This Is Not About Mystics: 
Or Why a Little Science Would Help a Lot

Paul Donley

Abstract

This paper applies James Reason’s systems approach intuitively from the perspective of the crew and workers on an Explorations and Completions rig, with particular focus on the role and attitudes of the driller and drilling engineer.

Reviewing the aspects of sociotechnical analysis leads to recommendations for more effective, inclusive and efficient regulatory functions applying principles from Dr Robert Bea and Dr Reason and employing Web 2.0 technology. Recommendations may be taken individually or as a whole to provide a structural strategy for training, recruitment, PR, and logistics making all aspects available to as many stakeholders as security concerns allow.

The paper examines the structure of the Oil and Gas industry from a sociotechnical perspective. There is a discussion of how External Risk Neglect functions within the Oil and Gas industry; specifically the Explorations and Completions operations. Sociotechnical methods have not employed in this area of the industry, despite considerable investment in change management throughout other areas of the industry.

Building on existing and emerging technology, a review of the sociotechnical options available to industry and regulatory agencies leads to recommendations for more effective, inclusive and efficient regulatory functions.

Recommendations attempt to fulfill the goals of the 3rd International Regulators’ Offshore Safety Conference, summarized in the Appendix, and building upon W Earl Carnes’ concept of Higher Reliability Governance, using Web 2.0 concepts. The overall recommendation is to closely integrate regulatory agencies with industry to keep up with emerging technology, and make all aspects available to as many stakeholders as security concerns allow.

Although a modest work by the standards of the other contributions to the DHSG Final Report, this paper could not have been written without the patience of Prudence Humble, to whom it is dedicated; the unending and often irascible vision of Wayne Needoba; and the encouragement and insight offered generously by W Earl Carnes.
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1. Systems and Data

It must be said that the amount and quality of the data may blind the developer to the definition of the system. This paper is intended to support the development of a risk management system. In terms of risk management, the data must not define the system. It is the system that defines the data by putting it in perspective. Some system must be at risk, and the risk can only be evaluated regarding that system. Once the concept of the system is lost, the data take on a life of their own, confusing the evaluation of risk. But first you have to spend the time to define the system. That’s not always easy.

The method is somewhat novel. Commonly, this sort of analysis is done top-down, from the management perspective. Because of the availability of drilling experts, this paper will turn the process upside down – to explore the Macondo blowout by defining the system under examination as the operations on the rig, particularly the role of Driller and Drilling Engineer.

This whitepaper will take a systems approach. We will define the system under examination as the drilling rig and Drilling and Completion operations, with specific focus on the role of the Driller. This approach is logical because of the availability of drilling experts with long experience in the Deepwater Horizon Study Group (DHSG).

The focus has been drawn to deepwater well development, however many of the issues brought under scrutiny by the BP Macondo blowout relate directly to other areas of Drilling and Completion, and the Oil & Gas industry as a whole.

In order to describe the issues in play, it will be necessary first to examine the suprasystem, or externalities, of the system: the culture and climate of the Oil and Gas industry with special attention to the culture and climate within BP.

Because of the media storm surrounding the Macondo incident, we will refrain from participating by not discussing the company culture within BP except as illustration or in passing. Commonly, corporate culture is analyzed over the previous 10 years or more, since large organizations take time to change. The corporate culture at BP over the past decade is contradictory. The corporate culture at BP has changed, and will change again, based on recent statements. Most of the media, and this paper at times, may not be discussing the corporate culture so much as the corporate climate.

The Oil and Gas industry, and any company involved in Exploration and Completion operations near the United States, exist within the framework of regulatory agencies and legislation, and under scrutiny by the media. These elements are inconsistently considered part of the industry.

The media storm has expanded and at once focused and obscured the suprasystem. Over the course of 87 days while BP struggled to close off the well, media attention encouraged another storm in the blogosphere. As in conventional media, commentary across the blogosphere ranged from editorials railing against the evils of ‘Big Oil’ and BP, to insightful professional analysis. Social networking sites – such as Facebook and LinkedIn – and forums dedicated to the industry – on the drillers’ club, epmag, American Petroleum Institute and Society of Petroleum Engineers websites - filled with comments. In effect, BP became the poster child for the whole industry.
Method and the Elephant

The first part of the paper will deal with externalities to the defined system: industry and company culture. The second part will deal with the human factor intricacies of the system from the perspective of the Driller.

Some might say the Driller is too far down the food chain to be used as perspective on the Oil and Gas industry or, more specifically, the Drilling and Completions industry. There is no better place to go than to the source.2

It was at this level – on the rig during Drilling and Completions operations – where a vertical-integrated, multinational and transnational, highly technical organization broke down and cost 11 lives. The Elephant in the Room is relatively easy to see. The external risk neglect2’ structure that works so well at the loosely-coupled corporate level does not work in the tightly-coupled, complex system on the rig.

Key Concept

The key concept of this paper is to be effective regulators must be concerned with governance. Regulators cannot be concerned only with laws, regulations, compliance and penalties. In dealings with industry, governance is best expressed as risk management. This concept is intrinsic to the concept of the regulatory function, and too often only implied.

It is the Elephant in the Room.

Regulatory Recommendations

At the end of this whitepaper, there will be a number of examples and recommendations to be submitted to the new BOEMRE agency. The recommendations may be taken individually, or as the basis of a whole system. All the recommendations are based on existing programs, technology and applications. At least one is already under consideration by BOEMRE.

Expertise may be defined as refined intuition.

[...]

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1 External risk neglect refers to a particular type of negative externality—raising risk levels others face. ... The three standard mechanisms to deal with externality problems—bargaining, tort liability, and regulation—encounter difficulties when the externality is an elevation in risk.

- First, changes in risk levels are not readily visible and might be hard to detect and trace to a source.
- Second, risk impositions are often created by many and imposed by many. Greenhouse gas emissions are a stellar example. When the creators and recipients are many, there can be collective action problems, and high transactions costs can impede both bargaining and tort solutions.
- Third, those creating the risk are often in a different political jurisdiction from those injured, inhibiting direct regulation.
- Finally, there will be many cases where current generations increase risks for future generations. Those politicians who pass regulations are elected by present citizens. Those receiving the externality are represented only by the altruism of current systems. Regulation is likely to be too lax.

A (managed) Perfect Storm

Consider the following advertisement from the HPInformer newsletter published by the Hydrocarbon Processing Industry (HPI) magazine:

**Most efforts to improve operating efficiency and lower maintenance costs are labor intensive and involve painful cultural changes.**

**Numerous progressive companies have experienced significant cost savings simply by upgrading lubricants.**

That’s right. Companies can avoid ‘painful cultural change’ and ‘improve efficiency’ while experiencing cost savings just by using different lubricants.

Now admittedly, that’s just advertising copy. Even as advertising copy, it’s a little overstated. Advertising copy is intentionally filled with phrases to catch the eye of the intended target audience.

But there is a subtle truth in those phrases: there is magic in those words. The words and phrases are a kind of incantation; a marketing incantation to draw attention of the target audience. These are the topics on the minds of the target audience:

- cultural change,
- improving operating efficiency,
- lower maintenance costs,
- (not) labor intensive,
- experiencing significant cost savings, and
- simple.

In this one paragraph advertisement, is the Elephant in the Room. Some experienced engineers would say: **“It's just Money.”**

BP, Halliburton, and Transocean have published draft reports on the chain of events. Each company report supports a legal position. A popular cartoon shows the CEOs of Halliburton, BP, and Transocean testifying before Congress. Each CEO is pointing towards the other two.
A veritable blizzard of PR efforts filled the media. As the snowstorm became a media whiteout, the facts became harder and harder to come by. Consider the sources of the draft report published by Transocean on June 8, 2010:

- Interviews & witness statements (subject to factors restricting access)
- Reports & documentation (need BP well design and other requested documents)
- Equipment inspection & testing (need access, protocols, court and U.S. Coast Guard approvals)
- Real-time well data (needed from BP, Sperry Sun)
- Modeling & analysis (through external experts for well design review)

Transocean based its draft report on 5 sources, none of which was complete. By inference, Transocean was quietly calling for transparency. That same day, BP released the requested hi-resolution images of the leak to NBC Nightly News.

There’s an old saying that the difference between salad and garbage is timing. That’s how a whiteout in PR works. To get the pertinent information - that much of the key information is being withheld - a person would have to read the Transocean document, but hi-resolution images are much easier on the eyes.

These efforts are examples of Risk Management. In this example, public perception of independent oil companies, national oil companies and the future of the deep water exploration industry is at risk. These efforts at risk management in the media affect all stakeholders.

2. Macondo

There is considerable speculation about the chain of events that led to the BP Mocando blowout. Multiple theories and factors have been proffered with regard to the specific failure mechanism and hydrocarbon pathway that led to the blowout of the Macondo well. Most of the theories and factors have common issues concerning the effectiveness of cementing the long-string production casing to prepare the well for temporary abandonment. What is the reason for this blowout?

- Was it a failure of engineering? Is it because the necessary skills aren’t there to drill at these depths? The number of deep-water, well-control incidents suggests requisite
engineering skills are not there.\textsuperscript{b} Was the reason an ethical issue for the engineers? Was the blowout so bad because no one is prepared to handle these sorts of accidents?\textsuperscript{c}

- **Was it a failure of science?** BK Lim from Malaysia and other geohazard specialists have criticized the placement of the Macondo well.\textsuperscript{d} Is it possible BP should not have drilled at the location at all?

- **Was it regulatory failure?** Regulatory and legislative changes come after catastrophes. Is it possible the regulatory model based on the industry 50 years ago is inadequate today? Was the cozy relationship between MMS and Operators the reason for too-quick authorizations and incomplete follow-ups? What can be expected from a paperwork model based on 50 year old planning and 64 inspectors for over 40,000 well sites? And yet, what changes might have prevented the blowout?\textsuperscript{d}

- **Was it Well Design and Planning** where engineers, scientists, consultants, and regulations contribute to prepare for hazards and schedule the drilling process? Halliburton assessed the geohazards as Moderate; and declared there would be little harm to “seals, sea lions, and walruses” which don’t inhabit the Gulf of Mexico.

- **Was it operator error?** The female DPO (dynamic positioning officer) sitting at the drilling console\textsuperscript{e} was supposed to sound the alarm in if one amber light went on and announce, “This is not a drill.” She felt a ‘jolt’ – probably the gas-driven liquids entering the mud-gas separator – just before the lights came on, and delayed making the announcement. She was doing on-the-job training.\textsuperscript{3}

- **Was there simply too much going on?** For a while, media focused on ‘Simultaneous Operations’ because the well had not been closed off but other crews on board were preparing to leave. At the same time, a corporate contingent from onshore had arrived to celebrate 7 years without a safety incident.

- **Was the problem the schedules themselves?** Was the drilling schedule too tight? The Deepwater Horizon had just come from another project and hadn’t been in for refitting and service for over a year. It was already scheduled to be on site for another project following the Macondo drill.

- **Was it the BP corporate culture and climate?** – or Halliburton, Sperry, Transocean, or Boots n Coots? Or was it the business structure of the Macondo well? Is it that Tony Hayward, installed as CEO at BP in May 2007, hadn’t had time to make the cultural and structural changes that would have prevented the blowout?

