

Innovative Technologies: What will Change the Energy Industry?

Innovation emerges from drivers: faster, cheaper, simpler, now safer, cleaner.

Water Standards – had access to innovation and use other people's ideas and breakthroughs applied into a different way into a new market. SO much more data available now. Intelligent Drill Pipe Increasing Automation.

How people interpret data and utilize it, and how much of the decisions become automated, is redefining the industry.

What will change today's sessions:

We ask ourselves What fuels innovation?

- In the realm of energy, without energy, you innovate, without water you die. Water == stagnates itself into tremendous global industry. Innovation on energy.

Innovation emerges from drivers: faster, cheaper, simpler, now safer, cleaner.

Focus on commodity when supply/demand issue.

- Water Standard == redefining water industry. Took technology from other industries, energy, and borrowed it in a new process into a new way of delivering water to municipal, industrial and offshore worlds. Membrane based tech, combined with power, onto bethel, desalivated, reduced water, delivering offshore and then deliving to shore.

Water Standards – had access to innovation and use other people's ideas and breakthroughs applied into a different way into a new market. That's what innovation is all about. Applaud those breaking through. This industry gets more out of what you have. EOR /ROR

Borrowing technology and innovation from the energy industry to the water side.

From business side, corporate side.

We are nothing if we do not innovate.

- OIL & Gas is one of the slowest to adopt new technologies. Compared to Computers, Oil industry is slow to adapt.

Over 19 years of working in the industry, there have been very little improvements

Recent years, breakthroughs -- intelligent drill data is as fast as physically possible. With increase in data coming to the surface, increased reliance on people to make decision at site, will be times when human mind won't be fast enough, more processes, more software, interpreting data, allowing us ot take advantage of all info coming uphill.

- Technology to help drill the way, same technology to produce the well, to help understand more information from the well in a timely manner.

More information, more efficiency to drill the well, hopefully leading to fewer wells being drilled in order to meet energy needs.

Intelligent drill type.

Oil & gas slow to adopt technology.

Technology only seen in offshore, or expensive markets.

Anyone who appreciates technology, will take a loss to implement it, and in 10/15 years such as a WIFI in a significantly # of wells and with that will be an increased need to interpret the information.

- Analogy to the oil business: history of camera, 100 of years ago, initial first photo paper with chemicals, lasted 30 minutes.....cameras more sophisticated...sit for 30 minutes, and get

permanent photograph, photographic film, mass production... megabytes of data, automatic...2 key innovations: data and automated....

The key word to remember for what's going to continue to innovate – more and more data which we have to figure out what to do with...and automation.

The word in the O&G is AUTOMATION. The word for how we think about the future.

- Technology is absolutely critical to solving world's energy problems. Company founded in 2002 in Norway. Raised \$400 million dollars under management with the basis that energy is going to be a key issue for the globe going forward. Hydrocarbon will be main driver of that energy for years to come. Focus on carbons. Game changing technology that will make a difference:

Cleaner, safer, more efficient with cost/benefit – these things are critical to make O&G easier to extract, cleaner, and now a focus on Natural Gas (preferable to coal).

Fossil fuels have a long way to go and we won't see a change in our lifetimes.

Always looking for innovation in the Hydrocarbon industry. HC industry has so much innovation that needs to happen. Will be main source, we better focus on it.

QUESTIONS FROM THE AUDIENCE:

Suggest best motivation for energy leadership of the IT advances other industries are leveraging in intelligence and analytics?

- End of day, cost-benefits analysis, cost savings, see how it goes to the bottom line. Always driven by bottom line. EOD does it make economic sense?
- Cloud computing IT Buzzword , as an example, interesting for the O&G industry, so much data, to process as fast as possible, how can we use this in complimentary fashion, and share data, with 'competitors', cloud computing could have something
- Taking gaming computers , and take a 3D Seismic graph – when not gaming. Mobil – Mobil phone beams a mobile video feed to anyone in headquarters and then beam it out to the field. Government operations and utilizes, and brought it to them, to bring it to oil & Gas. Some resistance from companies because of initial capital expenditure upfront, but if you can show a positive NPV that is believable and brings enough return.

Is the industry being slow to embrace technology?

Variation is the next big app, or someone who wants to see it implement 100x.

- Panelist remembers the first rig he was on in 1990, and it was 20 years old, and depressing (studied for this). Rigs in US through Texas, very basic technology being used, economically speaking probably justifiable at the moment, but at some time wells will become more complex.

Rotary steerable technology released in 1995 – opposed to motor drilling – seen as a revolution – worked on 11 years. Find customers who are prepared to take the risk and put it in the ground is a huge challenge – 11 years to make it commercial, takes incredible foresight, or get incredibly lucky.

