The art of managing risk in complex field operations and volatile energy markets

The energy sector faces a steeply rising risk profile, due to a combination of more complex field development projects, volatile commodity prices and unstable credit markets. Ruud Weijermars[*] outlines a framework for corporate risk management, illustrates risk management failures, and gives recommendations for improving risk mitigation practices.

To meet our future energy needs, the world community must invest heavily in the development of the full spectrum of energy supply systems (oil, coal, gas, nuclear, bio-fuels, solar, and wind). As much as $38 trillion is the estimated energy systems investment required between now and 2035 (IEA/OECD, 2011). That means the global energy industry must spend on average about $30 billion per week to maintain and develop our global energy supply infrastructure (Voser, 2012).The lion share of this amount is to be spent in the upstream oil and gas business.

Rising costs and risks

Meanwhile, the pressure on the petroleum industry to deliver more oil and gas beyond its impending peak is only mounting. In 2010, oil and gas already accounted for 55% of the global energy mix. This portion must grow to 60% by 2040 (Exxon, 2012). The easy legacy oil fields with low production cost and low technology risk have nearly all been developed. These legacy fields delivered high profits at relatively low technology cost (Figure 1). The anticipated growth in future oil supplies must entirely come from costlier supply sources: from reservoirs that require EOR methods such as thermal and chemical stimulation (heavy oil recovery, e.g., Schoonebeek, Netherlands) and from complex conventional fields in deep Arctic waters and pre-salt formations such as those found in the Gulf of Mexico, Santos Basin, Brazil, and Kwanza Basin-Angola. Unconventional resources include oil shales (the Bakken and the Niobrara, USA), extra-heavy oil sands (Orinoco, Venezuela), bituminous sands (Athabasca, Canada), and kerogenic shales (Green River Formation, USA and Bazhenov formation, Russia). Tight sands and shales need hydraulic fracturing to improve the well rates, and margins are only profitable as long as oil (and gas) prices remain high.

While today's oil and gas operators spend more money to lift more oil and gas than ever before, they face higher economic risks due to lower, and sometimes marginal, profitability of the remaining field assets and the rising cost of technology solutions. The range of strategic and operational risks has also become much broader. Companies face the risk of credit rate downgrades (BP), nationalization of assets (Repsol), volatility in commodity prices (Eon), debt-gearing shocks (Chesapeake), regulatory caps on earnings (El Paso), country risks (ConocoPhillips ventures in Russia and Venezuela), and reputational risks (global fracking fears).

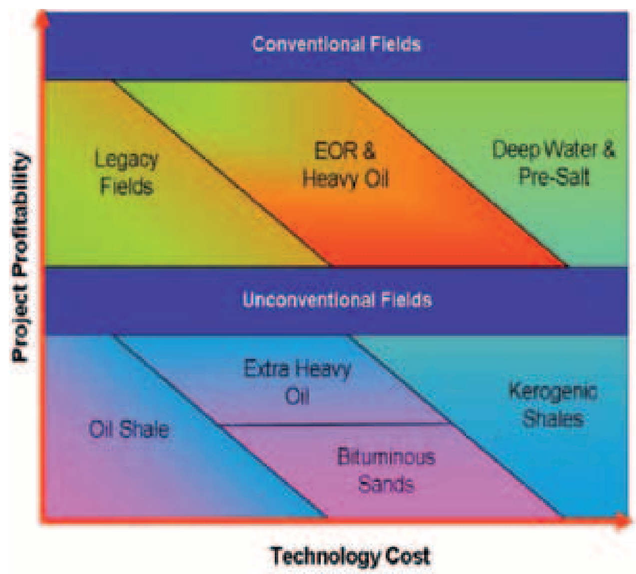

Figure 1 *Qualitative ranking of project profitability and technology cost for various types of conventional and unconventional oil fields.*

This article provides a framework for risk management and documents telling examples of setbacks and failures that highlight the new trend toward higher risk profiles in the oil and gas industry. Recommendations are formulated for dealing with – and mitigating – some of these growing risks.

Risk spectrum

The oil and gas industry community covets some of the world's prime experts in decision-making under uncertainty. Deterministic and probabilistic estimates of subsurface parameters are now routinely used to establish the size of our resources. Dealing with volumetric resource uncertainty only becomes risky when the economic return of the resource