- **Was the real reason the broader culture of the transnational Oil and Gas industry?**

- **Was the reason for this disaster equipment failure?** Apparently because of the failed BOP, most of the regulatory changes enacted and recommended involve certifying

\textsuperscript{c} At a hearing on June 15, when Congress pressed oil executives on their readiness to handle the worst-case blowout scenario, Exxon Mobil CEO Rex Tillerson responded frankly, “We are not well equipped to handle them. There will be impacts.” He added, “That is why the emphasis is always on preventing these things from occurring.” In the same hearing before the House Energy and Commerce Committee, BP argued that this disaster was an aberration and would not have occurred given proper corporate oversights and safeguards. BK Lim, Washington Post, Yahoo Finance, CNBC.
\textsuperscript{e} David Hammer, “Flashing warning lights on Deepwater Horizon were ‘a lot to take in,’ safety systems worker testifies,” The Times-Picayune, October 07, 2010. (from testimony to Coast Guard inquiry)
equipment. 200 new inspectors and engineers are planned to be added to the newly-christened BOEMRE agency (that replaces MMS) to do the thousands of equipment inspections – while continuing to monitor and authorize new drilling.

- **Was the reason simply poor communication?** Did Halliburton not communicate adequately the reasons for 21 centralizers instead of 6? Did the Company Man simply choose not to listen?

**RCA - Root Cause Analysis**

*Think of the small as large and the few as many.*

—LAO TSE, *TAO TE CHING*

The root cause of the BP Macondo blow out was due to gas getting into the casing after the cement job. Oil and gas came from the reservoirs after the cementing casing was in place. **But that isn’t really the root cause.**

If there hadn't been oil spilled and people killed, well control issues would continue to go unmentioned. Because of the size of the spill and 11 deaths, regulatory agencies in 15 countries are discussing the blowout. The Macondo blowout occurred after casing and cementing, at a point in the Drilling Plan when the wells were considered controlled.

—David M Pritchard

Definitive Root Cause Analysis (RCA) for this engineering disaster is not possible at this time. Key information is tied up in lawsuits or not available by BP and other companies. The greatest impediment to RCA is the structure of the industry itself, and BP in particular.

Table 2.1 below describes the elements of RCA.

**Table 2.1 – Root Cause Analysis human and technical factors.**

<table>
<thead>
<tr>
<th>Technical Design Factors</th>
<th>Human Factors</th>
<th>Socio-Cultural Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty design</td>
<td>Human-machine mismatches</td>
<td>Cultural values and norms</td>
</tr>
<tr>
<td>Defective Equipment</td>
<td>Operator error</td>
<td>Institutional mechanisms</td>
</tr>
<tr>
<td>Contaminated or defective materials</td>
<td>Perceptual constraints</td>
<td>o Regulatory mechanisms</td>
</tr>
<tr>
<td>Contaminated or defective supplies</td>
<td>Fatigue or stress</td>
<td>o Educational systems</td>
</tr>
<tr>
<td>Faulty testing procedures</td>
<td>Ignorance, hubris, or folly</td>
<td></td>
</tr>
</tbody>
</table>

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Root cause analysis is not just about the incident, however catastrophic. To be successful, the RCA must include business culture and climate, and human factors along with the sequence of events. Further, to be successful, the RCA report must include recommendations to take corrective actions, and the means to follow those actions to the completion of the process life cycle.

There has been a passionate debate about all of the technical elements, not only within DHSG but also around the world. Over 20 national and international commissions are involved, representing interest from over 15 countries.

**Lines of defense**

The line of defense against disaster in Drilling and Completion consists of:

1. Geohazards site surveys;
2. Industry Certification
3. Regulations dealing with equipment readiness, including critical failsafe systems and policies
4. Safety training and Medical fitness
5. Quality Control (QC) supervision at site.

**Deepwater Horizon Study Group (DHSG)**

The Deepwater Horizon Study Group (DHSG) has opened the door for experts from around the world to contribute plausible chain of events to this whitepaper. These submissions have been reviewed for accuracy by experts with long experience in the industry and related industries.

The DHSG has three major goals:

1) to produce a final report documenting results from the studies of the failures of the Deepwater Horizon Mississippi Canyon Block 252 well drilling project and the subsequent containment and mitigation activities;
2) to serve as advisors to the public, governments, industry, and environmental advocates who want timely, unbiased well informed insights and information regarding the failures and what should be done to reduce the future likelihoods and consequences associated with such failures in ultra deepwater and arctic hydrocarbon resource developments, and
3) to develop a central archive and communications system for data and information accumulated during the investigations that can be used by researchers and others for subsequent analysis and documentation of their investigations, studies, and reports.

The first progress report concluded: “This disaster was preventable had existing progressive guidelines and practices been followed. This catastrophic failure appears to have resulted from multiple violations of the laws of public resource development, and its proper regulatory oversight.” (DHSG July 2010 Progress Report).
Engineering catastrophes

No catastrophic engineering disaster has a single cause. All such disasters are the result of a sequence of events. RCA must go deep into the culture, operations, and events surrounding the disaster to be comprehensive, step by step, backwards from the moment of disaster. In some circumstances, the best evidence combined with expert interpretation cannot be certain.

The primary causes of engineering disasters\(^g\) are usually considered to be:
- human factors (including both 'ethical' failure and accidents)
- design flaws (many of which are also the result of unethical practices)
- materials failures
- extreme conditions or environments, and, most commonly and importantly
- combinations of these reasons

3. Is There an Elephant in the Room?

The phrase ‘elephant in the room’ (EITR) is used to describe facts or topics that affect many aspects of a situation, but are never directly mentioned. In a physical analogy, the elephant is ignored but blocks a clear view of the situation, communication, and must be maneuvered around to move from one point to another.

To stop ignoring the elephant requires becoming aware of everything in the room, including the elephant. One of the lessons learned from writing this paper is there are a lot of elephants.

*Asked about the BP Mocando blowout, two drilling experts said, “It’s because no one sees the elephant in the room.” What are the elephants in the room? Nobody talks about them unless to say, “You’ll figure it out soon enough.” The unspoken part is: “(Or you won’t be working here.)”*

4. Complexity

The most common phrase heard in the industry is “It’s complex.” Another phrase commonly heard is “We did not understand the earth model.” That will always be the case in these very complex wells. The underlying question is: Did we understand the uncertainties and plan for the resultant risks and consequences? Is it at question that this can be done, if the hazards are recognized and planning follows the rigor of safe design and applied process safety?\(^h\)

Complexity is common throughout the Oil and Gas industry. Deep water exploration, one of the topics particularly under scrutiny by the DHSG, is demonstrably more complex – and dangerous – than other types of well design.

References to complexity and the ‘earth model’ are methods of Denial, or Cognitive Dissonance.

\(^g\) Adapted comments from Dr Robert Bea.
On the rig

There over 30 job roles on a drilling platform, which doesn’t account for the geologists, managers, accountants, lawyers and other specialists who plan and design the well before the vessel leaves port, or contracted services and consultants who may visit from time to time. Because there are about 120 people on a rig, all job roles are tightly coupled. Incidents (safety violations or accidents) do not affect just one person. Every job role depends upon the performance of other job roles.

There is constant activity, 24 hours a day. Technical and skilled work is performed in close proximity to newly-certified manual labor.

Complexity is reflected in the seemingly unending acronyms, obscure terms freely mixed from any number of professional disciplines, and oilfield slang, add to the complex mindset. These terms are also a means to manage the complexity. They form a sort of secret language that binds offshore workers as a community. Complexity is also mitigated by teasing and self-deprecating, competitive humor. Peer pressure is important. No one wants to be branded a “worm” (Slang used to describe someone for asking seemingly “dumb” questions).

Team leaders and managers use checklists and to-do lists filled these acronyms and obscure terms converted into abbreviations over time. More or less standardized within each company, the abbreviations and acronyms may vary widely between companies over time.

Back ing away from such individuation for a moment, let’s look at the complexity of the Oil and Gas industry, and its culture.

5. Industry Culture

The structures of the Oil and Gas industry define the culture; and the goals and methods of Risk Management within the industry. Yet, discussions about industry culture become nearly mystical when the size and scope of the business is discussed. “Big” and “complex” are too often used as excuses to dismiss clear explanations and reasoning.

The structure of the Oil and Gas industry dictates its culture.

“The mistake made in many of the initial digital initiatives,” said Melody Meyer, President of Chevron Energy Technology Co., “was to not fully comprehend the significance of the installed base of fields and systems. Once that became clear, the need to effect an upstream work flow transformation was also realized. Doing this involves 80% mindset, 15% work flow, and 5% technology. We had it backward in the beginning.”

National and International

Some of us think of BP as “Big Oil.” But the 13 largest oil companies in the world, based on known oil and gas reserves, are owned by governments. National oil companies (NOC) -- like Saudi Aramco, the National Iranian Oil Company, Petróleos de Venezuela, Brazil’s Petrobras or Malaysia’s

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Petronas -- according to the United States Energy Information Administration, NOCs accounted for 52% global oil production and controlled 88% of proven oil reserves in 2007. A national oil company (NOC) is an oil company fully or in the majority owned by a national government.

The National Oil Corporation (an NOC) is the national oil company of Libya. It dominates Libya's oil industry, along with a number of smaller subsidiaries, which combined account for around half of the country's oil output.

International corporations

Transocean owned the Deepwater Horizon. Transocean\(^1\) moved its corporate headquarters from Houston to the Cayman Islands in 1999 and then to Switzerland in 2008, maneuvers that also helped it avoid taxes, disclosure laws and regulatory oversight. At one point during the Senate hearings, Transocean claimed that its liability was limited by Maritime Law not US regulations. Maritime Law limited liability to $75,000. Transocean quickly backed away from this position.

BP is a multinational corporation. Commonly, a multinational corporation will incorporate wholly-owned subsidiaries in host countries. BPAmerica, the wholly owned US subsidiary incorporated in Delaware, took advantage of sizable tax benefits from leasing the rig. The oil industry tax break allowed BP to write off 70% of the rent for Deepwater Horizon — a deduction of more than $225,000 a day.

An examination of the American tax code indicates that oil production is among the most heavily subsidized businesses, with tax breaks available at virtually every stage of the exploration and extraction process.

Tax breaks and other subsidies are only one aspect of doing business in differing countries. The strategy accommodates the demands of transnational business. For example, in order to do business in Thailand, at least 51% of the company must be owned locally; yet the company may shoulder all the regulatory and environmental risk.

Multinational

A multinational corporation (MNC),\(^6\) also called a transnational corporation (TNC) or multinational enterprise (MNE), is a corporation or an enterprise that manages production or delivers services in more than one country. It can also be referred to as an international corporation. The corporation has its management headquarters in the home country, and may have operations in several other host countries.

The Dutch East India Company was the first multinational corporation in the world and the first company to issue stock. It was the world's first mega-corporation, possessing quasi-governmental powers, including the ability to wage war, negotiate treaties, coin money, and establish colonies.

Many corporations have offices, branches or manufacturing plants in different countries from where their original and main headquarters are located, also known as domestic operations (DO).

Branch offices are sometimes required to incorporate in the host country in order to do business. In most countries, the domestic corporation enjoys substantial subsidies and tax advantages.

Multinational Companies are placed all over the world with subsidiaries or joint ventures to gain a competitive advantage on other companies. A multinational company is a company with a global strategy with production bases all over the world to achieve cost advantages through economies of scale and low labour costs.

In developing countries MNCs are influencing the shape of the economy in many different ways, through knowledge transfer but also building of infrastructure and directly labour conditions through their subsidiaries and joint ventures. Especially with the global recession it is interesting to see how MNCs contribute to economic growth in their host countries...

Munich Business School, University of Applied Sciences

It is a remarkable confluence of history that the 1970s saw a dramatic increase in the number and size of multi-national companies, and the use of the term “human rights” in the media increased tenfold.