Questioner: as an industry we spend a lot of R&D.

- Wind and Solar not competitive, consequence of govt' subsidiary, that's the consequence of regulation and subsidy. Amanda, tremendous amount of R&D done and on the shelf, and until we get the cost-benefits and eliminate the risk of implementation, the industry is slow to adopt. That is changing.

- Shell asked service providers were to adopt new technology. There are oil companies who are willing, but there are others, who want to sit and wait for it to be commercial. The Oil Industry's cycle: laggards, and adopted in down period.
- Schlumberger: billion dollars in R&D. some things work and some things don't work. You can't be innovative if the assumption is everything you try is successful from engineering or commercial sense. Sometimes you have to go and try it.
- Oil companies are making money whether they adopt new technology or stick with what's true and trusted. And have made money for many years.
- Sales of early stage technology companies is difficult, must have a very strong USP, value proposition, and its tough. Entrepreneurs have to understand the customer, their needs and how they manage risk.

Started with 2D seismic many years ago. Worked for independents; willing to take on new technology and try it. More disagreement with the staff. Companies used to keep rigs on the shelf during tough times. Now there are just so many drills. If an old technology, is cost-effective and does the job, no point is switching.

- Seismic Guided Drilling: some of what is going to innovate the E&G business is putting together different data together while doing the next step of the process, see what's happening, subsurface, as they're doing drill wells.

Energy and CO2 capture – similar nexus as energy and oil:

- Only scratching the surface with CO2 capture. They have a 8 year fund, so they have to commercialize and sell it. Comments about how long it takes, they're investing with entrepreneurs going 5-6-7 years. Total to market to 15 years. CO2 capture – can I make a return for my investor in the time window I have. Technology exists but is going to scale to make money in a timeframe. One of those 5, 10, 15, 20 year questions. Technology are really neat, but how do I think back to the investor?

How can we make energy affordable and abundant like Kitchen Salt?

- People are looking how to make energy affordable, efficient. The idea of the smart grid that Obama introduced. Focus on the delivery mechanism. For energy is going to have to be available on demand where people want it. Microturbines. Solar. Wind. It's the only way it brings it to the portable commodity with the technology we have today. Our children will breakthrough with some new way of transporting it. Long journey.
- Car that runs on water. 30 years ago electric cars, 30 years later a long way. Kitchen salt is the scalability issue – infrastructure of global energy grid is so enormous, that ability to get it through to mass distribution is huge.

Climate change and legislature – help or hinder continued innovation?

- Will only help if there's more pressure to be careful where we drill, good for us. CO2 capture legislation makes more people do the right thing and spend the money they're forced to spend. Drive new and better ways.
- Issue will be enforcement. Will it have teeth. Regulation is always a driver of change.
- Never though Coal would last until 2009, but legislation made it possible.

How from a corporate standard should we reward innovation?

- Rewarding people for trying. Aside, generations coming up from behind, early 20's are more motivated by environment and making a difference, than they are to invent a post-it note and make a lot of money.
- promoting innovations by having a pot of money by having money that specifically goes for innovation, a couple of people come up with idea, get \$50k, \$100k, and centers hold an innovation fair...some things turn into a real product.

Automation, how to keep people involved with automation:

- Drilling and automation. Do I think we'll ever get rid of people—I don't think so. People driving automation, may be in a central office, watching an operation 24x7, have experimented with automated drilling centers, and people are watching it on television. We're in our infancy . Like a continual x-box game. They're a lot of human involvement still.

Supply & Demand for energy. Seismic, deepwater, subsea tie backs, shell gas, which technologies are out there could be game changers?

- Water side is low cell is ROR/EOR, LOW CELL, on north slope, papers showing a 40% increased recovery. Using water and treated to water increase recovery. The next trillion is what they get from what they got.
- More and more breakthroughs in the area of chemistry. (I'm not a chemist). Green chemistry: based on water, using compounds to help crack formations, and then the stuff that you're using to frack just goes away. Just goes away. In a good way. Other areas, microtechnology and nanotechnology. Things do smaller and can do more, can we eliminate getting stuck in the hole. Just ripe for the OIL& Gas.
- Shale Gas – nano-gas technology. Recent innovation from Rice – a lot of innovation from universities – this one is a nano-technology, Oxane, developing an artificial sand. Tons of sand for shale, this technology which is lighter and stronger than sand, enable to increase production.

Knowledge transfer in the industry:

- As challenges become more complex, importance of leverage different experts, perspectives, knowledge bases to solve these problems and drive innovation.