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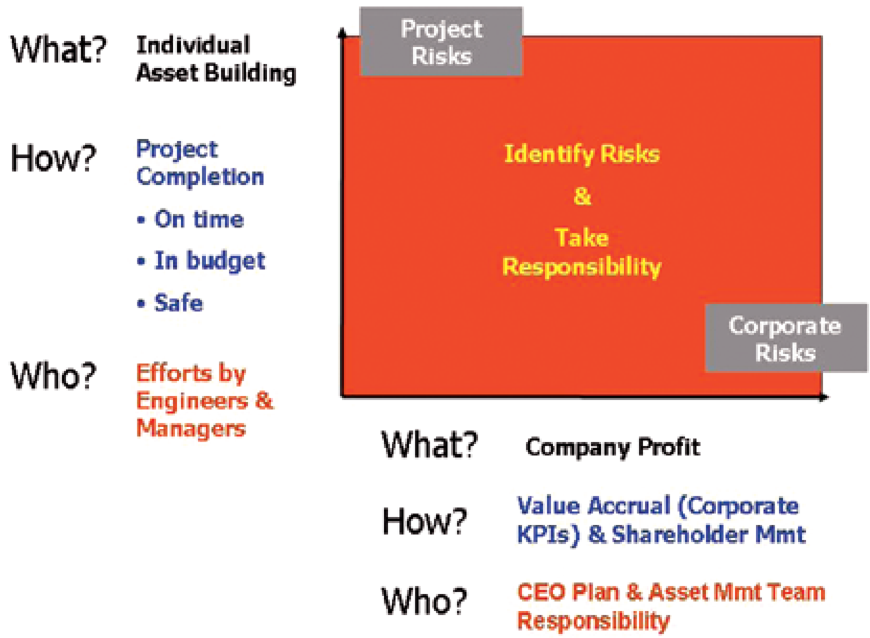

Figure 2 *Corporate risk management focuses on portfolio optimization and risk management of individual projects is mandated to the project teams.*

is adversely impacted by price volatility, new taxation policies, or disappropriation. The difference between *risk* and *uncertainty* is as follows: uncertainty means there is a range of possible future outcomes – they may all be positive and are not necessarily risks. A risk is a future event that may have a negative impact on your status – gambling and incurring money loss, asset value depreciation or loss, personal casualties, or reputational loss. Responsible risk management means your company proactively: (1) quantifies the risks' potential impacts were these to occur, and (2) assesses the likelihood or probability of these impacts actually happening.

As everything we do involves risk, a conscious person or company only engages in those projects and actions where the risk of failure is low enough, as factored into the upside or net present value estimated outcome of the project or action, to justify repeated exposure to the risk. For example, the risk of a dry well should be taken if the expected monetary value (EMV) of a drill or drop decision is positive:

$$EMV = (POS \times NPV \text{ oil production}) - [(1-POS) \times \text{Cost of Well}] \quad (1)$$

Equation 1 can be generalized for assessing the EMV of any risk exposure. Risk exposures where the future outcomes are assumed to be positive are those *business opportunities* that justify risky engagements.

What is of additional and overriding importance for successful corporate risk management is a clear management structure for risk governance. The chief risk officer (CRO) has the ultimate responsibility for designing and implementing an active risk governance structure. Figure 2 highlights the decision-making space from a strategic, corporate perspective, and an operational, project management perspective. A potential gap in responsibility may arise when perceptions of risk management responsibility are different for the different managerial layers. It is therefore important to clearly identify which functions bear responsibility for the proactive monitoring, assessment, and decisions related to the management and mitigation of the various risks.

Figure 3 highlights a non-exhaustive inventory of a commonly used risk spectrum for the oil and gas industry. Overall risk management is a corporate responsibility, but operational risk management should be delegated to the project teams. Sources of risk with a strategic component that may affect all projects in the company portfolio must be proactively managed at corporate level. Examples are hedging against oil and gas price volatility, portfolio risk

Figure 3 *Framework for corporate risk management that covers both strategic and operational risks.*

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balancing, and reputational risk decisions. To illustrate how risk exposure and acceptance can evolve and impact the company, some specific cases are discussed below. These cases also provide a sound basis for the recommendations for improvement of risk management in oil and gas companies.

Price risk

Nowhere has the impact of price volatility been felt harder than in the US natural gas market over the past few years. US shale gas operators have seen wellhead prices dwindle, from an annually averaged price peak of $7.74 per million Btu in 2008 to about $2 per million Btu in 2012 (Q1). This means that shale gas wells in fields that were previously assumed to become economic with rising gas prices have instead become sub-economic. Figure 4a is a stylized version of the Haynesville sweet spot core region with lower well-productivity zones contoured as one moves away from the core area. Figure 4b shows the hurdle rate for the corresponding wells, based on a detailed cash flow analysis (Weijermars and Van der Linden, 2012), indicating that all wells have become sub-commercial at 2009–2012 wellhead gas prices.

The impact of the negative cash flow from these Haynesville wells and similar shale gas assets in other US regions (Barnett, Woodford, Eagle Ford, Fayetteville, Marcellus) is compounded for companies that hold such acreage. Not only are their operational earnings negative (Weijermars and Watson, 2011a,b), their collateral asset base will also evaporate with the unavoidable and imminent outcome of future impairment of their proved reserves (Weijermars and McCredie, 2011).