For some, the transnational corporation is an object of derision and scorn, and there is ample evidence to support their feelings. There is also ample evidence oil companies have embraced a school of thought called holistic business theory:

Business has become, in this last half century, the most powerful institution on the planet. The dominant institution in any society needs to take responsibility for the whole. Business has not had such a tradition and this new role is not yet well understood or accepted ... Therefore, business has to adopt a tradition it has never had throughout the entire history of capitalism: to share responsibility for the whole. Every decision that is made, every action that is taken, must be viewed in the light of that kind of responsibility.

These concepts are not as radical as they seem. Holistic business theory is reflected in efforts towards social responsibility evident in many industries.

A short history

Size and vertical integration has been the Oil and Gas industry paradigm since the beginning. In 1902, John D. Rockefeller, founder of Standard Oil of Ohio, had accumulated a personal fortune equal to about 2% of the GDP of the United States. Although the story of Big Oil is fascinating, only the perception of size and vertical structure of the industry are important for this paper. A quick history will suffice.

After Standard Oil of Ohio was a victim to the Sherman Antitrust Act, the Seven Sisters roamed the world hunting for oil. The stories are legendary, full of mythical horror and drama. Even during the Great Depression though, the number of cars and trucks increased. WW2 changed the oil industry as it changed much of the world.
From the 1950s, wildcatter exploration companies flourished nationally and internationally. Multi-National Companies, or transnational companies, came to their own in the 1970s.

In the early 1980s, large downstream (oilfield jargon for services from the refinery to the pump) companies drove out the wildcatters as easily exploited oilfields became harder to find. Offshore drilling and international deals became the paradigm. The petropreneur phenomenon from the late 1990s continues, but increasingly technology is enabling large companies to provide integrated services.

Many of US-based petropreneurs,\textsuperscript{10} such as Enron (before it collapsed), Koch Industries, and Apache, pursued international opportunities as long term strategy.

The majors had not lost the structural advantages that helped them attain their formidable size. But their ability to exploit these advantages was impaired by insufficient skills, outdated management processes, and inadequate people practices. An ambitious program of change driven by market forces moulded the petropreneurs into formidable competitors. New roles were replicated by the major oil companies within their own organizations.

The petroleum industry witnessed an unprecedented series of discontinuities during the last decade of the 20th century. The commoditization or growing availability of major technologies (floating production, storage, and offloading, 3D seismic, subsea completions, and horizontal drilling), increasingly efficient global spot markets, numerous strategic asset sales of commodity chemical plants, refineries, and mature E&P (exploration and production) properties, along with the emergence of innovative financial and risk management financial instruments - destroyed many of the advantages that the major oil companies once enjoyed.

Into this arena came a new breed of CEO, such as Dr Tony Hayward\textsuperscript{11} of BP in May 2007.

**Risk by Division**

Risk is managed by contracting out nearly every role in the project from beginning to end. The most important role in oil exploration is the Operator, and as stated by Lacy\textsuperscript{12}... \textit{“the Operator is the Operator.”} The Operator is totally responsible, yet seeks to dilute the responsibility and risk exposure and expenditures through contracting. In contemporary management science terms, this is the strategy of external risk neglect.

The decision is made by an Operator looking at an area to drill. A geophysicist specializing in a region may plot out the general area. A geologist is brought in on contract to examine the geological patterns produced by a contracted geology service. Bathymetry, satellite imagery to determine water depth and undersea formations, is combined with various types of sonic and radar geologic studies. Well planning may be done in-house by the Operator, but with contracted logistics and well design consultants.

The result is a granular definition of responsibility for tasks by contract, - a division of risk by contract - enforced by two levels of law: regulations and commercial law contract.
Regulations affect the course and quality of performance of a contract, and define penalties for non-compliance. Compliance with applicable regulations is written into the contract. If the contractor fails to comply with the regulations, the Operator or other contractors may be subject to penalties.

Civil and commercial law courts enforce the terms of the contract. If the contractor fails to perform the tasks defined in the contract, or fails to perform the tasks to the specifications, the Operator - and perhaps other contractors – may sue for compensation and damages. Disputes arise often about the definitions and scope of the contracted tasks. Most disputes are settled out of court. The Operator goes to great lengths to avoid civil actions.

In the final analysis, the enforcement of the terms of the contracts\(^k\) is left to laws and lawyers.

\[\text{A prime example of (a dispute) is well control itself. From a regulatory perspective it is the clear responsibility of the Operator. In practice, well control training has been diluted as a training requirement, and is left up to the rig contractor. There is no practical bridge for well control, and if catastrophes occur, the Macondo incident clearly shows that the courts are left to sort out the ultimate blame game.} \]

- David M Pritchard

In effect, the industry culture is based on a distributed, divisive, risk adverse structure. The broader guiding strategy is external risk neglect. The strategy to lease or outsource rather than own core services and capital has proven efficient, productive and flexible for transnational industries.

The particular form of a Virtual Organization (VO) applicable to Drilling and Completions industry is called a platform organization.\(^{13}\) Although the usual hierarchical organization chart is drawn up, it lacks relevance because of the closely-coupled teams performing tasks on the rig. The organization chart is only confusing with the need for constant intense communication between all teams and individuals. Network analysis\(^{14}\) based on when teams were on duty and on the rig would have been far more effective for all concerned.

Risk mitigation is also dependent on effective communication processes at organizational interfaces, where the VO and its members are defined to each other and to the outside world. Such communications transmit the organization's culture, and are particularly important when organizations are distributed across geographical areas.

In traditional organizations, the focus of communication is on effective talk among individuals within an organization. In distributed, linked organizations, the focus shifts to communications across system interfaces. This is underscored in distributed systems with risk mitigation mandates.\(^{15}\)

**External Risk Neglect**

External risk neglect is a strategy to raise the risk levels others face. The risk is externalized via contract from the system. For each contractor, the duties and capacities are defined, and constitute a

\(^{k}\) “There is commercial law as well as standards and regulations. The point is the focus is on words rather than building the team with a holistic vision of all the goals (it) what creates the uncertainty. (There is a) need to be mindful not to generalize because there is some who have it, although the IOC’s and NOC’s will have the biggest gaps.” - Wayne Needoba
system or subsystem. Three standard mechanisms to deal with externality problems: a) bargaining, b) tort liability, and c) regulation.

So long as everything goes according to the contracted terms, it provides the flexibility to an industry that must deal with variegated national regimes and regulations. Like so many management and financial models, the assumptions are based on the independence of the variables. Like the financial models underpinning financial instruments in the recent financial crisis, the system breaks down when risk increases. When risk increases – such as a drop in house prices or an engineering catastrophe – the model variables show themselves to be dependent and, indeed, tightly coupled.16

Because these risks have been externalized at so many levels, changes in risk levels are not readily visible to the contractors or others, and are exceedingly difficult to trace to a source.

- Risk is abstracted in contracts to explicitly define required duties and capacities. All other risk not defined in the contract is imposed on those not party to the contract, such as regulatory agencies and the public. Environmental, lifestyle, and business risk are defined for the convenience of the parties to the contract.
- When those who defined risk and those affected are numerous, the difficulty of collective action acts to further avoid risk. High transaction costs are a form of institutional version of plausible denial, and impede both bargaining and tort solutions.
- When those creating the risk are in a different political jurisdiction from those injured, direct regulation becomes at best problematic. For example, Transocean moved its corporate registration to Switzerland, outside the jurisdiction of the United States. Initially, Transocean sought to limit their fiscal responsibility in the Macondo blowout by imposing Maritime Law. Maritime Law limited Transocean’s exposure to $75,000.
- Time framing becomes an issue. In many cases the current generations increases risks for future generations. In his technical analysis of the Macondo blowout, David M Pritchard surmised that many of the capped and completed oil wells in the Gulf of Mexico may have similar geologic and well design issues as the Macondo B. If so, there would be gas at the top of many wells that would only be discovered when the wells were opened for Production or further Exploration.
- Time framing allows contractors to avoid political backlash and public recrimination in the long term. It’s been estimated that a catastrophe like the Macondo blowout affects a company’s reputation for at least 5 years. (The industry effect may be much longer.)
- Legislative and regulatory response is reactive rather than pro-active, acting only when the public focuses on a catastrophic event. The response is commonly to reinforce activities already in place. For example, all recommendations to the newly-formed BOEMRE (Bureau of Ocean Energy Management, Regulation and Enforcement) include extensive inspections of equipment throughout the GoM to be carried out by an augmented staff of 200 inspectors and engineers despite the fact that only one device, the BOP, failed.
- This abstraction of risk results in not lax regulation, but improper regulation. The new inspections may be unnecessary other than to assuage public opinion. Public
opinion rather than concerted analysis of the root causes determines the actions taken. The goal is to appear to do something concerted and meaningful to allow the public and media focus to dissipate.

**Investors as Subsidy**

For nearly all large drilling projects, there’s another level of risk management or abatement in the investment structure. Investors subsidize the costs of Exploration, Drilling and Completion in hopes of sharing in the Production.

One company, the Operator, will decide to drill a well or wells. The Operator draws up a Prospectus for possible investors.

Best Practice until the 1980s called for drilling a couple of exploratory wells before sinking one for Production. Investors commonly were at risk for the cost of exploratory wells.

With modern technology, the Operator may not approach Investors until a Development Plan has been worked out. The Operator may do a few lateral bores in multiple directions to investigate and have more extensive geology before approaching Investors. The strategy of a well may be altered based on the results of geologic surveys and bathymetry. In some cases, the well may be declared ‘Unexploitable with present technology’.

The Operator approaches other companies to invest in the well as silent partners, or as active partners taking responsibility for different parts of well development. The Operator will keep the majority interest in order to maintain control – and most of the profits. The investors subsidize the investment in the well, protecting the Operator from the risk of the cost of exploration.

This structure acts as a barrier to entry for smaller exploration companies. Even if a smaller Operator finds a good field, they may not be able to find investors to move on it. In time, the smaller Operator runs out of lease or has it bought out.

**Partners: Anadarko and Mitsui**

“The mounting evidence clearly demonstrates that this tragedy was preventable and the direct result of BP’s reckless decisions and actions,” Jim Hackett, Anadarko’s chairman and chief executive, said in a statement. “Frankly, we are shocked by the publicly available information that has been disclosed in recent investigations and during this week’s testimony.”

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2 Business Wire, June 18, 2010. —Following this week’s hearings in Washington regarding the Deepwater Horizon tragedy, Anadarko Petroleum Corporation (NYSE: APC) issued the following statement: “The events surrounding the Deepwater Horizon explosion represent a terrible loss for the families of those who lost their lives and an unprecedented environmental tragedy,” Anadarko Chairman and CEO Jim Hackett said. “Sadly, it also continues to have tremendous impacts on the livelihoods of
Nothing has been heard from the other partner in the Macondo well, the giant Japanese conglomerate Mitsui. It’s assumed Mitsui was silent partner owning only 10% of the well. BP owned 65% and was the Operator of the well. There’s no indication Anadarko or Mitsui had any decision-making role after investing, although both partners may or may not be, depending on the contract terms of investment, liable for any fines or settlements.

The Macondo well operations budget was $159 million. At the time of the blowout, it was already at least $20 million over budget. How those costs were apportioned, again, depends on the terms of each investment contract.

Estimates of the total cost of the blowout are over $40 billion as of this writing. Some estimates over the next 10 years are as high as $100 billion.

Assuming Mitsui invested $16 million as its portion of the exploration and is fully liable, and the $40 billion estimate is correct, Mitsui looks to lose $500 for every dollar invested in the budget to bring the well into production: a 500:1 loss.

6. Drillers’ Perspective

“I brought the well in.”

“In the Execution phase, the focus moves to the Driller and Drilling engineer. Drillers are highly skilled technicians who take a personal interest in every well. This small, tightly woven fraternity of opinionated people is very aware of their importance to the success of the project. The majority of skilled drillers are over 50 years old. Their individuated perspective of the Human Factors is unique from the business culture; and is a unique resource to examine the risk factors in well operations.

