge of erosion rates and location determines the service life of field equipment. By combining experimental results and CFD,[29] product design can be optimized. Fluent's CFD package was used to compute erosion rates for the components of MI-SWACO's Super Auto Choke[30] (SAC) for a range of flow

[23] *Computational fluid dynamics.*

[24] *Net present value.*

[25] *SPE 110939. http://spe.org/atce/2007/tech_prog/documents/spe1109391.pdf.*

[26] *Bits per second. Although the original title of the paper included the phrase 'ultra high speed drillstring telemetry network,' this is NOT broadband!*

[27] *SPE 110463 - http://spe.org/atce/2007/tech_prog/documents/spe1104631.pdf.*

[28] *Image courtesy MI-SWACO.*

[29] *Computational fluid dynamics.*

[30] *http://www.miswaco.com/New_Technologies/SUPER%20AUTOCHOKE.cfm.*

rates and choke positions. Erosion curves were calculated as a function of choke position, flow rate and sand volume concentration. Erosion increases as the square of flow rate. More from www.miswaco.com.

0715_5.8 Integrated asset management on San Manuel complex[31] – Fernando Morales, Schlumberger (for Pemex)

Pemex' San Manuel complex today has 64 active wells producing oil & gas. It was designed and built 25 years ago in a different operating context. Today, topography-generated slugs and backpressure lead to deferred production and other problems. Pemex set up a team to analyze fluid transport and process from wells, through network to delivery point. The team used integrated asset management to re-jig resources, hiking production by 2,000 bopd and reducing operating costs by 600k$/ year. Simulator models were built ofr each well and a method developed for updating fluid compositional models from separator discharge data[32]. The project identified opportunities for increasing production, flow assurance and suitable wells for optimization. One pipeline was changed from a gas to multiphase flow and several other changes were successfully implemented. Pemex now uses the field-wide simulation tool.

Q&A

What product is used for this modeling?

Schlumberger's 'Avocet' Integrated Asset Manager.

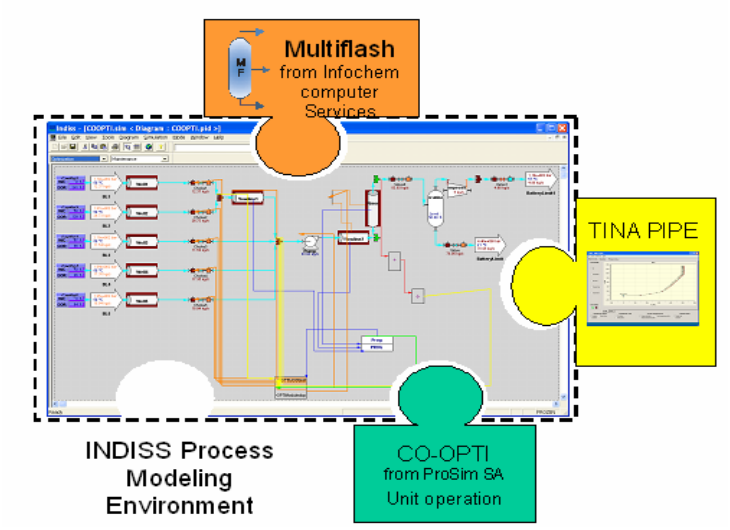
Did the exercise reveal any insights that weren't obvious to engineers?

The exercise mostly involved testing ideas from engineers. Some panned out, some didn't. We ranked them and implemented one or two right away (one with a phone call...)

0715_5.9 Flow modeling with the CAPE-OPEN standard[33] – Martin Gainville, IFP

Flow assurance modeling reservoir through facility and onwards involves a multiplicity of software tools such as ECLIPSE, PumaFlow, Prosper, OLGA, PIPESIM, etc. Design and operations increasingly cross boundaries and optimization requires coupled simulators, leading to issues of data consistency, numerical precisions etc. The IFP/Total Transient Integrated network Analysis (TINA) joint industry project sets out to leverage process control standards for transient and steady state model interoperability[34]. Another reservoir to process project (R2P) project was also mentioned.

The Computer Aided Process Engineering interoperability standard CAPE-OPEN was released in 2002. CAPE-OPEN has backing from process simulation vendors such as AspenTech, Invensys SimSci-Esscor, Honeywell and others. CAPE-OPEN provides rules and interfaces for computer aided process engineering interoperability. The standard is 'widely used' in the process industry for thermodynamic design and optimization.



TINA pipes and COOPTI optimizer with MultiFlash thermodynamics into INDISS[35]

[31] *SPE 109260 http://spe.org/atce/2007/tech_prog/documents/spe1092601.pdf.*

[32] *SPE 109261 http://spe.org/atce/2007/tech_prog/documents/spe1092611.pdf.*

[33] *SPE 110864 http://spe.org/atce/2007/tech_prog/documents/spe1108641.pdf.*

[34] *See also http://colan.org/CO@Work2007/IFP_IPTransient.pdf.*

[35] *Schematic courtesy IFP.*

TINA investigated the feasibility of integrating complex physical models from different software providers into a CAPE-OPEN-based simulation platform. TINA pipe and process modules (which embed TACITE[36]) have been coupled with an optimizer and Multiflash thermodynamics into the INDISS[37] platform for optimizing simulation on a complete deepwater production system. CAPE-OPEN proved efficient and modular. Total is working with the Petroleum Engineering of the University of Tulsa to integrate R&D developments into 'a unique process model.' More on CAPE-OPEN from www.colan.org.

Q&A

Some of these optimization use cases are very reminiscent of PRODML. Is there overlap?

These are different areas of operation but Total is working on models with both CAPE-OPEN and PRODML interacting – they are not incompatible.