Figure 5a shows the generic PRMS classification categories relevant for our discussion, distinguishing reserves and contingent resources based upon the commercial value of the established hydrocarbon volumes. Doubts about the reliability of EUR estimates of shale gas wells (Berman, 2009a,b; 2010a–c) are no longer the leading reason for an impending downgrading of US shale gas reserves. The principal reason for proved reserves impairment (both developed and undeveloped) and downgrading to contingent resources (Fig. 5b) is the steeply declined wellhead gas price – for which none of the US shale gas plays is returning a profit. With losses as steep as $1–6 per million Btu (depending upon which zone is producing) field assets that previously may have been reserves under a higher 12 month price average (for example, in the 2008 SEC reporting year) are now no longer realistically economically producible at the depressed gas prices prevailing in 2009 till today. These proved reserves must be diligently downgraded and will thus become classified as contingent resources in the company balance sheet (Weijermars, 2012a). Diligent resource classification and a self-audit reserve reporting system compliant with SEC guidelines mandates such reserve downgrades.

The business impact of these reserve downgrades will be severe: whereas proved reserves are recognized collateral for

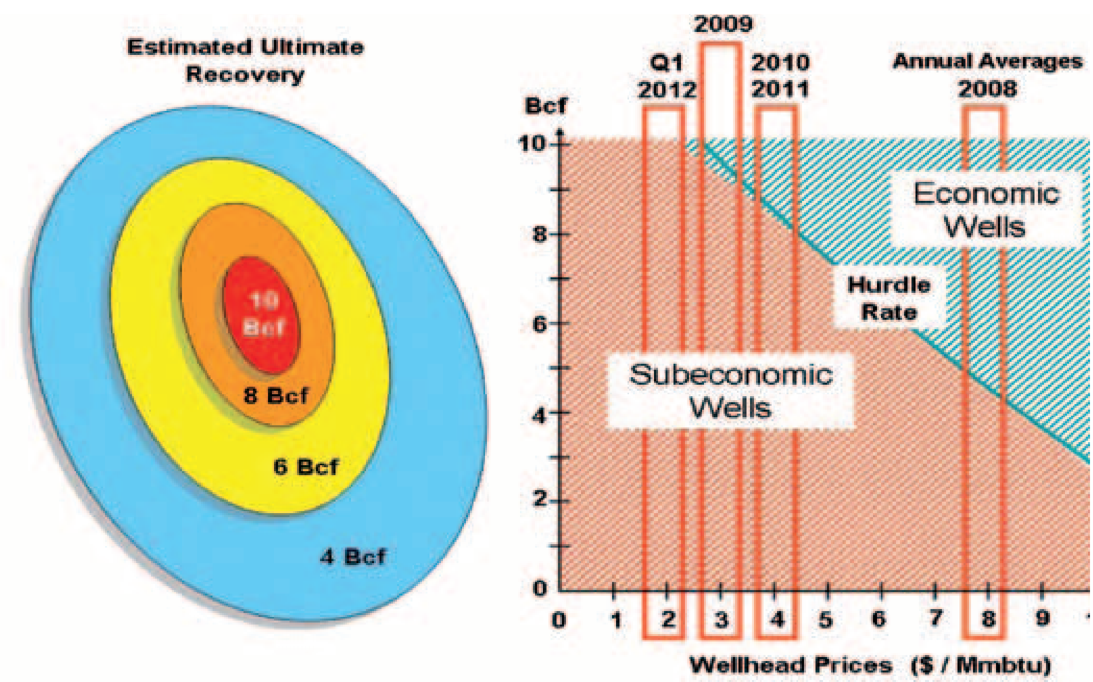

Figure 4 (a) Summary of EUR zones of shale gas wells in the core area of the US Haynesville shale gas play. (b) Hurdle rate curve of 15% separates economic wells from sub-economic wells, based on a detailed NPV and cash flow model analysis using representative input parameters (Weijermars and Van der Linden, 2012). The columns outlined show the annually averaged wellhead prices for 2008-2012 (Q1). Virtually all wells are sub-commercial for the gas prices fetched between 2009 and 2012 (Q1).