The Drillers’ mindset is shaped by the years of experience and on-the-job time required to achieve their role. This is a mindset that vocally resists change, yet embraces new ideas and encourages learning. Drillers are at once resistant to new methods of training, and open to anything that works. It’s more an inductive, heuristic perspective rather than analytical and deductive.

It is a leadership role, by practice if not definition.

Drillers are, in practice, heuristic engineers. There are many heuristics in their expressions, ranging from insightful statements about procedures and applied methods to grand malevolent diatribes against forces beyond their control.

It comes out over and over. Long time professional Drillers are so trained to 'mindfulness' that it is sometimes difficult for them to express ideas succinctly. To do so requires an obvious effort. In effect, the only people who may understand all the meaning in these expressions are other Drillers.

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\( ^{\text{a}} \) Anadarko owns a 25 percent stake in the (Macondo) well.
\( ^{\text{b}} \) Mitsui Group. [http://en.wikipedia.org/wiki/Mitsui](http://en.wikipedia.org/wiki/Mitsui)

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18
In many cases, every statement must be a complete essay, regardless of whether the wording is grammatical, or the meaning is conveyed clearly.

The individuation in this mindset stands in stark contrast to much of what is described as the industry culture above.

“We have to identify and prioritize risks—understanding the threat, the vulnerability and the consequence. And then we have to apply our resources in a cost-effective manner....”

Former DHS Secretary Michael Chertoff on the allocation of funds to prevent terrorism

Responsibilities on the Rig

“The Driller's responsibilities are in some ways comparable to that of a Rig Manager: get the work done safely, efficiently, and within the Operator’s work plan. All of the actions have been pre-approved by government regulators and are within a defined company policy.”

“Drillers run and pull pipe in and out of the hole. They operate all the tools on the drill floor and have certain procedures to follow with regard to well control. On the Deepwater Horizon at the time of the blowout, drillers would be running the pumps while others kept track of pit gains and losses. Because of the simultaneous operations, the driller wouldn’t have realized he was even worried about the well control.”

“Drillers work for a drilling contractor rotating 12 hrs on and off, 2 weeks on and off, or 28 on and off. No driller is a drilling contractor. He's an employee of one.”

“To be successful a Driller must possess excellent organizational skills, be a good communicator and listener, be able to work quickly while keeping an eye on detail, and work well with others.”

“There are about 120 people on an offshore rigsite. The driller on each tour runs the "rig floor" and all the various tools. All Toolpushers come up through being Drillers. Many only have high school but are bright.”

“The crews are hired on contract, beginning as Roustabouts. There are approximately 3 or 4 on the floor: Derrickman, Motor man, and Mechanic; sometimes the Subsea Electrician.”

“Transocean owns the rig, and leases it to BP. Halliburton is contracted to run the job. Transocean provides a Rig Manager that knows the rig, and a few other key personnel. All services are contracted by either Halliburton or BP.”

“On marine operations there is the Captain or OIM (offshore installation manager) doing marine and logistics. Then there is the Tool pusher doing the drilling rig, and the Company Man / Drilling supervisor is in charge of the drilling operations below the drill floor and BOP. (The) Geologist looks after evaluation.”

Adapted from an interview with Wayne Needoba.
“All the people in the field can be contracted because some smaller operators might only drill 3 wells in a year. They contract all the field people. Their office staff are usually employed long term.”

“Drilling contractors and companies like Halliburton might work for 4 oil companies in a year, all having different geologists, company men, work boats, helicopters etc... Caterers go with the drilling rig (Transocean.) The rig have crews go with the rig. They are hired by the drilling contractor like Transocean. That's a separate business from drilling holes in the ground.”

“There is a selection process called tendering. (It) is a big part of the EITR in the way they choose people to work on the rig. Every contract, even for a roughneck, is tendered. The Driller works as a technician under either the Drilling Engineer or the Rig Manager (also called the Toolpusher.)”

“If someone volunteered to drill the well for free, the current management would grab it once they were sure there were no liabilities that could be held against them. They'd be damned fools because without remuneration, there is no contract - and that driller would have no legal liability.”

“Planning and drilling strategies have nothing to do with the drilling contractor. The problem (on the Deepwater Horizon) had nothing to do with the BOP stack condition. That's the reason I hate to see it mentioned in our papers.”

“The Driller is responsible for the crews and following the instruction from the company man. If driller doesn't know how to manage the crews, the tool pusher will fire him and get someone else.”

“Driller has all care and no responsibility down hole except to call the drilling supervisor when he sees something wrong. With well control while drilling there are criteria where he stops the pumps, checks for flow; and if the well is flowing, he checks space out of tool joints and shuts the well in, either using hard shut in or soft shut as instructed by the company man.”

“Once the well is shut in on a kick, he calls the company man and (the) Toolpusher and follows instructions. He has a crew to handle rig floor equipment.”

Ongoing comments
Here are a few comments from drillers and drilling engineers from various sources:

Investigations

- Two government hearings have turned up the topic of casing design and cementing, combined with the known record of insufficient circulation of well fluids before cementing.
- The incorrect analysis of two tests of well integrity and the cancellation of one important test because it would have shut down the well, and the expense involved has been pointed out repeatedly.
• Several investigations have reached the conclusion that the gas pressure in the annulus\(^9\) pushed the casing up across the BOP making it impossible for the shear rams to work.

**Technical**

• Signals from the well - well listening - are emphasized by other experts: the incorrect sequence of detection, analysis, and action beginning as much as a month before the blowout.

• Gas is a quiet mover. If it is never understood how it gets into the well after a cement job, the risk of an explosion' can never be eliminated.

• The production of sand in completed wells cause erosion of pipes and the failure of manifolds. This area hasn't had much attention largely because of the novelty of the BP blowout, but it is a consideration whenever a well is capped.

**Culture and Consensus**

• Consensus depends upon the composition of the group doing the analysis.

• There is a great deal of continued secrecy in the industry culture that's tied to ‘power development and maintenance’, by any other name, in place. Old habits are hard to change. (Dr Robert Bea)

• The industry culture of ‘reward continuing high profits and hope for acceptable quality and reliability’ continues. (Dr Robert Bea)

• If a group - company or industry - institutes policies and practices that succeed in reducing risk, the system will paradoxically erode because there are no major failures, because these policies take up a lot of resources. (Dr Robert Bea)

• High level managers - even the board or CEO level -, accountants and lawyers have encountered considerable push-back from engineers on the well (as risk management succeeds then erodes). The same engineers expect their bonuses to be based on meeting schedules and hope the HR department will handle the people.(Comments, drillers club)

• Anticipated Hazards in the well drilling sequence are more than just a geologists’ challenge. The deliberations have to cross a number of professional disciplines and cultures, not the least of which including feedback from drillers.(David M Pritchard)

> Good progress can always be subverted by people not doing what they should be doing. The secret to desirable quality and reliability are good, capable, experienced people doing the right things at the right time."  

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\(^9\)“Independent BP investigation and model pretty much illustrate that the gas and oil came in through the casing shoe, so need to reflect. Also the shear rams appear to have cut the drill pipe but not sealed. Confirmation is still to be done but leak on Montara and Macondo is likely to be via the shoe leak.” - Wayne Needoba

\(^*\)“Gas migrates carrying pressure with it and expands to follow a path to lower pressures. How it gets into a well bore is often not easy to surmise. The risk of an explosion evolves as soon as it encounters the oxygen in the air.” – Wayne Needoba

David M Pritchard’s Elephant in the Room cartoon

Further observations by David M Pritchard and Wayne Needoba, both professional drilling engineers with long experience – over 40 years each – in the Oil and Gas industry:

- Critical systems are heavily people dependent. Yet the industry expects to be safe and successful with a relationship model between Operators and Drilling Contractors that denies this obvious fact. The best way to describe this relationship is disjointed and dysfunctional, allowing very little feedback.
- Regulatory Agencies are undermanned and technically thin in deep water experience. Most often, inspectors are drawn from the ranks of new graduate engineers with little industry experience, or from semi-retired engineers or drillers who are not familiar with current equipment.
- Even Operators and other service providers fail to recognize that the Operator is fully accountable.
- The most common and important means for managing complexity during Planning and Design - technology, integrated disciplines, and careful planning - is passed on to the Execution phase as a series of lists in printed or spreadsheet form.

Figure 6.1 – The Elephant in the Room.¹

¹ Cartoon© 2010 by David M Pritchard, President of Successful Energy Practices International, LLC.
Here’s the list from the Elephant in the Room dilemma:

- Denial
- Flawed designs
- Questionable life cycle reliability
- Corner cutting procedures and practices
- Schedule drivers
- No learning
- Presumed competencies
- Low performance metrics
- Coaching and training
- Opaque policies and organizations
- "wink-wink" the regulations
- Popular opinion root cause

**Empathy and Agency**

Taken superficially, the list on the elephant is just professional shared humor, with a cynical bend.

But that conclusion ignores the intuition developed over decades of experience. Why do these ideas resonate? The list from the elephant comes from shared intuition. The topics are derived from across many disciplines and regimes.

These men (in this case, but there are women too) are professional Drilling Engineers and Drillers whose duties are matched clearly to their proven capacities. Reasonably, these people are paid well to do specific jobs. They have been working those jobs for decades, and have proven themselves competent and capable. These issues are not part of their contractual or professional purview. Why are they concerned with such issues?

The reason is their long experience and commitment to the industry. The intensity of the job and their success in their jobs, produced a deep loyalty – not to the companies which hired them during industry upturns, but to the industry and the job itself. They developed intuition beyond the mindfulness required by their duties about issues and problems. Although their contracts didn’t explicitly require it, they learned to be leaders, motivators, and mentors. These intrinsic responsibilities drove a wider vision. They sought answers, or at least perspectives, from other disciplines. Lacking the vision and leadership from above, they looked to whatever thinking available. Sometimes, they found resonance in other professional disciplines or regimes. Too often, the only resonance was in scientism and mysticism.

If you compare the list from the cartoon with the list from the advertisement (at the beginning of this paper), at first glance there is very little connection. Or is there?

The elements from the cartoon are clearly a call for change. There is a call for results implicit in the list. The elements from the advertisement are the issues concerning the decision makers in the industry. Advertising copy addresses the culture, or a prevailing climate, within the target industry. If
we were to interpret the relationship between these two lists as “Will result in” and “Resistance from,” we have a complex – informative – relationship. See Table 6.1.

The table can be filled in any number of ways to form connections as statements or questions. The phrases almost make sentences.

The comments from the scroll and thought bubbles in the cartoon complete the intuitive view.

- Scroll on the wall: We must have a risk management system!
- Let’s copy and paste our competitors - Saves money!
- What metrics!
- What a great press statement!

<table>
<thead>
<tr>
<th>Change the Elephant</th>
<th>Will result in</th>
<th>Resistance from</th>
<th>Advertisement topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denial</td>
<td></td>
<td></td>
<td>Cultural change</td>
</tr>
<tr>
<td>Flawed designs</td>
<td></td>
<td></td>
<td>Improving operating efficiency</td>
</tr>
<tr>
<td>Questionable life cycle reliability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corner cutting procedures and practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule drivers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No learning</td>
<td></td>
<td></td>
<td>Lower maintenance costs</td>
</tr>
<tr>
<td>Presumed competencies</td>
<td></td>
<td></td>
<td>(not) Labor intensive</td>
</tr>
<tr>
<td>Low performance metrics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coaching and training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opaque policies and organizations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wink-wink the regs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popular opinion root cause</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It’s almost as if the scroll and the thoughts are arguing with one another over the prevailing vision in the meeting. But they still can’t see each other for the elephant. Turning again to the advertising copy, there’s a better, but still uncertain, relationship.