Are software vendors compliant?

Scandpower is going CAPE-OPEN compliant. We are also talking to Petex. Although there is not so much interest if companies just use black oil models.

0715_5.10 Risk management in oil and gas[38] – Scott Randall, Lloyds Register

There is a 'crisis of confidence' in many industries including oil and gas, where data is not considered reliable. Companies need to address such issues with 'stakeholder analysis' – to address different stakeholders with respect to their 'power and influence.' For instance, individual shareholders are low power, but politicians are high power. Probabilistic methods and graphing can show, for instance, 'why we missed our forecast for ultimate recovery.' Lloyds' specialization is risk management. The company has announced a new framework for data validation – applying financial methods to oil and gas projects, leveraging the Porter model[39]. This shows that IT gives competitive advantage through 'cost leadership' and/or competitive differentiation. Randall's new book, Enterprise Risk Management and the Information Imperative will explain all (due out next year).

TW0715_6 Exhibitors

0715_6.1 Saudi Aramco – The POWERS, 'gigacell' simulator

Tom Dreiman presented Saudi Aramco's in-house developed POWERS 'gigacell' simulator—designed to simulate supergiant reservoirs without sacrificing the accuracy of fine grain geological models. Massively parallel technology is used to model, 'without upscaling,' bypassed oil and fine grain water breakthrough that was masked in the coarse model. The Shaybah field was previously studied with 14 different models. Now one model simulates hundreds of millions of cells and 800 wells, some maximum reservoir contact (MRC) multi lateral 'smart wells.' Smart wells have reduced the new well count from 800 down to 600. Aramco's POWERS simulator features black oil, dual poroperm, compositional, well management, locally refined gridding around wells, coupled surface network and MRC wells. Smart wells with downhole control valves can also be modeled. A 'mixed paradigm' of MPI and OpenMP is deployed on Aramco's Linux clusters. CPU counts vary for different jobs. A gas condensate study on a 1 million cell model runs in 90 minutes on 60 CPUs.

Q&A

How many total nodes?

There are two machines, one for development, another for production. The production machine has a variety of configurations. For instance a 258 million cell model with 60 years of production history might use 400 CPUs. We can go higher or lower.

What sort of scalability are you seeing?

We aim for 'straight line' scalability. Our algorithms are 80% linear scalable – this is the biggest challenge in simulator development.

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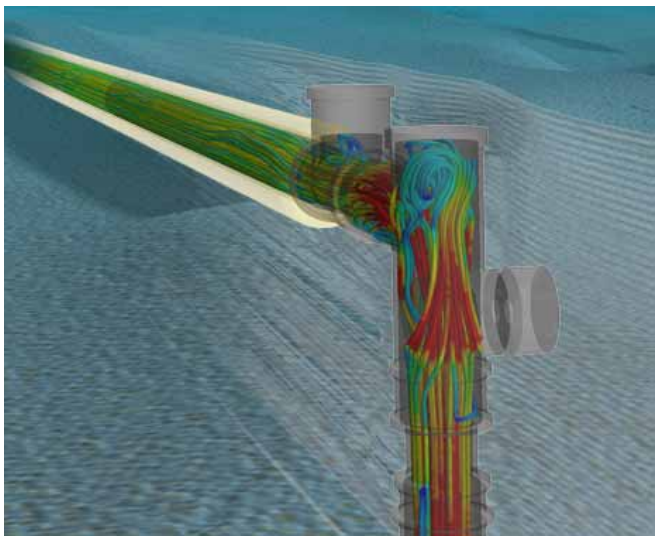
[36] *A joint Invensys/IFP Development - http://www.simsci-esscor.com/us/eng/products/productlist/tacite/TACITE.htm.*

[37] *INDISS is developed by IFP's RSI unit - http://www.simulationrsi.net/.*

[38] *SPE 109822 http://spe.org/atce/2007/tech_prog/documents/spe1098221.pdf.*

[39] *See for instance http://www.quickmba.com/strategy/porter.shtml.*

0715_6.2 CD-Adapco



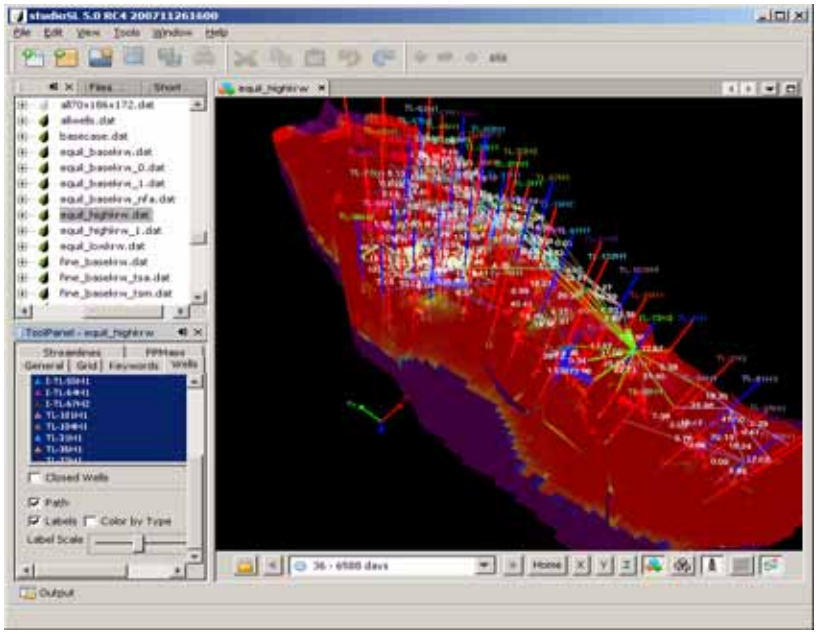
Sub sea flow line modeled with STAR-CCM+[40].