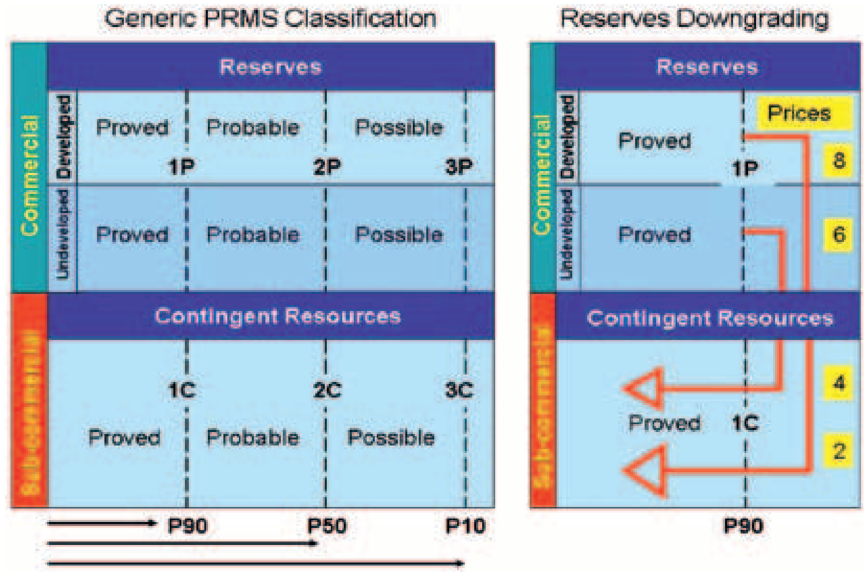

Figure 5 *(a) Proved reserves are those P90 volumes that can be produced with reliable technology and with economic profit using 12 month averaged market prices over the past reporting year. (b) The depressed US natural gas prices (indicated in \$/Mmbtu) have rendered virtually all shale gas plays sub-commercial. Technically, this requires the declassification of formerly proved reserves as contingent resources.*

credit transactions, contingent resources are not. This means that nearly all of the \$430 billion combined market capitalization of US shale gas independents is at risk of becoming illiquid. With an unusually high average-gearing ratio (debt leverage) of 0.7, there is no feasible room left for any refinancing.

So how could this US natural gas default risk have been handled better? Firstly, vicious gas price volatility can be dampened by proactive regulation which ensures gas producers a minimum return on investment. Such regulation is already in place for the US mid and downstream gas sector (Weijermars, 2010). Secondly, skilful gas price hedging provided some security against gas price drops and companies like XTO and EOG have been very successful in using such hedges (Weijermars and Watson, 2011b). For example, XTO earnings for 2009 from its price hedges were even higher than the earnings from its operational sales – physical gas wellhead prices for 2009 averaged only \$3.16 per million Btu.

However, with gas prices steadily declining off their 2008 peaks, there have been no viable opportunities to lock in new hedges, which is why many US natural gas producers are now 'naked' and fully exposed to the risk of further price declines. Thirdly, companies and their lenders should have been far more conservative in their debt acquisition programmes. Now these over-leveraged companies have no room left for refinancing. At this stage many professional analysts of the US gas market agree that a significant number of US natural gas independents has become technically illiquid with no other remedial option left but asset fire sales. Some of the largest US gas independents are even beyond rescue of a Chapter 11 bankruptcy – a full-out asset sale is the only remaining option, most likely at prices well below the companies' earlier market values. These companies will cease to exist as separate entities.

For example, Chesapeake Energy has been managed with an unusually high risk exposure which even captured the media's attention (Box 1). The company is now left vulnerably exposed to adverse impacts of a negative press, governance misjudgements, credit risk and reserve-impairment risk -- and these risks now begin to exert their compounded effect. The company has also taken on an extraordinary accounting compliance risk by entering in no less than 10 unorthodox volumetric-production-payment (VPP) agreements. These are presented by Chesapeake as off-balance sheet debt, but that interpretation is not undisputed. Additionally, the perception of poor corporate governance by the entire corporate board – the CEO and Board of Governors – is growing.

Chesapeake Loan Scandal

Numerous critical reports about Chesapeake have appeared in the published media. Here is a selection that contributed to a reputational risk factor now called the 'Chesapeake Loan Scandal':

25 June 2011: *New York Times*, Ian Urbina, 'Insiders sound an alarm amid a natural gas rush'

13 February 2012: *Forbes*, Christopher Helman, 'Chesapeake Energy's new plan: desperate measures for desperate times'

1 March 2012: *Rolling Stone*, Jeff Goodell, 'The big fracking bubble: the scam behind the gas boom'

25 March 2012: *Pittsburgh Post-Gazette*, Erich Schwartzel, 'Chesapeake Energy CEO capitalizing today on tomorrow's profits in West Virginia's farmland'

18 April 2012: *Reuters-Thomson*, Ana Driver and Brian Grow, 'The Energy billionaire's shrouded loans'

23 April 2012: *Washington Post*, Joe Carroll, 'Chesapeake 25% decline seen spurred by personal conflict'

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The Board says it is not responsible for its CEO taking out over $1 billion loans against a 2.5% stake of every company well – linked to an already disputable bonus system termed the Founders Well Participation Program (FWPP). Actually, the intricate web of financial risks taken by the company has now become a serious financial and reputational risk factor for the entire global shale gas industry (Weijermars, 2011a). If the unfolding of the company's finances and the lawsuits filed by shareholders establish fraudulent actions or comparable malpractices, the global investor community will promptly respond by putting a high risk premium on any new shale gas investments – thereby raising the hurdle rate for the development of any new shale gas plays.