<table>
<thead>
<tr>
<th>From the cartoon</th>
<th>Advertisement</th>
</tr>
</thead>
<tbody>
<tr>
<td>We must have a risk management system!</td>
<td>Cultural change</td>
</tr>
<tr>
<td>Let's copy and paste our competitors - Saves money!</td>
<td>Improving operating efficiency</td>
</tr>
<tr>
<td>What metrics!</td>
<td>Lower maintenance costs</td>
</tr>
<tr>
<td>What a great press statement!</td>
<td>(not) Labor intensive</td>
</tr>
<tr>
<td>Experience significant cost savings</td>
<td>Simple</td>
</tr>
</tbody>
</table>
It’s again a complex relationship. The phrases almost make sentences. Even the advertisement contains a call for cultural change.

If Table 6.1 and Table 6.2 seem a little obscure, they’re not. They’re derived from examples of a technique for network analysis. These examples are just for demonstration, of course, since the network described here is too loosely-coupled – from a cartoon to a public advertisement – to be direct responses, but the tables suggest some interesting concepts for analyzing responses from real networks.

For example, if we had a network for drilling engineers and regulators, we could take David M Pritchard’s questions (below) for the regulators, and track the responses.

*Do the regulators really understand the following?*

- **Well Design and Primary Barriers**
  - *Gaps in best practice in design and assessment of the casing and cement*
  - *Assumptions of barrier integrity that were incorrect leading to failure to maintain at least two confirmed barriers between the surface and the reservoir*

- **Detection and Response**
  - *There were numerous warning signs but also distractions,*
  - *Several hours elapsed before detecting the influx and attempting to respond however simultaneous operations and monitoring gaps made it difficult*
  - *Gaps in stopping work to understand the changes in the well bore conditions*

- **Emergency Readiness**
  - *Crews had only minutes from recognizing the influx till gas was at surface*
  - *Critical minutes were lost in activating the emergency disconnect*
  - *There were failures in redundant controls and “failsafe” equipment.*
  - *ROV’s were unable to secure the well – industry had no further response capability*

This tracking over time would yield many valuable responses while making regulators more aware of the concerns of experienced drillers. Tracking these responses can develop and define Empathy between groups such as drilling engineers and regulators. Agency - in this case where drilling engineers and regulators speak for themselves on issues, builds confidence and trust. This sort of network analysis can drive changes while making all stakeholders positions more flexible.

One of the key issues in management is metrics – having a way to quantify issues. Another advantage of this method of network analysis is to put real numbers to heuristics and other topics usually described as qualities, such as leadership.

The metrics come from tracking sources and responses over time; and evaluating the characteristics of these interactions. Frustration manifests itself in detail and long exchanges, for
example. This paper contains has many expressions of frustration from the drilling community, for example. These long exchanges can be cut off without resolution by the imposition of ideology. Examples of possible ideological answers are on the right side of the tables above, from the Advertisement. These metrics also provide part of the answer to quantifying elements of risk analysis.

Industry change

How does an industry become aware of a need for cultural change? – or a company become aware of a need for a change in the business climate? Industries tend to change cultures behind the successful moves of one company. How does a company recognize what sort of change is required? Cultural change must be driven from above, but the indicators for business culture or business climate change are found at the lowest levels within the company. Find the leaders at the lower levels. They know what’s required. Listen to those leaders, motivators, mentors, and they will be the agents of real change. Fail to listen to them, and the change will not be instituted, or will take much longer to succeed.

Based on consulting studies, institutional change may take a generation or more. Using network sociotechnical methods, changes in culture and climate can be instituted more quickly with all stakeholders aware and involved. Realistically, no suggestion to change the Oil and Gas industry will happen overnight. Experience shows such changes require years of effort. However, the cynical view that habits will not change is irrational. With the involvement of large players and the platforms already developed, changes may be possible much quicker than past experience would anticipate.

Integrated Asset Management

From EPMag, Figure 6.2 is the structure of the Oil and Gas industry, presented as Integrated Asset Management.

![Integrated Asset Management](image)

Figure 6.2 – Integrated Asset Management.

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Despite all the levels of external risk neglect in the structure, the area of greatest environmental, financial, and personal risk is the least defined: the Operations Area. It’s simply a grey box at the bottom. The graphic does, however, conceptually define the level of Institutional Empathy (or how sensitive the structure is to the needs and realities of the people in Operations.)

**Discovery risk**

This is an adversarial model that requires inordinate personnel resources, and has given rise to a management strategy based on Discovery Risk. Managers are trained in Discovery Risk: the risk a regulatory infraction may be discovered. Discovery Risk depends upon a practical risk-reward calculation. If the cost of a penalty to the company is significantly less than the rewards from production, there is an incentive to take a chance on Discovery Risk.

Similarly, the manager or supervisor may do the risk-reward calculation to get a bonus. Managers’ or supervisors’ bonuses depend upon meeting schedules. If an intentional violation is not discovered, the manager or supervisor will be paid for meeting the schedule, and any consequences will be in the future when the manager or supervisor may be long gone – with the bonus in hand.

The external risk neglect model encourages Discovery Risk by example.

**7. Organizational Network Analysis Example**

Based on Figure 6.2, shown below (Figure 7.1) is an example of the assumed passing on of contractual responsibility of work products based on External Risk Neglect, or a Top-Down management style. It may represent work being completed within a company or passed from company to company. While this structure allows some autonomy to initiate work and set goals, all Output is assumed checked and approved by corporate control, and if not approved will re-enter the system as Corporate input.

As work moves from one node to another it’s assumed all contractual requirements have been met. Risk, both internal (contractually defined) and external (undefined) is passed on. The last node before Output may be interpreted as Quality Assurance (QA).
The sketch hardly defines the communication required to complete the work though. If the nodes are interpreted as separate companies, considerable residual risk is passed on from node to node. This residual risk may be seen as either additive, or multiplicative, when Output. After the work is done, the risk is passed on to the public.

Top-down reporting structures and company cultures resist conflict and hide problems. Employees were given a list of tasks to complete and were expected to finish them by whatever date or time their boss considered reasonable.

Departments were separated by function and work independently on projects approved by departmental leaders. Employees work in separate offices with doors, to allow for privacy. Knowledge hoarding is common and is seen as critical to acquiring and retaining power and job security. Team decisions are rare, and there is no challenge to the status quo.

Realistically, such a loosely-coupled structure only exists in legal fiction.

Whether within a company, or between companies, constant interaction exists in both directions between individuals and whatever interpretation is applied to the nodes. This communication may be formal (letters, memos, or signed email) or informal (unsigned email, chat, or postings to forums, etc.). Interaction may include regulators or between companies and/or contractors. Yet the legal positions of companies involved in the BP Macondo blowout reflect the structure in Figure 7.1. For example, testimony reveals that the BP Company man cut off and overrode professional recommendations from Halliburton at least twice.

Figure 7.1 is intended to illustrate work and control channels, not network analysis. Block arrows represent more formal levels of interaction between groups. These are important for regulators to monitor (see Figure ) because many problems can be identified in the interaction between these levels. In a responsive regulatory regime however, regulators need to monitor and be aware of other levels of interaction.

Social interaction has been recognized to increase efficiency, decrease risk, and add value to the resulting work. Social capital (SC) has been recognized as Intellectual Capital (IC) or Goodwill (sometimes called Retained Earnings), and increase share value. Some Oil and Gas companies have gone to considerable expenditure to develop social capital.

See Figure 7.2 for a more common form of a Basic Network Diagram from Michael Dulworth. It is taken from a real life oil industry study and then simplified. Dulworth unintentionally reinforces many of the hypotheses in this paper. Finding it was serendipitous.

Certain aspects of the attitudes towards social or professional roles can be derived from this diagram alone. The Drilling Crew: Taylor, Sen, Moore and Miller, have relatively few connections. Miller, by the diagram the lowest ranking driller, is well connected. In social capital terms, Taylor (probably the Toolpusher or Drilling Engineer) has learned the advantages of having many sources of advice and information.

Sen and Moore, representing half the drilling crew, have only one connection each. Sen has only one informal source of information, Taylor. Moore is connected to Cross on the Petrophysical team.
In order to interpret the Basic Network Diagram a manager will either have to make a number of assumptions or follow up with a few questions. The frequency of interaction and direction are important. Are the connections personal or professional? While the diagram defines a community, can it be interpreted as a community of practice?

Roles within a network may be defined according to a framework (Roberts, et al above), or subjectively on the network. To provide a little insight, consider a few questions:

- Whom would Sen or Moore turn to as mentor?
- What would happen if Taylor refused to be a mentor?
- What would happen if Cole were removed from the network?

![Basic network diagram](image)

Figure 7.2 – Basic network diagram.
Regulatory efforts

Current regulatory efforts are based on a model that is at least 50 years old. Originally, regulatory oversight was done on paper and forms. Today, forms have been replaced by spreadsheets, but the philosophy and procedures are essentially the same: the focus of oversight is still to inspect equipment and check procedures.

This model is reflected in nearly all the recommendations to the newly-formed BOEMRE agency. Most of the recommendations call for increased equipment inspections and closer scrutiny of procedures. The present system of regulatory oversight does not allow an adequate number of points of contact to protect the public or the environment under this model.

Institutional Empathy is not only not encouraged, but blocked. The only agency provided for from the regulatory agency to the higher echelons of the company. This dilemma often places inexperienced, relatively-low paid regulatory operatives in untenable positions of direct contact with heavily compensated managers and executives.

Regulatory agencies are part of a wider effort to restore social order and social capital after an event has occurred. If the regulatory model does not have the capacity to incorporate well new technologies and social forces, new regulations and laws will have little effect.

Because penalties are legislated, they often don’t reflect accurately changes in economic realities, which may make a penalty largely meaningless. New technology or technological risks inherent in deep water drilling are not easily incorporated into oversight procedures. Regulatory oversight is not flexible because changes are reactionary.

In the long run, after media and public focus have moved on, past experience shows the enforcement of regulation will become lax. The future will depend upon the altruism of the contemporary political process.

Training

The present regulatory model in the Drilling and Completions industry does not deal with Human Controllable Factors (HCF) directly. Training – in safety procedures and job skills - after certification is left to the contractors. Yet this is the level individuals, the environment, and perhaps the industry, are most at risk.

Training is dependent largely on on-the-job, when the opportunity presents itself, and classroom training. Occasional seminars on safety or soft skill are sometimes provided. On-the-job is the slowest method to train technical skills. It takes about 7 years to train a drilling technician, for example. Retention from classroom pedagogy can be as low as 25% after 30 days.

Since 80%, or perhaps 90%, of safety incidents are related to human error, this model serves no stakeholder well. When combined with the external risk neglect structure of the industry; and on-again, off-again employment cycles, the training structure acts to prevent transparency and escalates risk.

Vertical Risk structure

Regulatory agencies commonly fail to acknowledge the vertical nature of risk management (Figure 7.4 below), as defined by Rasmussen and others since 1997.\(^{21,22}\)

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\(^x\) This framework points to a critical factor that is overlooked by all horizontal research efforts – the additional need for ‘vertical’ alignment across the levels. Decisions at higher levels should propagate down the hierarchy, whereas information about the current state of affairs should propagate up the hierarchy. These interdependencies across levels of the hierarchy are critical to the successful functioning of a system as a whole. Even if researchers do an excellent job at conducting horizontal research on a particular topic, they may have little impact on reducing risk unless vertical integration is also achieved (Rasmussen, 1997).