A new release of CD-adapco's STAR-CCM+ computational fluid dynamics engineering design package introduces a multiphase flow capability. Lagrangian models simulate movement of particles, liquid droplets or gas bubbles in a fluid. Trajectories are calculated from the inertia, hydrodynamic drag, and gravitational forces acting on the discrete phases. The technique can be applied to calculating the erosive effect of small particles of sand carried in an oil pipeline or for studying separator efficiency. More from www.cd-adapco.com.

0715_6.3 Petroleum Experts IFM V2.0 – new API for workflow integration

Integrated Field Management IFM was released last year and is now the company standard for Shell, Chevron, Statoil and Saudi Aramco. Version 2.0 (June 2007) has an API to allow clients to customize their workflows. For instance Chevron integrates its proprietary workflows into the 'open platform' spanning engineering, economics and maintenance. This lets users study the impact of all three on a model forecast. Conventional simulators do not always consider, for instance, maintenance downtime. PE offers Platform LSF for load sharing and Windows CCS 2003 for doing multiple realizations (Resolve).

0715_6.4 StreamSim Technologies – studioSL 5.0



studioSL 5.0[41].

[40] *Image courtesy CD-ADAPCO.*

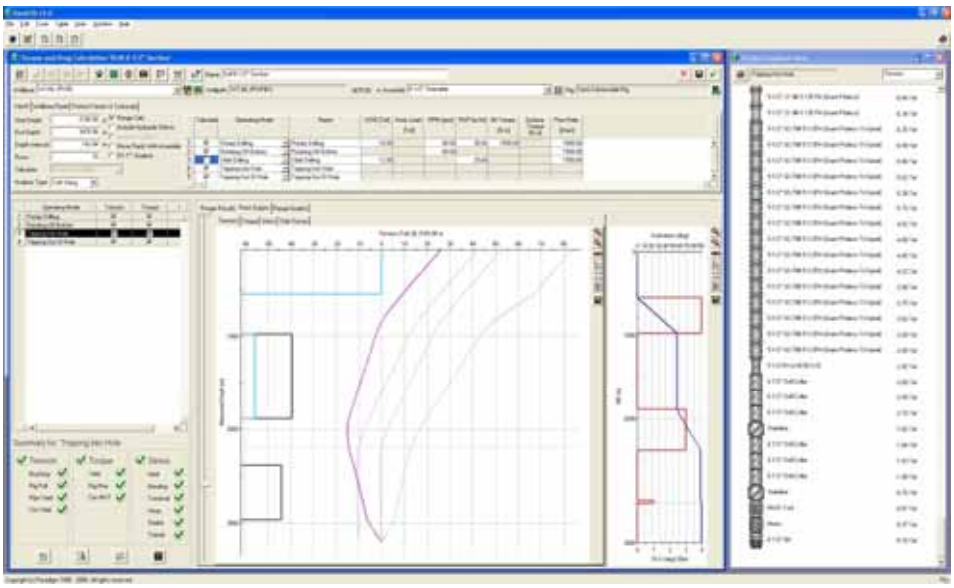
[41] *Image courtesy StreamSim Technologies.*

Streamsim Technologies is to release its new reservoir engineering package, studioSL5.0, in January 2008. studioSL is a Java-based application for streamline studies of production surveillance, history matching and flood optimization. StudioSL allows users to view well-pairs, streamline-bundles, and injector efficiencies. StudioSL also offers standard features of well production profiles, 3D graphics, interactive simulation runs, and 'web-enabled auto-updating.' More from www.streamsim.com.

0715_6.5 NITEC MatchingPro – neural nets for history matching

NITEC's MatchingPro history match (HM) technology uses a simulation model and historical production, injection, and pressure data to determine an optimal match. MatchingPro uses Artificial Neural Networks (ANN), Genetic Algorithms (GA), and statistical methods. These reveal 'complex relationships' between HM parameters and the simulator results. MatchingPro can also determine multiple HM solutions and provide a quantification of their likelihood. More from www.nitecllc.com.

0715_6.6 Paradigm – Sysdrill V3.0



Sysdrill torque and drag[42].

Paradigm's new Sysdrill (Version 3.0) release adds, *inter alia*, new functionality for automatic well planning, casing wear and dual gradient modeling. A well control kill sheet, volume and packer calculators have also been introduced. Interoperability is enhanced with DEX/WITSML interfaces.

0715_6.7 SensorTran – PerfectVision DTS calibration system

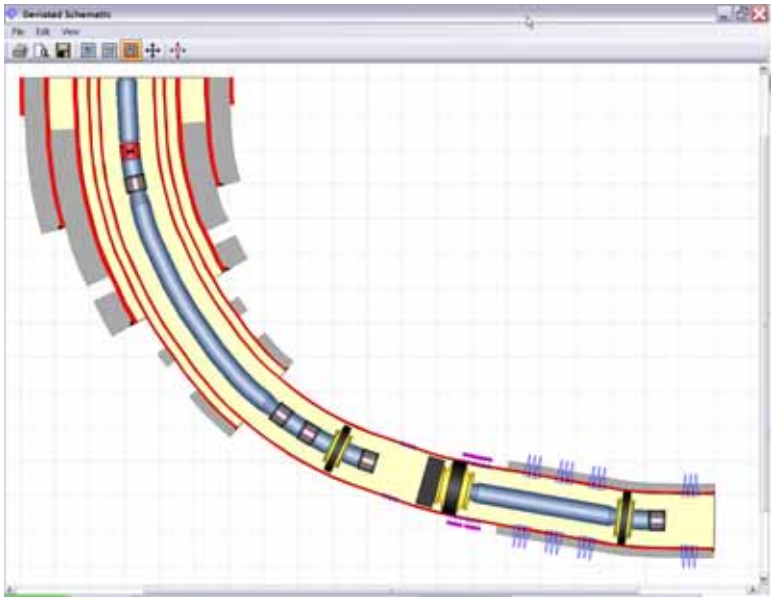
Digital temperature calibration[43].