Credit risk

Regulation of minimum earnings for US transmission companies and utilities has limited their risk of exposure to transmission price volatility. However, overly-tight regulation of the returns on investment has a downside if rates are set too tightly (Weijermars, 2012b). The low ceiling for the authorized cost of capital set for US energy transmission companies and utilities has increased the risk that the true cost of capital cannot be recovered from operational earnings by companies with lower credit ratings. Energy companies with lower creditworthiness pay higher interest rates for access to unsecured debt (i.e., debt without an equity stake in return for the cash provided, Weijermars, 2011b). Debt rates are cheaper for some than for others, based on the corporate credit rating. For example, the weighted average cost of capital (WACC) for El Paso, an integrated US energy company, became much higher than the authorized WACC. Table 1 shows El Paso's real cost of capital in 2009 was as high as 11.03%, while the authorized cost of capital was 8.15%. The gap of 2.78% between the real and authorized cost of capital could not be charged to end-consumers according to the regulatory principles – general rate case (GRC) method and cost of capital mechanism (CCM) – adopted by most US States (Weijermars, 2012b). This forced El Paso to sell assets in order to cover operational losses – a situation that was not sustainable. El Paso ceased to exist as a separate corporation due to persistent earnings shortfall and credit default – it is now a brand name of Kinder Morgan.

What can be done to avoid such defaulting and reduce company's risk of exposure to a rising cost of credit associated with the authorization policies of the US federal and state regulators? The regulatory risk of WACC gaps can be reduced by policy measures that enable energy transmission companies and energy utilities to regain their creditworthiness. Corporate credit risk can be mitigated (and earnings potential improved) by three simple fixes to the current US regulatory regime. First, the true cost of capital should be allowed and authorized in rate cases under the current covenants (GRC and CCM). Second, higher equity ratios should be allowed and authorized by the regulator in rate cases, to help utilities reduce their cost of capital, thereby reducing the risk of credit default. Third, faster settlement of rate cases is required to help accelerate the new infrastructure investments in power plants and smart grids for modern energy transmission systems and improve earning potential.

Country risk

Over the two decades since the end of the Soviet Era, nearly all major oil companies have flocked to secure and operate Russian oil and gas assets. The track record shows that Russia's country risk is substantial. ConocoPhillips exited Russia altogether, early 2011, after years of struggling with its 20% Lukoil stake, acquired for $7billion in 2004. The company sold 13% back to Lukoil for $5.8 billion and 7% to smaller investors. In addition, it has written off substantial losses on its Lukoil venture over the years (McCredie and Weijermars, 2011).

At Sakhalin1, there is a joint venture between Exxon (30%), Sodeco (30%), ONGC (20%), Sakhalinmorneftegaz (11.5%), and Rosneft (8.5%). However, Gazprom wants to sell Sakhalin's gas domestically and is only prepared to take gas in its pipelines at domestic Russian gas prices. But the Sakhalin 1 operator disagrees and wants to sell its joint venture (JV) gas at premium export prices to the Asian-Pacific market. Meanwhile at Sakhalin 2, the joint venture between Shell (55%), Mitsui (25%), and Mitshubishi (20%), renegotia-

Regulation risk for cost of capital					
Capital Structure	Ratio (%)	Authorized ROR (%)	Authorized Wt. Cost Capital (%)	Real ROR (%)	Real Wt. Cost Capital (%)
Debt (Long-term)	46	6.05 (Moody's bond rate)	2.78	12.3 (junk bond rate)	5.66
Preferred Stock	2	5.68	0.11	5.68	0.11
Common Stock	52	10.11 (=ROE)	5.26	10.11 (=ROE)	5.26
Total	100	-	Authorized WACC=8.15%	-	Real WACC=11.03%
ROR=Rate of Return; ROE= Return on Equity; WACC= Weighted average Cost of Capital					

***Table 1** Example of risky gap between real cost of capital (real WACC) and authorized WACC – El Paso Energy.*

tion of the earlier terms resulted in the formal handover of operatorship to Gazprom in 2008. The original JV partners received $7.45 billion for surrendering their 50% stake, which covered only two-thirds of the 50% share in expenditures already made by the JV partners.

BP continues to seek a successful Russian partnership. Its Russian subsidiary TNK-BP has encountered several major setbacks including the abortion of the Kovyckta gas field development after the production licence obligation could not be met. Slavneft, the other major TNK-BP subsidiary, is facing difficulties in obtaining pipeline access to meet licence requirements for its East Siberian assets. BP also failed in 2011 to gain support from its Russian shareholders for the proposed tie-up with Rosneft for development of Rosneft assets in the Barents Sea.