\(^y\) Adapted from Rasmussen (1997).
Industry tends to be pro-active, responding to market forces and technological change. Innovation is constant. In order for regulators to achieve their goals, the obvious conclusion is that industry must be actively involved in regulatory efforts. The only stakeholder with the financial means to achieve effective regulatory compliance is the industry itself. The most encouraging fact is much of the technology already exists.

The concept is neither novel nor new. Other industries, such as Nuclear Power, Food Handling and Distribution, Pharmaceuticals, and Health Care provide models that can be applied. There is room for considerable discussion about engineering and scientific ethics in the Oil and Gas industry.

The present adversarial relationship between the Oil and Gas industry and regulatory agencies is inadequate and ineffective. Only with industry involvement can regulatory agencies keep up with technological change, and respond constructively to evolving markets. Conceptually, regulatory agencies need to be plugged in to each level of interaction (Figure). There is no need for regulation or legislation to manage or control the propagation of information, only monitor certain outcomes.

In addition, regulatory agencies must facilitate interaction between levels as modeled in Figure 7.4. Facilitation will make the monitoring easier, pro-active, and provide what may prove to be an indispensable service to the industry.

In addition it must be said that the interactive industry-supported regulatory efforts must be propagated internationally. Restricting such efforts to a single jurisdiction only propagates the external risk neglect model. This may seem like a radical conclusion, but much of the technology already exists, and is in use around the world to accomplish these goals. Digital Oil Field technology provides functions that parallel regulatory goals. To allow regulatory agencies to monitor well control events (kicks) and have access to pertinent data after a blowout, all that’s needed is a few adjustments to feed information to regulatory agencies and record data in hardened receptacles.

Although it is beyond the scope of this paper, levels of interaction may be further analyzed using Zahra Mohaghegh’s SoTeRiA risk management network analysis techniques.

8. Recommendations

“Events can move from the impossible to the inevitable without ever stopping at the probable.”

-Alexis de Tocqueville

Before discussing any recommendations, a question must be asked: Was this event an example of the social amplification of risk phenomenon? 

An example of the power of social amplification is Three Mile Island. No one was killed or injured at the Three Mile Island nuclear plant, yet it had enormous social costs – much stricter regulation, reduced operation of reactors worldwide, greater public opposition to nuclear power, and a less viable role for a major long-term energy source. No one is likely to die from exposure to
radiation from TMI. Yet TMI is cited universally whenever opposition to any new technology is discussed.

It’s hard to say that an event lasting 87 days and spilling tens of thousands of barrels of crude oil into the Gulf of Mexico could be exaggerated. However, we must acknowledge, despite the massive press coverage over the whole time period, no horrific example of pollution was revealed. In fact, the results were almost anticlimactic when the blowout ended. 11 lives were lost and over 60 people injured on the first day. Media coverage nationally and internationally hardly focused on them. The anticipation of stories with “billions” and “thousands dead” seemed to be ready to be cut n pasted to the headlines that never occurred.

There has been nominal regulatory reform ordered over periods of 30, 60, 120 days and within one year. 200 new inspectors and engineers are planned for the new BOEM agency. But the regime of regulatory oversight has not changed. Most of the plans are for increased equipment inspections. There has been a euphemistic call for improved training which will still remain within each oil company, and based largely on on-the-job.

The changes and additions appear to be intended to assuage public opinion and end the media circus rather than making truly progressive changes. The strategy implies a response to social amplification.

These recommendations may be taken in part or as an example of at least a part of a strategy.

Regulatory agencies as Information Repositories

One means of achieving the flexibility and extend the capacity of regulatory personnel is to embrace the semantic web, or SemWeb. A commitment to social networking, or the SemWeb, will not be instantaneous or easy. Because agencies have not kept pace with industry efforts such as the HIVE\(^a\) and BP Connect\(^b\) BOEMRE will find itself working backwards, from folksonomy to taxonomy.

As it turns out, the new director of BOEMRE has very similar ideas.\(^25\)

In the future, “we may rely somewhat less on our inspectors going on rigs, having their clipboards, going through lists and checking whether the rigs meet certain requirements,” said Michael Bromwich,\(^26\) director of

\(^a\) But the integration extended beyond the data itself. The ability to visualise the particular properties of a proposed well in three dimensions - and particularly in BP’s advanced HIVE (highly immersive visualisation environment) - helped to bring members of the subsurface and drilling teams together to collaborate on common ground. For example, it enabled the drillers to view pore pressure data along the proposed well path, as well as the geological context of the data. (“The art of well planning”), BP Global Reports and publications Frontiers Issue 25

\(^b\) BP uses a voluntary corporate Yellow Pages system, dubbed Connect, as the platform for making networks (known more commonly as communities of practice) visible. Connect serves as a directory to BP’s knowledge workers and associated networks. Originally conceived as a way for technical staff to articulate their capabilities, experiences and interests, BP’s Connect system has grown to include the web-based personal profiles of more than 18,000 knowledge workers and more than 250 networks. The system is open to employees and contractors, and includes engineers, scientists and technicians as well as commercial and administrative support. It permits individuals to build web pages for themselves in which they describe their skills and experiences, and what they have to contribute. They may include anything from the projects they most recently worked on to the languages they know. David C Barrow, Sharing know-how at BP Amoco, Research Technology Management, May 1, 2001.
BOEMRE, Instead, he said, “there is a need for more instrumentation on these rigs to provide real-time kinds of electronic data to us as a regulator.”

It’s surprising to discover some very forward-looking ideas already implemented in the Chevron-BP training alliance. The training alliance has been in development since at least 1999.

The HIVE concept was only one of many. It's based on social networking concepts. Shell, BP, and Chevron have taken some bold steps in social networking since 2001. This is an effort by these companies towards transparency and corporate social responsibility.

Regulatory agencies need to be actively involved.

Perceptual bridge

Regulatory agencies act as a perceptual bridge for the public. The public places its confidence in the regulatory agency to protect the public and the public interest. The public perception of an industry is guided, and heavily influenced, by the actions of regulatory agencies.

When regulatory agencies only have the force of law, or punishment, at their disposal, the only information conveyed by the regulatory agency is negative. The only response is reactionary. The public will have a negative perception of the industry.

Risk regulation refers to the governance, accountability, and processing of risks, both within public-and private-sector organizations as part of their risk management and compliance with government laws. Risk regulation is inherently about the anticipation of risk and preventing its realization: It is forward looking, trying to be preventive rather than reactive in its outlook. Social commentators associate these governance regimes with a new modern worldview in which risks are conceptualized as manageable.27

Regulation and regulatory agencies are perceived to prevent risk. It is important that the public and the media be aware of the activities of regulatory governance. Presently, these activities are not transparent.

This fact leads to an unfulfilled public anticipation which results in a lack of trust that invokes cynicism about regulatory activities. The lack of transparency presents opportunities for abuse of the system by the industry and, unfortunately, the regulators themselves. Because the abuses are reported commonly too late to respond to the increased risk, the cycle becomes intransigent and self perpetuating.

This cycle does not serve the interests of any stakeholders well.

Real Time Alerts and Black Boxes

One of the most vexing issues in the BP Macondo blowout has been the availability of logs and other data tied up in legislation. Technologically, there is simply no reason for this problem. Regulatory agencies have the authority to monitor any actions on the rig. Until now, it has been considered impossible to have real time data, but that's changed. A virtual machine server that
would monitor real time data from the drilling console, analyze it based on a few heuristic rules, and when it found a possible issue, alert BOEMRE directly over the Web.

The agency have accurate data about kicks and other defined anomalies, but – if the black box is implemented too – it will be possible to analyze the situation based on public data; avoiding the legal gridlock hampering informed decisions about the Deep Water Horizon.

**Real time monitoring**

As a VM device (program), the server and functions would not interfere with the functions of the drilling monitor. The VM device will not interfere with any of the software already installed. As far as the console monitors are concerned, the VM device would be completely transparent. At present, data is written to the database every 10 seconds from the drilling logs. 10 seconds is a huge time frame in the virtual world of 64 bit machines.

Some adjustments may be required to the Digital Well software already installed. SAP, CSC, and Oracle are already working on these functions.

The information would be taken directly after the write cycles to the database, or log, providing complete transparency to the regulators. Legal safeguards will be needed to protect access to the data in tort actions.

The heuristics guiding the analysis and alert functions would parallel the metrics in the proposed stress tests. This will give regulators an up to moment monitoring capability of possible problems. It should be emphasized that regulators do not have to respond to every alert.

**Black box**

The same VM device could function as a black box to recover data for RCA. However, if the device were to function as a black box for recovery, it would require some sort of hardening to protect it from fire, water damage, and explosions. The installation can be connected to the virtual machine server described above easily. Down the line, the black box function can record other data from the rig and operations such as release monitors, electrical boxes, and other safety monitoring functions.

**Crowdsourcing regulatory compliance**

Even 200 new inspectors and engineers at the new BOEMRE will not be sufficient. Their focus will be equipment, not guaranteeing procedures are followed. The 200 new inspectors will take years to learn what to look for and how to see it. BOEMRE needs more eyes and ears than it can reasonably budget.

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**Footnotes:**


2. The acronym ‘VM’ here does not refer to VMWare or any commercial product, although VMWare could be used. The same functions can be set up using Open Source virtual machine software with similar results.


The glaring reality that international oil companies do a risk-reward analysis on penalties is ignored. If the penalty, if caught, is $50,000 and the reward is $1M, the company will quietly decide to take its chances. Even if caught, they reward is so much larger than the fine, it makes non-compliance part of the system.

The same sort of risk-reward analysis is done by managers and supervisors about their bonuses. Although even if caught, the manager may not risk anything. The company will be fined, and the manager will have already received a bonus.

If someone reports non-compliance under the present system, they are quickly identified and blacklisted. No one in the industry will hire them. The boom and bust nature of the industry makes such actions irrational.

The odds are definitely in favor of intentional non-compliance. BOEMRE needs to level the playing field.

**How can it be done?**

The system will have to protect the identity of the whistleblower in all circumstances. A secure server will be used for all communication with the website. Revealing exculpatory information must be a choice.

- Set up a website for reporting non-compliance with a semi-autonomous reporting structure.
- The person registers with the site and receives a coded number. They are not required to reveal more than an email address unless they choose. The person can set up an anonymous email using one of the free services, such as Yahoo or gmail, to remain anonymous.
- If the report results in a fine, the person is contacted using the email and arrangements are made for payment.
- In cases where testimony is required, more personal information can be requested via email. The person will be allowed to decide if they are willing to testify using email contact.
- Rewards may be limited to 10% or $50,000 (or some other mechanism) to dissuade abuse of the system.

Even though many of the reports will not result in fines or settlements, such as where testimony is required but the person refuses to testify, managers will be aware of the reporting procedure and less likely to intentionally abuse the regulatory system. And the regulatory system is far more likely to be aware of abuse or the tendency to abuse.

Such a structure can be set up without further legislation by BOEMRE based on the recommendations already planned, and the laws in place. There will be legal tests of this system.

If Crowdsourcing compliance is set up: a) it will reduce the viability of applying risk-reward analysis driving intentional non-compliance (discovery risk), b) extend the capacity of regulatory agencies to monitor, and c) empower individuals at all levels.
Unfortunately, Crowdsourcing compliance will have little effect on risk-reward analysis based on paying the fines or penalties. If a manager or supervisor decides the rewards, either to themselves or the company, far outstrip the penalties, they will still choose non-compliance.

**Limiting feedback by structure**

The industry uses the contracting structure to limit feedback from the individuals who must perform key work roles that are dangerous, and dependent upon human capabilities.

The present contracting system is ill-defined at the most important levels, implicitly enforcing denial and presumed competencies:

- The present system hampers human factor engineering which in turn amplifies risk.
- Job definitions are shallow and too broad to allow adequate risk management.
- Too much of the risk in the present system is pushed into the Residual Risk category.