[42] *Image courtesy Paradigm.*

[43] *Image courtesy SensorTran.*

Digital temperature sensor (DTS) specialist SensorTran now offers high accuracy calibration systems for DTS in a 'plug and play' hardware/software combo, 'PerfectVision.' The package uses dual fiber to automatically adjust for transmission variations. PerfectVision compensates for fiber darkening, deteriorating splices, changes in connector losses, and stress-induced deployment losses. The new system automatically calibrates individual measurements in real time. SensorTran uses the ModBus data standard. A ProdML interface was also developed at Shell's request.

0715_6.8 INT – New horizontal well schematics



INT's schematics for deviated wells[44].

INT's schematic for deviated wells will be available by January 2008. The WellSchematic libraries are part of INT's GeoToolkit package and currently available for Java and C#. The company is also working on 'data aware' schematics that can, for instance, push data to Excel for automated daily reporting (e.g. drilling status). Data management is left up to developers, but INT provides data adaptors for WITSLML, LAS files etc. More from www.int.com.

0715_6.9 Baker Hughes Rig Count spatialized

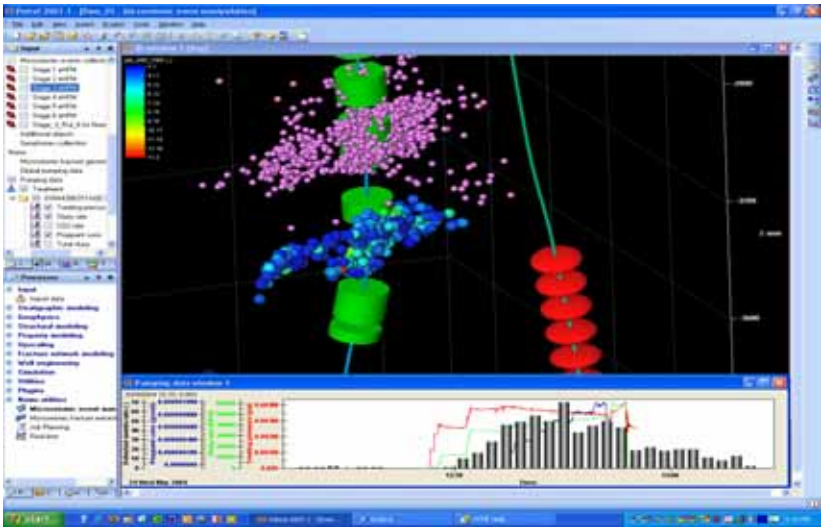
A spatialized Rig Count allows for GIS-based data selection and ...

[44] *Image courtesy INT.*

... header information is retrieved ready for use[45].

Petris has used PetrisWinds to spatialize Baker Hughes' Rig Count service (on BH Investor relations website at http://gis.bakerhughesdirect.com/RigCounts/default2.aspx.) RigCount drilling activity information is gathered by Baker Hughes' 500-strong US sales force during weekly visits to rigs. The US site is now live. Canada goes online in Q1 2008 and by year end 2008 the service will be world wide. Data is mostly 'very accurate,' although there are some challenges internationally e.g. in Saudi Arabia, China and Russia. On Friday this is the 'busiest site in the oil industry.'

0715_6.10 Schlumberger - StimMAP Live service



Microseismic application in Petrel[46].

Schlumberger's microseismics service provides insight into what is really happening during a frac job. The system is claimed to be especially useful for horizontal wells with multiple frac jobs. StiMAP monitors pressure, proppant concentration and slurry rates. An 8 geophone downhole shuttle and an InterAct satellite link to the office lets users visualize fracs in real time. Automated event detection (a.k.a 'eHFM[47]') provides continuous microseimsic mapping with no manual picking. StimView (TW0714_31) was tested on synthetic data and a 'Richter scale' of microseismic events has been developed. Data is viewed in Petrel as an uncertainty ellipsoid of a microseismic event. A video of a Cotton Valley frac job showed fracs moving from one formation to another and across the whole field. Fracs could also be observed coalescing over multiple jobs. Such insight is said to allow for the rationalization of frac jobs[48].

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[45] *Images grabbed (with permission) from Baker Hughes' web site.*