What can be done to minimize your company's country risk? Country risk can be mitigated utilizing the kind of asset swap deal that Exxon has recently struck with Rosneft (April 2012). Exxon walked away from its intended acquisition of Yukon in 2003 after a veto by Putin, but has now cleverly leveraged the deal with Rosneft by trading Rosneft assets located in Russia for Exxon assets located in the US. In case a tit-for-tat war were to develop between the two nations, the mutual asset swap unwinds with a neutral result as long as accrued net investments in each asset remains balanced.

This leveraged construction of country asset swaps was not utilized by Repsol, which left itself totally exposed to the nationalization of its Argentine assets in April 2012. In the absence of comparable oil and gas assets, oil companies should think of alternative substantial collateral leveraged asset swaps by foreign nations when doubts about asset security in the host country prevail.

Reputation risk

The reputation of oil and gas operators is known to be severely impacted when the safety record of operations, human health issues, and care for the environment are compromised. BP has seen its risk of operational failures rising with a string of accidents – a major Texas refinery explosion with casualties, an Alaskan pipeline explosion, and the *Thunder Horse* production platform capsizing. All of these incidents preceded the catastrophic 2010 blowout of the Macondo well and collapse of the *Deepwater Horizon* drilling platform, involving 11 deaths, $20 billion in damage fund payment, and an adverse impact on the BP brand's reputation.

Operational safety procedures remain paramount for sustainable success in our global oil and gas business. And a new suite of stakeholder concerns has emerged with the development plans for major shale gas fields on land. Risk of sunk cost in leases is high with moratoria and suspensions on fracking now in place in numerous states and nations (New Jersey, USA; Quebec, Canada; France; UK; Netherlands; Bulgaria; and South Africa).

EU regulation of unconventional gas
The grant of authorizations for exploration/production is covered by the Hydrocarbons Directive
Water Protection is covered by the Water Framework Directive, the Groundwater Directive, and the Mining Waste Directive
The use of chemicals is covered by Regulation for Registration, Evaluation an Authorization (REACH) and administered by the European Chemicals Agency (ECHA)
Protection of Natura 2000 areas for the sake of safeguarding biodiversity within the EU is regulated by the Habitats Directive and the Wild Birds Directive
The requirement of an Environmental Impact Assessment (EIA) as well as public access to environmental information is laid down by general environmental legislation (The E.I.A.-Directive and European legislation implementing the Aarhus-Convention)
Operators may be subject to liability for damages under the Environmental Liability Directive and the Mining Waste Directive

***Table 2** Principal recommendations regarding EU regulations for unconventional gas E&P in Europe (EU Report, 2011)*

The new stakeholder concerns are not only relevant for shale gas development projects, but also for the development of kerogenic shales in the US Green River formation for which a Programmatic Environmental Impact Study (PEIS) was completed in January 2012 as a final step to prepare for commercial licensing. The EU and US have both issued recommendations addressing shale gas development concerns, as summarized in Tables 2 and 3, respectively. Companies need to be sure they comply with local regulations, and observe environmental policy regulations. Environmental impact studies are advised.

How can companies reduce the risk of an eroding support base for their local shale gas projects? One precaution is to identify the most relevant stakeholders. When differences of opinion intensify, find out where and why exactly the opinions differ. Engage positively with the stakeholders and address the local energy consumer concerns. What are the mutually aligned concerns? Can there be a reconciliation of the various non-aligned topics? Get support from the relevant policymakers and ask their advice to work with the interests of their constituency. Make sure the company offers the best solutions, and engage with the local research community to help build a local expertise and support base. Treat reporters with courtesy and engage positively with the media at all times.

Champions of risk management

Oil and gas companies are outstanding experts in the quantification of geological subsurface uncertainty by utilizing G&G expertise. However, continuity of operations is continually

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under threat by a suite of operational risks (well blow-out, fluid loss, etc.) and additional strategic risks that should be mitigated at corporate level (country risk, price volatility risk, reserve volatility risk, credit risk, regulatory risk, etc.). The oil company of the future must be a champion in risk management of the full range of strategic and operational risks.

The oil company of the future must also continue to meet a number of societal expectations in order to keep the support of the general public, policy makers, and the investor community. Some of the topics that require attention to reduce the risk of eroding societal support for the oil and gas business are rooted in communication issues and in performance issues (listed in Table 4).

Most risk mitigation measures reviewed here relate to the rapid changes in the energy business landscape. Clearly, innovation goes beyond technology issues alone. Figure 6 shows the risk of a corporate disconnection from the industry's best practice. Such a disconnection does not occur abruptly but evolves gradually due to a decline in the organizational learning capacity, which in turn compromises the company's Corporate IQ (Weijermars, 2011c-e). When the learning ability is compromised and the company's inability to read and lead the change process is not restored but instead is deteriorating further, the likely outcome is an eventual demise of the company -- unless a major realignment is realized (the Big Bang re-connect in Figure 6).