Current training methods are dependent upon on-the-job training. On-the-job training consumes the most time, and is the least reliable of all training methods. When on-the-job is the primary or only training method, it's inflexible because training is performed on the available system. In an industry that's constantly changing and updating technology at all levels, on-the-job leaves many people fighting the last war.

Although there are simulations available, they don’t deal well with the demands of deep water drilling. In fact, most simulators don’t deal with well incidents in a practical, applied technology standard. According to the experience of our industry experts, available simulators teach how to drill a ‘normal’ well. There is not enough attention to anticipated well control issues; nor to the responsibility and authority of the person.

Blended learning concepts, encompassing varying forms of pedagogy and heutagogy into a standard of metrics that include human factors such as leadership, mentoring, and individual competencies, are required to achieve the necessary level of competency.

Job roles cannot depend upon broadly objective certifications. Certification needs to be subjective by quality, dynamic, and transparent to all stakeholders.

**9. Regulators as Partners in Learning**

These thoughts are echoed by the recommendations from the International Regulators Conference in the Appendix below. Implicit in these recommendations is for regulators to develop and define a community within the industry; a community that includes regulators and other stakeholders. A community requires trust and involvement.

Etienne Wenger has written extensively on the concept of communities of practice. Regulators will fulfill the role of facilitator required by communities of practice.

Regulatory agencies as partners in the heutagogical (self-directed) learning process is part of the answer to the most significant argument against applying HRO principles to the oilfield: the work is
not consistent. There is no question the primary reason for HRO: low probability, high consequence operations describe offshore drilling. But in every other example of an HRO, employees are on salary and available for work on a regular schedule. This facilitates the maintenance of high reliability standards. An HRO requires a community.

It should be stated that in deep water drilling, the standards required are more likely HPO (high performance organization), not just HRO.30

Oilfield employment is by contract because the work is not constant. During downturns or when the particular company has limited wells under exploration, there is no work. This fact alone dissuades many from seeking a career in the offshore industry.

During those periods, there is little opportunity for individuals to maintain their skills, or to learn new skills on the new technology that appears consistently.

This presents an opportunity for regulatory agencies to leverage existing technology in partnership with the oil companies to the advantage of all stakeholders.

Integrate Training with Planning and Design phases

At first glance, this recommendation only adds to the cost of the well. If regulatory agencies accept the recommendations to take on the strategic value propositions of Perceptual Bridge and Repositories of Information, the concept takes on a wholly new dimension.

Even if those value propositions are not incorporated, integrating training or learning during well design process means there will be time allocated. This provides an extra level of risk awareness and risk management, and metrics.

During the email collaboration process, a heated discussion arose about the role, purpose and style of training, or learning. Here are some of the points that came up:

- Neither Learning (training) nor Well Design has kept pace with the development of the deep water part of the industry.6 People must be trained to work in different depth and temperature environments.31 Generalized training combined with mentoring32 and experience on the job does not give workers insight and understanding – intuition – to make critical decisions. Certification focuses on normal well control. As more than one driller has said, “There is no such thing as a normal well.”
- Deep water drilling is simply not the same. Workers must be authorized to make life or death, expensive decisions with clearly defined authority, and have a feedback channel to onshore decision makers. One of the keys to making this process work is to avoid the Blame-and-Shame game.
- Regulatory oversight is improved and becomes more flexible since near-real time information can be gathered about the skills of the workers. This process also serves as an inline stress test to alert regulators to possible problems. Automation of the process – including online simulations and adaptive testing – can avoid fudged data.

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- The regulatory agencies can assign ‘learning points’ for participation. Training and certification gains more depth and specification.\(^{35}\)
- **Mentoring must be defined as formal and informal.** Levels of mentored achievement can be defined. This is not just a stop gap. It should be an integral part of any training process and ongoing.
- **Simulations must include varying drilling environments.** That means incorporating differing physics, well behavior, and anomalous situations. Fortunately, most of these situations have been documented and incorporated into existing industry resources.

**TRAINING needs to come back stronger than ever – and folks need to lose the “cultural” sensitivity of using the word. There are three tiers:**

1. **Training:** goes to fundamentals and **CORRECT practices which cannot be compromised for safe drilling**

2. **Mentoring and coaching – and this goes to techniques and best practices. BTW – there is a world of difference between “best” practices and CORRECT practices.**

3. **Learning:** Learning will return to what it should be if the above two are done properly and of course the blinders to the Elephant management culture changes for the blame game of conniving a few bucks back.\(^{36}\)

**Virtual (real time) rig**

As an example of what can be done using existing technology partnering the goals and requirements of regulatory agencies, oil companies, and other stakeholders, imagine if a person wanting to work offshore could learn from the actual members of the team they will work with on an accurate virtual representation of the rig they’ll be working on.

**How can it be done?**

Every vessel has been drawn up in a wireframe. Companies such as Pixar, Cisco or others represented at the SVV\(^{\text{h}}\) conference Cisco can take the wireframe and create a 3Dimensional representation, and animate it. Every piece of authorized equipment on the rig has been wireframed and engineered. The same representations can be done. With some modeling and OOP programming applied, every time a piece of equipment is brought on board or sent off, it can be tracked virtually.

Much of this work, if not all of it, has already been done for some vessels.

A person wanting to learn about the rig can be guided through a virtual walk-around without the need for a classroom induction. The advantages for regulators and companies are hard to list comprehensively.

- Safety features can be pointed out, distances and locations familiarized, and work schedules presented – all from the complete safety of the virtualization. As new equipment is installed, it can be represented, along with maintenance schedules.

\(^{35}\) David M Pritchard, email to Ken Kotow and Wayne Needoba, September 29, 2010, 8:13 AM.

\(^{36}\) Serious Virtual Worlds conference. [http://www.seriousvirtualworlds.net/](http://www.seriousvirtualworlds.net/).
This feature alone may pay for the expense of the virtualization by limiting the requirement for a trip to the rig.

- Repetition and drill can be done without interrupting the work flow on the rig.
- Combined with simulators of drilling consoles, the process of training a driller can be made more convenient and quicker.
- By using a facsimile of the actual vessel or rig, the training can be more attuned to the specific requirements.
- And both the regulatory agencies and companies will have a means to document the level of skill, knowledge, and ultimately experience of the prospective employee in direct relation to the specific vessel and equipment.

**Different purposes and models**

Varied Virtual Rig models can be developed for different purposes. A Walkaround model serves as Publicity or rudimentary Training purposes similar to dated interactive training. To encourage learning – andragogy and heutagogy – the Virtual Rig can be set up as games. Access to different models is dependent upon security levels.

- The purpose of the Publicity model is to alleviate public fears by providing familiarity, countering the fear of the unknown and technology. This model primarily deals with the goals of the company and industry. This model may also act as a recruiting tool for people interested in offshore work.
- The walk-around model may be extended to serve as an induction presentation.
- The Adventure Game model can be used for self-directed learning. Motivations are curiosity, competition, and accreditation. Individual progress would be tracked by both companies and regulatory agencies. The game is to move around areas of the VR performing various tasks describing safety and job roles to earn points by efficiency (timing) and mindfulness (completeness and complexity).
- Building on the Adventure Game model, the VR can be set up modeled on SimCity, where each element affects other elements. This model is still a game, where efficiency and mindfulness are allotted points for competition. In addition, the elements are programmed to affect one another such as blocking access or becoming incidents in different work contexts. The Learner may also assemble a rig, team, or parts of a rig to accomplish work tasks.

The VR models above are conceptual models. In development, the conceptual models will be expanded upon and new features added. Progress, or successful play, can be tracked by both regulatory agencies and companies.

Insurance companies may find other applications for the VR. The VR can be combined with other multimedia to achieve an enriched learning environment.

**Full Web 2.0**

Combine the Virtual Rig with forums, chats, blogs, and other social media, and much more can be assessed, documented, and evaluated not only by the prospective employee, but by the regulatory agency and company. Leadership and attitude, motivation, the drive to learn, and the ability to mentor can become apparent before the person sets foot on the rig. Utilizing the constantly expanding world of multimedia opens a whole new dimension.
These features dovetail nicely with the fact that the oilfield needs smart young workers from Gen X and Gen Y to replace those who will retire. These generations grew up on the Web. The virtual rig will appeal to them.

**Security levels**

There is good reason to have a wholly public version of any rig to serve the purposes of regulatory agencies and exploration companies. The industry and regulators have suffered considerable damage in the public eye. Being able to look over the vessel, perhaps even view a presentation by company spokespeople or the managers on a rig will do much to restore public confidence.

Public access may be restricted for homeland security reasons, though.

There is no reason for all the information about a rig to be available to the public, employees, or prospective employees. Depending on evolving company policies, security levels can be set. Whatever decisions are made regarding policy and security, all the stakeholders must be attuned to feedback from the participants or users.

**Ongoing training**

The most important aspect of the Virtual Rig is it will allow authorized people to pursue their training without scheduling classroom time or requiring on-the-job. This opportunity addresses the goal of heutagogy, or self-directed learning. If the VR accurately represents the specific vessel, the person is able to learn about the specifics of their specific work environment.

Their efforts can be tracked and evaluated. It’s important for both regulatory agencies and companies to have a means to measure and evaluate the interest and abilities of employees. To quantify some of the important qualities, the methods of sociotechnical network analysis can be applied.

The person can ask questions, develop friendships, and learn to articulate their capabilities and interests to those they will be working with.

The virtual world will never supplant the need for hands-on training or the need for classroom training completely. It can augment those training methods considerably, and empower people to learn more effectively.

How far the training goes will depend upon policies and progress that cannot be determined at this time. It’s possible a person could begin as a roughneck and go all the way to being a petroleum engineer or geologist largely in a virtual world.

**Communities**

... the essence of community, its very heart and soul, is the nonmonetary exchange of value. The things we do and the things we share because we care for others and the good of the place. Community is composed of things we cannot measure, for which we keep no record and ask no recompense.\(^3^4\)
The best goal of regulatory agencies is to foster a sense of community amongst the stakeholders. Implicitly, that has always been the goal of regulation, legislation, and regulators. Law and regulation define common morals in an ethical code. The goal of law is not to create outlaws, but to indicate to all what is considered appropriate and inappropriate behavior.

**What communities are not, as Peter Senge and his colleagues remind us, is exclusive**\(^35\): we do not need to sell our soul to the company, it does not need to take over a whole town and dominate it, and we can still belong very healthily to communities outside of work.

A question that arises is how to motivate this sort of change. Based on rationales of extrinsic motivation, there is no answer other than bribery or punishment.

Fortunately, we are not dealing with Homo Economicus – that species has not been born yet. We are dealing with human beings, Homo Sapiens – the thinker (– or Homo Poeticus – the maker of meaning, as per W Earl Carnes.) As recent neuroscience has confirmed, supporting common sense, that human beings are hard wired for Empathy.\(^36\) The tendency to imitate and create communities is a part of human nature rationalized, or more correctly over-rationalized, from business thinking until approximately 1995. That’s not to say there are not advantages that translate into real dollars.

This concept may change the definition of NPT and downturns in the industry from unavoidable periods of loss and expense to useful time. If the individual is responsible for learning, and that learning platform is available, downtime becomes optional learning and team building time. In the real world, a portion of downtime is already used for learning and socializing, or team building. Self-directed learning platforms can add a new option.

The power of community building cannot be overemphasized. Every article or book about sociotechnical methods speaks at length about the psychological, personal, and motivational advantages of the sense of community.