[46] *Image courtesy Schlumberger Information Solutions.*

[47] *E-Hydraulic Fracture Mapping (?).*

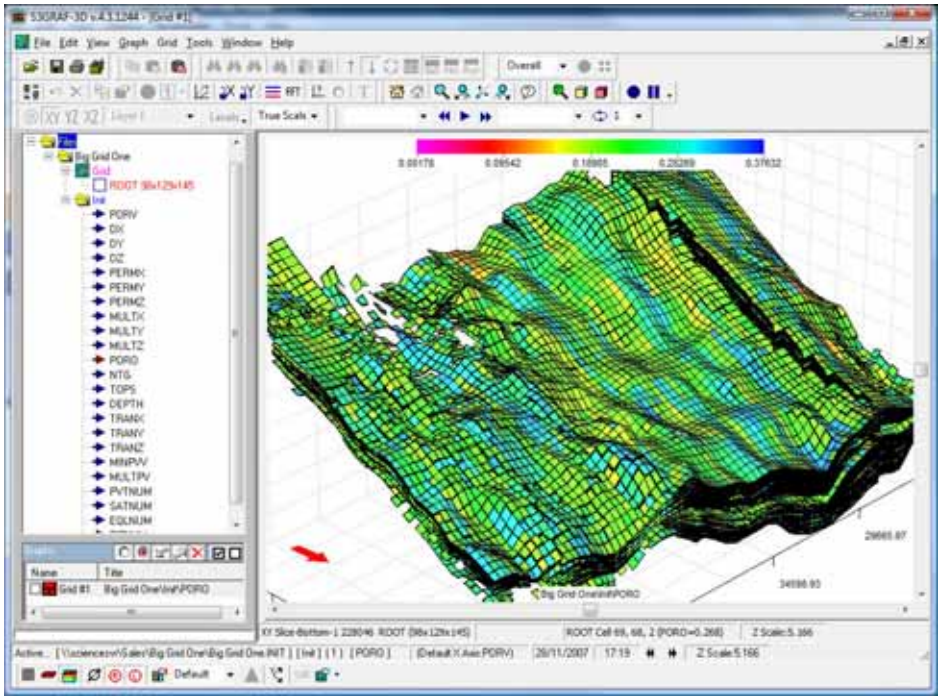
[48] *After the Schlumberger talk, we saw a very similar demonstration on the Halliburton booth regarding its StimWatch fracture monitoring the service.*

Q&A

Why not 'join up the dots' and show the fractures instead of the events?

Yes that's where we're going in Petrel – moving to fracture 'horizon' mapping.

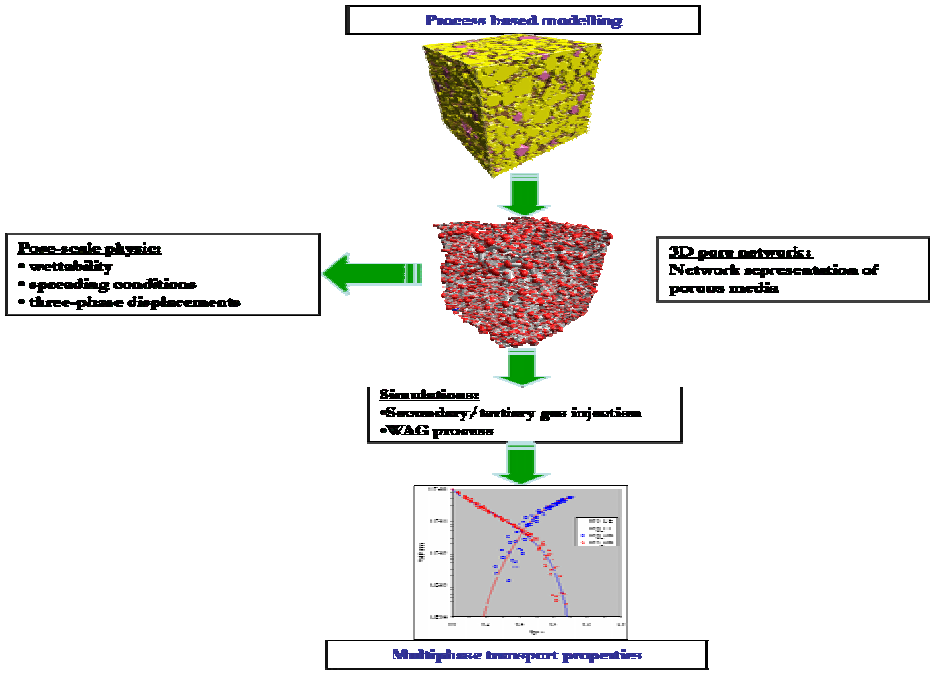
0715_6.11 ScienceSoft – S3Graf-HPG speeds loading of Eclipse restart files



S3GRAF-3D displays 265,000 cell simulation in under 3 seconds[49].

Simulation grids are getting bigger and bigger. An Eclipse restart file is easily 1GB and can take around 15 minutes to load. ScienceSoft's new tool S3Graf-HPG compresses the Eclipse grid such that a 1.5 million cell grid loads 'instantly'. A unified restart file with its associated initialization data opens in 3 seconds. More from www.sciencesoft.com.

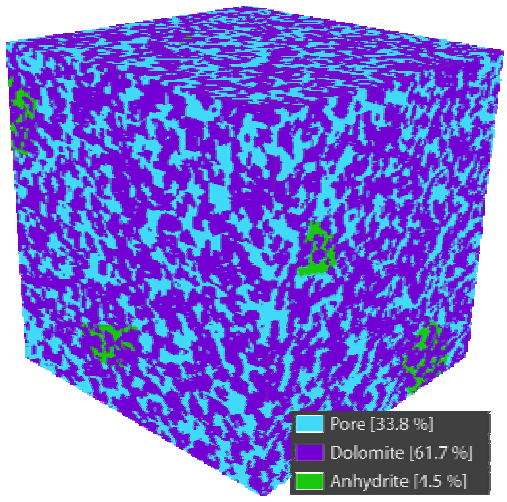
0715_6.12 Numerical Rocks – pore scale 3 phase flow, carbonate JIP



Schematic numerical rock analysis[50].

[49] *Image courtesy ScienceSoft.*

Numerical Rocks is developing software for investigating three phase flow at the micro (pore) scale. By numerically simulating rock-building processes, the pore network of a reservoir can be modeled and flow parameters predicted. Input parameters for the modeling are obtained from thin sections. The company reports that companies are increasingly using micro CT[51] scanning machines for core investigation and is developing software to import CT images and perform threshold calculations, extract network and do fluid flow and digital SCAL[52].



Dolostone with anhydrite cement[53].