US shale gas production recommendations

Rec.# Recommendation	Comment & Status
1. Improve public information about shale gas operations	Federal responsibility to begin planning for public website. Some discussion between DOE and White House offices about possible hosting sites but no firm plan. States should also consider establishing sites.
2. Improve communication among federal and state regulators and provide federal funding for STRONGER and the Ground Water Protection Council	Federal funding at $5m/y will allow state regulators/NGOs/industry to plan activities. Possible minor DOE FY2012 funding; no multiyear commitment.
3. Measures should be taken to reducee missions of air pollutants, ozone precursors, and methane as quickly as practicable.	We encourage EPA to complete its current rulemaking as it applies to shale gas production quickly, and explicitly include methane, a greenhouse gas, and controls from existing shale gas production sources. Additionally, some states have taken action in this area, and others could do so as well.
4. Enlisting a subset of producers in different basins to design and field a system to collect air emissions data.	Industry initiative in advance of regulation. Several companies have shown interest. Possible start in Marcellus and Eagle Ford.
5. Immediately launching a federal interagency planning effort to acquire data and analyze the overall greenhouse gas footprint of natural gas use.	OSTP has not committed to leading an interagency effort,but the Administration is taking steps to collect additional data, including through the EPA air emissions rulemaking.
6. Encouraging shale-gas production companies and regulators to expand immediately efforts to reduce air emissions using proven technologies and practices	A general statement of the importance the Subcommittee places on reducing air emissions.Federal funding at $5m/y for state regulators/NGOs/industry will encourage planning. Some states have taken action in this area, and others could do so as well.
11. Launch addition field studies on possible methane migration from shale gas wells to water reservoirs.	No new studies launched; funding required from fed agencies or from states.
14. Disclosure of Fracturing fluid composition	DOI has announced its intent to propose requirement. Industry appears ready to agree to mandatory stricter disclosure.
15. Elimination of diesel use in fracturing fluids	EPA is developing permitting guidance under the UIC program. The Subcommittee reiterates its recommendation that diesel fuel should be eliminated in hydraulic fracturing fluids.
20. R&D needs	OMB/OSTP must define proper limits for unconventional gas R&D and budget levels for DOE, EPA, and USGS.

Table 3 *Principal Recommendations by US Shale Gas Production Subcommittee (SEAB, 2011).*

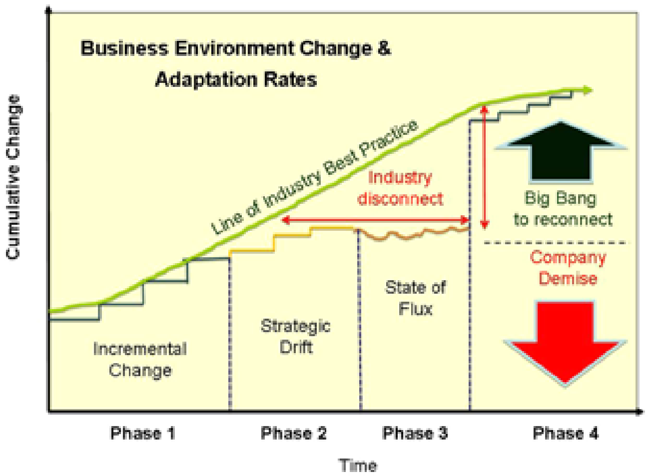

***Figure 6** Industry leaders must lead change with best practice solutions. Some companies gradually enter into strategic drift when the business environment deteriorates for them. Persistent failure to readjust the company strategy and risk profile to the new market developments marks their entry in a state of strategic flux. Finally, when the company progressively disconnects further from the new realities in the business environment a major strategic readjustment (Big Bang) is needed to save the company from total failure and demise. The risk profile of the company needs to be sanitized and recalibrated to equip the reorganized company with appropriate risk management tools and a robust risk management governance structure.*

The most important elements to prevent such disruptive Big Bang events remain: (1) generating creative solutions utilizing the intellectual capacity of humans to look at problems in unconventional ways, (2) analyzing which ideas are worthwhile, and (3) excelling at the articulation of the most promising ideas in order to convince others that these ideas are truly worthwhile and should be pursued. However, such ideas need to get a hearing in the company. The problem is that companies in strategic drift and flux are no longer open to articulated alternative views and progressively lose common sense – the top management of such companies typically is out of touch with reality.

Ensuring societal support
A. Communication issues:
Repeat the message about the realistic speed of de-carbonization
Engage the public at large in the energy debate
Work closely with policy makers and regulators to gain political support and project approval
Engage local communities when drilling plans are perceived by them to affect their daily lives
B. Performance issues:
Communicate both the risk and importance of learning opportunities of new fossil fuel plays (shale, etc.)
Mitigate reserve volatility that comes when market prices are unstable – keep safe margins
Inform the investor community properly about the operational uncertainties
Accelerate the innovation rate to bring down the cost of reserve growth
Innovate technology fast enough to secure access to new oil and gas resources at affordable consumer prices

***Table 4** Risk of Erosion of Societal Support – mitigation measures.*

Lessons learned tell us that corporate energy failures are ugly and costly when internal and external alignment processes are all failing (ENRON, Amaranth, El Paso). Who is next? If Chesapeake is not your role model company, then better ensure that your organizational learning, Corporate IQ development, and accelerated corporate risk management are in line with industry's best practice.