Numerical Rocks has also announced a carbonate Joint Industry Project to launch early next year. The JIP is to extend 'e-Core' technology to carbonate reservoirs which are hard to model because of their complex genesis and subsequent alteration. The JIP leverages previous work performed in a feasibility study for StatoilHydro that used modified Numerical Rock codes and micro CT images. A number of reservoir dolostones were reconstructed and petrophysical properties such as absolute permeability, formation factor, NMR simulations and elastic properties were calculated. More from www.numericalrocks.com.

0715_6.13 Schlumberger – Microsoft HPC goes mainstream

A 'Compute Cluster Server[54]*'*

Windows Compute Cluster Server (WCCS) 2003 is now going 'mainstream.' WCCS aims to 'eliminate isolated Linux islands,' leveraging Microsoft's installed base including Active Directory, Windows security model etc. WCCS 2003 is made up of Windows Server 2003 CCE edition as the core HPC platform. A 'CC

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[50] *Image courtesy Numerical Rocks.*

[51] *Computerized tomography.*

[52] *Special Core Analysis.*

[53] *Image courtesy Numerical Rocks.*

[54] *This image comes from the Microsoft press pack. It's unclear if the machine is really running Eclipse!*

Pack' adds Microsoft MPI, a job scheduler and cluster management. Developers write parallel applications from inside the Visual Studio IDE. Schlumberger showed how WCCS was used to run multiple Eclipse fluid flow models and geostatistics. A barrier to running Eclipse of the cluster has been the 'complex setup and maintenance of Linux' still, 'the standard for this environment.' Small companies may not want 'this level of investment'. In such cases Schlumberger suggests a move to a workgroup cluster with 8 – 32 CPUs serving a few engineers working in a Windows environment. Schlumberger's experience is that the WCCS offers 'similar performance to a Linux machine, *at least for up to 8 processors*[55].' Schlumberger will support Eclipse on both Linux and Windows CCS for the indefinite future. Note that WCCS 2003 is 64 bit only. Many developers are (paradoxically) waiting for WCCS 2008 (announced the same week at SC07) because of its 32 bit capability.

0715_6.14 Well Integrity Management System[56] –ExproSoft

Exprosoft's Well Integrity Management system[57].

ExproSoft's Well Integrity Management System (WIMS) was the result of a JIP backed by Statoil, Hydro and Total. The package was commercially released in July 2007. Well maintenance supervisors input data and the system is connected to real time data sources for pressure monitoring etc. WIMS interfaces with SAP, PI (for Total), Documentum and Synergi's HSE system. WIMS can store historical data or link to other data sources with a web services interface. The product is adaptable to different companies' use. Check out the WIMS movie on http://www.exprosoft.com/products/wims.html.

0715_6.15 JMP - Design of Experiment used on Shell's tar sands project

SAS unit JMP is targeting oil and gas with its Design of Experiment statistical package. This uses 'response surface methodology,' variable interactions and polynomials to create a 'desirability function.' The package was used by Shell to design its cyclic steam stimulation program on the Peace River Carmon Creek tar sands project[58]. JMP is partnering with Variance Reduction International to sell into the oil and gas vertical. Area Energy is a user. For those (like us), to whom design of experiment remains a mystery, the book – JMP Start Statistics has a chapter introducing the technique. The package is also available bundled with statistical textbooks from John Wiley & Sons. More from www.jmp.com.

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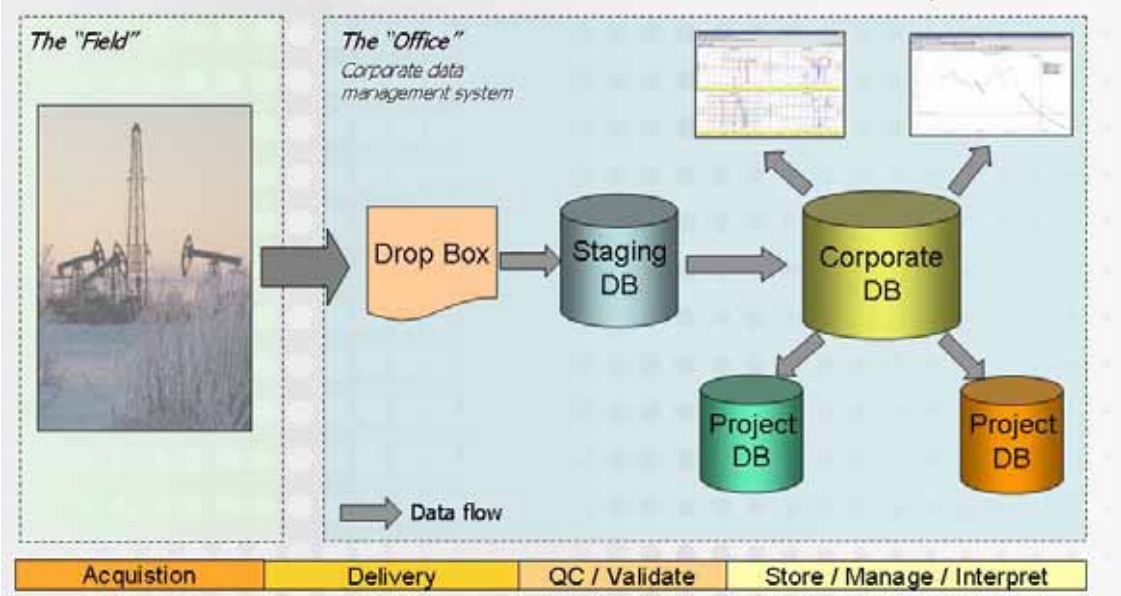
[55] *This sounds like damning with faint praise. We had a similar comment from CMG which finds WCCS useable for running multiple jobs like history matching but not for big simulation runs.*

[56] *SPE 1103471 – http://spe.org/atce/2007/tech_prog/documents/spe1103471.pdf.*

[57] *Image courtesy ExproSoft.*

[58] *SPE 109826 - http://spe.org/atce/2007/tech_prog/documents/spe1098261.pdf.*

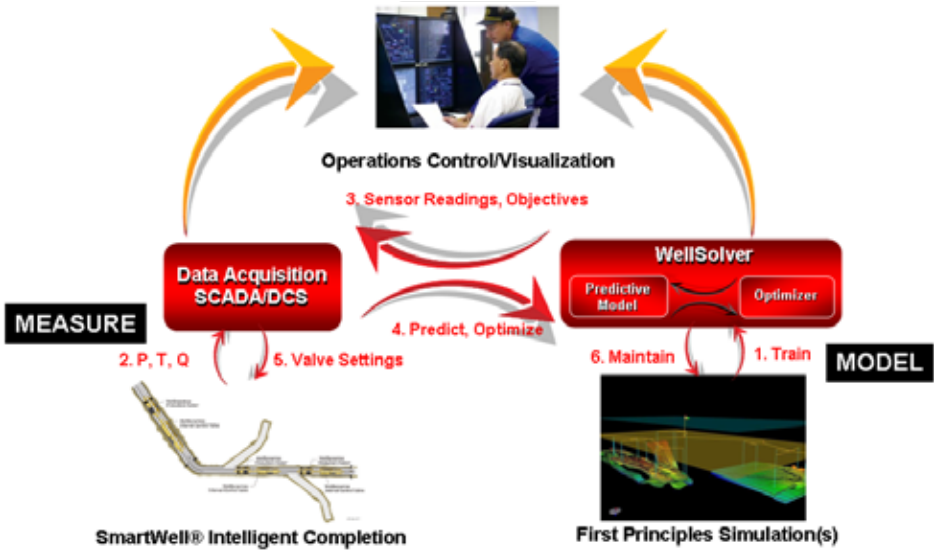
0715_6.16 Geotrace/Tigress field data acquisition



TIES drop box data capture[59].

Geotrace/Tigress was showing new 'drop box' technology. Drag and drop text file of production data and it automatically loads to the database. This is a configurable ASCII loader for data visualization and analysis in Puma (a Tigress component application). One decline curve analysis workflow was demoed with the addition of drop box data and an update of the decline curve on the fly. The system was running CentOS[60] and VMware Workstation. More from www.geotrace.com.

0715_6.17 Well Dynamics Smart Well Solver (Halliburton/Shell JV).



Real time production optimization from WellDynamics[61].

WellDynamics' SmartWell intelligent completion system has been integrated with Landmark's WellSolver62. The solution combines a reservoir simulator, reservoir and well models and historical production data as well as pressure, temperature and flow data to optimize well performance by tuning completion settings. Operations can be either automated or run in an 'advisory' mode with engineers calling the shots. The approach has application in both high end deepwater environments and it 'cost sensitive'

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[59] *Image courtesy Tigress/Geotrace.*

[60] *A community 'rebuild' of Red Hat Linux – see http://en.wikipedia.org/wiki/CentOS.*

[61] *Graphic courtesy WellDynamics.*

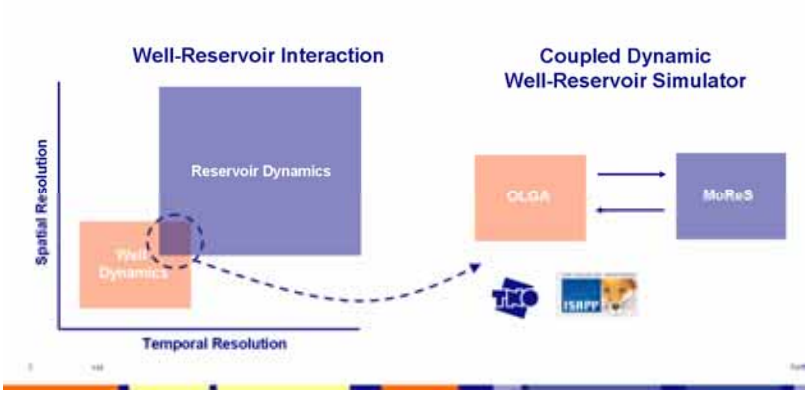
[62] *See also Oil IT Journal article – 'Control loop reaches downhole' – http://oilit.com/2journal/4php/4_makemonthly.php?year=2006&month=10#28.*

environment of California or West Texas where it has been used to control injectors and producers on Kinder Morgan's CO2 flood[63].

0715_6.18 Saudi Aramco – downhole valves on Harahd III development, Ali Al-Rabba.

Saudi Aramco is increasingly relying on multi lateral, maximum reservoir contact (ML/MRC) wells with smart completion. Aramco's 'iField,' 'game changing' technology is a synergy of ML/MRC and geosteering – to let the integrated team monitor real time drilling and optimize well placement. Horizontal wells and smart completions with downhole control valves (DHCV) are now the norm in Saudi Arabia. These have brought significant production increases and have minimized the risk of water breakthrough. A cartoon showed water encroachment stopped as a DHCV closed a lateral with water – resulting in dry oil production and avoiding killing the well. Data management, reservoir characterization and planning also ran. This is the dawn of a new era – a basis for more incremental progress. Teamwork is the key.

0715_6.19 TNO — ISAAP Knowledge Centre



Modeling involves a multiplicity of spatial and temporal scales[64].