Disclaimer

This study analyzes company performance based on data abstracted from company reports. The analysis of these empirical data inevitably involves a degree of interpretation and uncertainty connected to the assumptions made. Although the results derived here are reproducible using the outlined research methods, the authors, Alboran Energy Strategy Consultants and publisher take no responsibility for any liabilities claimed by companies included in this study. Readers, especially serious investors, should perform their own due diligence analysis regarding internal corporate technical risk management, considering the wisdom of some risk premium for companies having primary assets in newly evolving plays and potentially unstable business models.

References

Berman, A. E. [2009a] Lessons from the Barnett Shale imply caution in other shale plays. *World Oil*, **230**, 8, 17.

Berman, A. E. [2009b] Realities of shale play reserves: examples from the Fayetteville Shale. *World Oil*, **230**, 9, 17.

Berman, A. E. [2010a] ExxonMobil's Acquisition of XTO Energy: The Fallacy of the Manufacturing Model in Shale Plays. *The Oil Drum*.

Berman, A. E. 2010b, Shale Gas—Abundance or Mirage? Why The Marcellus Shale Will Disappoint Expectations. *The Oil Drum*, 29 October.

Berman, A. E. [2010c] EIA Annual Energy Outlook 2011: Don't Worry, Be Happy. *The Oil Drum*, 29 December.

EU Report [2011] Final Report on Unconventional Gas in Europe, TREN/R1/350-2008 lot 1. Philippe & Partners, Brussels.

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Exxon [2012]. *The Outlook for Energy: A view to 2040.*

IEA/OECD [2011]. Resources to reserves 2011. *International Energy Agency, Paris.*

McCredie, C. and Weijermars, R. [2011] Gas Forecasting - Russian Gas Key to 2020 targets. *Petroleum Review*, **65**(7), 774, 30–34.

SEAB [2011]US Secretary of Energy Advisory Board, Shale Gas Production Subcommittee – Final Report – For public comment. Second Ninety Day Report. US Department of Energy.

Voser, P. [2012] The natural gas revolution. *Energy Strategy Reviews*, **1**, 1, 3–4.

Weijermars, R. [2010] Value Chain Analysis of the Natural Gas Industry – Lessons from the US Regulatory Success and Opportunities for Europe. *Journal of Natural Gas Science and Engineering*, **2**, 86–104.

Weijermars, R. [2011a] Security of Supply: Operational Margins at the Wellhead and Natural Gas Reserve Maturation, Abstract & Forum Presentation, Taking Natural Gas Seriously: Opportunities and Challenges. AAPG General Assembly. Search and Discovery Article #70106.

Weijermars, R. [2011b] Credit Ratings and Cash Flow Analysis of Oil & Gas companies: Competitive disadvantage in financing costs for smaller companies in tight capital markets. *SPE Economics & Management,* **3**, 2, 54–67, SPE paper 144489.

Weijermars, R. [2011c] Why energy companies need to monitor their Corporate IQ. First Break, vol. 29, no. 9 (September Issue), p. 45-48.

Weijermars, R. [2011d] Moving the Energy Business from Smart to Genius by Building Corporate IQ. *SPE Economics & Management*, **3**, 3, 186–194, SPE 144490-PA.

Weijermars, R. [2011e] *Building Corporate IQ: Moving the Energy Business from Smart to Genius: Executive Guide to preventing Costly Crises*. Springer, London.

Weijermars, R. [2012a] Jumps in proved unconventional gas reserves present challenges to reserves auditing. *SPE Economics & Management*, SPE 160927-PA, in press.

Weijermars, R. [2012b] Regulatory Reform Options to revitalize the US Natural Gas Value Chain. *Utilities Policy*, **21**, 50-58.

Weijermars, R. and McCredie, C. [2011] US Shale Reserves – Inflating US Shale Gas Reserves, *Petroleum Review*, **65**(12), 780, 36–38.

Weijermars, R. and Watson, S. [2011a] Can Technology R&D close the Unconventional Gas Performance Gap? *First Break*, **29**(5), 89–93.

Weijermars, R. and Watson, S. [2011b] Unconventional Natural Gas Business: TSR Benchmark and Recommendations for Prudent Management of Shareholder Value. *SPE Economics & Management*, **3**, 4, 247–261, SPE 154056.

Weijermars, R. and Van der Linden, J. [2012] Economic Margins of Sweet Spots in Shale Gas Plays. In review.