TNO, working with the Integrated System Approach Petroleum Production (ISAPP) of Shell and Delft, is studying the connection of different spatial and temporal models used in production optimization. Models are connected at time steps when pressure and flow data is exchanged. This may involve file transfer or in memory data access. Explicit schemas avoid some stability and coupling issues when well bore storage is important – depends on time scale. The coupled dynamic well-reservoir simulator has been applied to well cleaning, shut-ins and start ups. The simulator is also used to study production instabilities like slugging or gas coning[65].

TW0715_7 Other papers of interest

0715_7.1 SPE 110066 – Simulation in reserves – guide for SEC/SOX compliant reporting.

'Simulator models constrained by a reasonable history match are likely to produce a reasonable recovery factor in a mature well or field.'

0715_7.2 SPE 110320 – RPS Group – EU Gas Storage

Paper concludes that there will be competition between gas storage and CO2 sequestration for depleted oil fields.

0715_7.3 Wescorp Energy – RFID field resource management

Wescorp Energy's 'Intelligent Field Resource Management' (IFRM) solution uses radio-frequency identification (RFID) tags to help oilfield operations and maintenance (O&M). Tag information is managed with Wescorp's 'Navigator' services. More from www.wescorpenergy.com.

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[63] *http://www.spe.org/atce/2006/technical/documents/spe1001171.pdf.*

[64] *Graphic courtesy TNO.*

[65] *See also the TNO/Shell paper, 'A dynamic coupled well-reservoir simulator,' SPE 110316, http://spe.org/atce/2007/tech_prog/documents/spe1103161.pdf. .*

0715_7.4 Where will the next generation of PEs come from[66]? – S.M.Schraeder, U. Texas

Survey of Texas high school students finds that the oil and gas industry is perceived as low-tech. While jobs are highly paid, employment is unreliable. A very complete picture of perceptions of PE education and industry perceptions – lots of graphs and statistics.

0715_7.5 2007 SPE/AAPG/WPC/SPEE reserves definitions[67] – J. Etherington, PRA International

A comprehensive overview of the convergence of reserves and resources definitions from a joint initiative to update the 1997 SPE/WPC petroleum reserves definitions and the 2000 SPE/WPC/AAPG petroleum resources classification and definitions.

0715_7.6 What software do we expect? Engineering vs. IT[68] – Sharon Wang, BJ Services

An interesting, if somewhat descriptive, analysis of the big issues of software engineering.

0715_7.7 Production optimization by real-time modeling and alarming[69] – Jacques Danquigny, Total

Describes use of a 'Well Performance Monitoring' application developed for Total by Atos Origin for production optimization and alarm management on the Sendji field, offshore Congo.

0715_7.8 Real time production optimization – a piece of the digital oilfield puzzle[70] - Robert Thompson, Aethon

An interesting and detailed analysis of the application of 'digital oilfield' technologies in 'one of the most cost sensitive environments in our industry.'

0715_7.9 Real-Time Fiber-Optic Casing Imager[71] - M. Appel, Shell

Describes Baker Hughes-developed real-time fiber-optic based casing 'imager' for continuous monitoring of the shape of casings or well tubulars. Lab tests demonstrate sensitivity to deformations of less than 10°/hundred feet.

0715_7.10 Design and build of Campos basin 600,000 bopd flow system[72] - Eduardo Bordieri, Petrobras

A good high-level view of this massive development.

0715_7.11 The 'virtual well,' dynamic simulation for well operations[73] – Juan Carlos Mantecon, SPT Group

Digital oilfield workflows for production optimization leveraging large amounts of streaming data flowing from a number of wells. Case studies of mature waterfloods in four fields with over 60 wells.

TW0715_8 IT Technical Section circa 25 present

Mehrzad Mahdavi reported on the first full year of the SPE's IT Technical Section (ITTS) to an audience of around 25. The aims are unchanged from last year – to 'facilitate the implementation of the digital oilfield with best practices for integration of IT between subsurface and field operations.' The ITTS also seeks to promote a 'new discipline,' train individuals and to develop IT security best practices, combining IT and Digital Oilfield initiatives. The intent is also to 'avoid too many competing conferences.' ITTS board members include Kathy Pepper (CIO Upstream ExxonMobil), Washington Salles (Petrobras), Herb Yuan (Shell) and Don Moore (Oxy). A White Paper on best practices is in preparation and a site for information sharing has been set up on http://communities.spe.org/TechSections/IT/default.aspx. The ITTS is also 'looking at' standards such as PRODML. To avoid 'competing' standards, collaboration is planned with the standards communities who 'need to work in harmony to make the business work.'

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[66] *SPE 110686 - http://spe.org/atce/2007/tech_prog/documents/spe1106861.pdf.*
[67] *SPE 107693 - http://spe.org/atce/2007/tech_prog/documents/spe1076931.pdf.*
[68] *SPE 110642 - http://spe.org/atce/2007/tech_prog/documents/spe1106421.pdf.*
[69] *SPE 110296 - http://spe.org/atce/2007/tech_prog/documents/spe1102961.pdf.*
[70] *SPE 110525 - http://spe.org/atce/2007/tech_prog/documents/spe1105251.pdf.*
[71] *SPE 109941- http://spe.org/atce/2007/tech_prog/documents/spe1099411.pdf.*
[72] *SPE 110487 - http://spe.org/atce/2007/tech_prog/documents/spe1104871.pdf.*
[73] *SPE 109829 - http://spe.org/atce/2007/tech_prog/documents/spe1098291.pdf.*

TW0715_9 The Data Room – Technology Watch subscription information

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The Data Room
7 rue des Verrieres
F-92310 Sevres France

Tel (USA)	281 968 0752
Tel (UK)	020 7193 1489
Tel (France)	+33 1 4623 9596
Fax	+33 1 4623 0652

Technology Watch Home Page info@oilit.com