For companies and regulatory agencies, the advantages are also numerous. By monitoring and guiding discussions based on standards, not necessarily regulations, regulators can come to know the skills, attitudes, and capabilities of individuals, not just contractual requirements. Companies have the same needs for different purposes.

The key is to align the networks under scrutiny to a clearly understood strategic purpose. Since both companies and regulatory agencies have similar goals, this alignment can be relatively easy to achieve.

**Formal structure determines in large part who is sought out in networks: we are driven to reach out to people by virtue of the decisions they get to make, the information they hold, and the resources they dole out. But informal relationships are crucial as well: some people may lack formal authority but possess technical expertise and organizational**
wisdom, or they may simply be likable and dependable and so an important source of help and information.  

High Reliability Organizations (HRO)

It may be argued that a HRO cannot be established without a sense of community. One of the key elements not always recognized in an HRO is the community that surrounds and supports the workforce. At the Operations level of Drilling and Completions, work is dependent upon industry upturns and downturns. These periods may last for months, and damage the sense of community and the level of efficiency required to achieve an HRO.

If the person has learned new skills, research indicates they may lose up to 75% of those skills after only one month. Considering on-the-job training is a matter of opportunity, it’s not surprising it takes 7 years on average to train a drilling technician.

Psychological stress

The psychological experience must be considered in establishing an HRO for drilling operations. Seeking a model as analogy, life on the rigs may prove to be more similar to service on a nuclear submarine than as an employee of a power company. As an employee of a nuclear power plant, the person can go home or anywhere away from the plant after their shift is done. There is a daily release from the sublimated or conscious threat.

On nuclear subs and on offshore rigs, there is nowhere to go. For extended periods of time men and women are under the threat of severe harm or even death 24 hours a day, 7 days a week. The threat of grievous bodily harm or death is always present. When off duty, the person must depend upon the skills of others to prevent harm to themselves. This situation may also be likened to combat.

While nuclear submarine personnel are carefully screened psychologically and monitored, people in combat or on an offshore rig are chosen at random. In the context of combat, this can result in combat fatigue or long term PTSD. Is it possible there will someday be a version of PTSD called Rig Syndrome? Is this also an obstacle to establishing an HRO in offshore drilling? The answers are beyond the scope of this paper.

The professional sports team is a metaphor for a high reliability organization. Capacity and duty correlates with skill levels. The broader measure of competence transcends all levels of the metaphor. No entity in a sports team or HRO stands alone. In different circumstances, elements may seem to be tightly or loosely coupled. Team building, shared attitudes and heuristic rules, are always being explored and established.

Here are the essential aspects of an HRO, according to Dr Robert Bea:

- Observes and tracks small failures and anomalies
- Resists oversimplification
- Remains sensitive to operations
- Maintains capabilities for resilience
- Looks to expertise not rank to inform decision
These are not goals for regulators. These are goals for the Operators and contracting companies, not only individually but in coordination. Because the industry organization is based on the external risk neglect philosophy, industry cannot accomplish these goals alone. Individual companies cannot achieve high reliability alone.

To achieve high reliability, it must be an industry-wide effort. Industry will require the active involvement and support from regulatory agencies, and perhaps other stakeholders to achieve high reliability. Not only within the jurisdiction of the United States, but internationally, with special emphasis on operations in the southern hemisphere and Asia. This will require agreements between governments and agencies from many cultures.

Figure 9.1 – ISO 31000 Conceptual Framework.
The first step, in accord with already accepted business practices of being ISO 9001, ISO 14000, and often ISO 18000 compliant, is to institute the ISO 31000 standards across the industry. Minimally, ISO 9001, ISO 14000, and ISO 31000 compliance may be mandatory for all levels of operation are required to achieve high reliability.

But even that is not enough without explicit regulatory involvement. It’s important to emphasize ‘involvement’ not ‘requirement’. Regulators must work with industry as facilitators, not enforcers. The overarching goal of regulatory agencies must be to foster a sense of community at every level. Enforcement must only be a last resort if the process is to be successful. The adversarial model only compounds risk to individuals and the environment, and ultimately to the companies and industry itself.

The proposed changes will not be instantaneous or easy. Industry history suggests a 50-year time period, but there is no reason it has to take so long. If Web 2.0 concepts, already largely in place, are applied, the changes may take less than a decade. Many of the goals – broader communication and transparency – may be a matter of realizing the existence of resources and applying the appropriate strategic value propositions. This process may be facilitated by accepting some of the other Recommendations in this paper.

Drawing again from network analysis concepts (Figure 7.4 – Levels of a complex sociotechnical system involved in risk management.), interfaces between companies and teams on any project can be mapped and verified. Because of the current industry culture, these interface mechanisms will be difficult. Many of the issues that immediately appear daunting may be allayed by referring to analogous issues in other industries, such as nuclear power and airline training. The U.S. Department of Energy human performance improvement handbook is especially clear about management strategy and techniques. These techniques are expressed in common sense, clear language that can be understood by anyone (once you get past the references to the nuclear industry.)

Simulators and training to intuition

Simulators can no longer be generalized. The specific work environment on a rig demands too many adjustments for generalized training to be effective. People must be certified as knowledgeable about their roles subjectively; and all stakeholders need to be able to be confident about skills, knowledge and capabilities.

Of the questions that arise one is the possibility of training to intuition. Although this would make a great topic for another paper, suffice it to say that no simulation can accomplish this level of cognition without other techniques being applied such as immersion and/or other forms of augmented learning.

Passive/Active RFID

This is both a security and logistics feature.

Passive. If every item on a vessel were required to have a embedded passive RFID chip and readers are set up to broadcast and read by section, a complete inventory of the vessel can be done in seconds from anywhere. The passive chips are inactive until a reader comes within range. Output from the reader activates the chip, which reports as programmed.
When activated, the chips report the location of the item, and can be programmed to report other information such as status.

For example, a fire extinguisher already has a pressure valve to show readiness to function. This valve can be connected to the chip to report not only the location of the fire extinguisher, but the amount of usable fire retardant. The results can be either sent to a security or safety officer onboard, or sent to regulators as a quick check of readiness. For verification and redundancy, a crew member can walk through the section with a handheld reader, or do a visual check.

RFID can be built into other features, such as the Virtual Rig, and made accessible only to specific security levels. There may be some conflicts with other safety or control devices, or even metal bulkheads, but those can be largely overcome by engineering.

**Active.** Active RFID can give an alert when items are being moved from one area to another. When an item with active RFID passes a bulkhead with an installed (passive) reader, the movement can be reported to a security or safety officer onboard, and the information sent to the monitoring software to be sent to regulators and recorded on the black box.

**Security badge.** The security badge already in use can be equipped with either passive or active RFID chips to quickly locate and identify personnel on the vessel.

**Equipment.** RFID can be used to determine if a crew has all the equipment required to do a job. In most cases, equipment lists should be redundantly checked manually, but in an emergency this sort of check can save precious seconds.

**Learning or Training.** Reports of location and status can be used in drills and training to build or test awareness of procedures, proper locations, and usage.

**Cost and Redundancy.** Probably the best feature of RFID technology is it’s inexpensive to implement. Readers cost about $200. Chips cost about $0.40 each even in relatively small quantities. Printers can be used to produce passive chips. Passive chips can be embedded or attached inconspicuously. Crew members can quickly learn to replace any active chips. A passive-active RFID system can be used to provide redundancy for other safety and security systems already in place. RFID systems can be installed on any legacy vessel. There will be some issues with range and blocked transmission areas, but those can be overcome.

10. **Appendix**

A. **International Regulators Forum**

**Conference Summary**

3rd International Regulators’ Offshore Safety Conference, 18-20 October 2010
Vancouver, British Columbia, Canada

In support of these proposals, consider the recent conferences with the International Regulators Forum. The International Regulators Forum issued\(^a\) the following observations on Nov 1, 2010.

…The consensus findings and recommendations of the conference, which provide guidance for assessing and improving offshore safety programs, are summarized below.

- Regulatory regimes function most effectively when a single entity has broad safety and pollution prevention responsibility. Gaps, overlap, and confusion are not in the interest of safety or regulatory efficiency.
- The regulator’s core responsibilities and objectives must be clearly identified. Managers must minimize distractions so that regulatory personnel can focus on these objectives.
- Safety management and regulatory priorities should be identified through a comprehensive risk assessment program. Training and competency development programs should be updated to reflect the new risk information. Contracting strategies should be reviewed to assess their safety and risk implications.
- Government and industry should promote an improvement mentality, not a compliance mentality. Continuous communication among regulators, operators, contractors, workers, industry associations and public interest groups is essential for continuous improvement.
- Operators and contractors must manage their companies to achieve safety objectives and must continually assess the effectiveness of their management programs. Regulators should challenge industry to resolve potential safety problems rather than seek to resolve the problems for them.
- Regulators should serve as catalysts for learning by distributing information, hosting workshops, participating in research, and identifying gaps in standards and best practices. Wherever possible, the best standards should be identified and applied internationally.
- Accident investigations should be conducted independently and findings should be promptly and broadly distributed. Industry or government should maintain comprehensive and verified incident data bases. Offshore companies should regularly discuss the causes and implications of past accidents with their employees.
- Industry and government cannot rely solely on incident data to identify risks. New indicators must be explored and assessed, particularly for major hazards and safety culture. Worker input is also essential.
- Peer-based audit programs should be considered for both regulators and operators.
- Industry and regulators should make better use of technology for real time monitoring of safety parameters.
- Sustaining outstanding safety performance is critical to the reputation of industry and government. All personnel should be trained to be safety leaders and should be empowered to stop work without blame.
- Industry and government should Investigate other actions and programs that might help promote, sustain, and monitor a culture of safety achievement.
B. Design and Planning stages
The current design model must be challenged. Learning, or training, can be a part of the Design phase.

*The current design model must be challenged.*

*In order to ensure safer deepwater operations, this paper suggests there is an industry need to focus on problematic wells and their design. It is further evident that in some categories of deepwater wells, industry performance has become worse, and the final proof is the Macondo catastrophe itself.*

*It is clearly understood that there are many causal factors around this incident.*

- David M. Pritchard

As has proven so often the case with the BP Macondo blowout, the irony is BP had instituted similar ideas at every other level of their business.

*BP's framework for sharing knowledge starts with the business objective and ends with business results.*

*This may sound like corporate pabulum, but the idea is that learning and knowledge transfer must not be an end in itself. BP thus portrays learning as a cyclical process that takes place around the execution of business plans, with generally separate activities to be taken up before, during and after a project.*

*Underlying the framework is the idea that business units draw on shared knowledge assets which comprise explicit knowhow, and that they rely on human networks (or communities of practice) to do that. BP takes the view that networks are the building blocks of the knowledge process, …*

- David M. Pritchard

There is ample evidence that in 2001, when that quote was taken, BP was on its way to being a progressive company with a commitment to learning and professional community. The influence of Amoco was still strong. What happened between 2001 and 2010 has not been disclosed for all the press about the spill. Whether the changes were driven by a different strategy within BP, or a conflict of cultures between BP and Halliburton, the drilling contractor, on the Deepwater Horizon remains unanswered. The reason may simply have been difficulty with stubborn habits of offshore personnel.

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C. Training or Learning?

The committee of academics appears to have been taken aback by the education and training levels of people on the rig.\textsuperscript{49} 

“Personnel on the Deepwater Horizon were mostly trained on the job, and this training was supplemented with limited short courses,” the report said. “While this appears to be consistent with industry standard practice and current regulations .. it is not consistent with other safety-critical industries such as nuclear power or chemical manufacturing.”\textsuperscript{40} 

We agree.

In the course of the research for this paper, a curious quirk of terminology arose. At first glance, there isn’t much difference between the terms ‘training’ and ‘learning’.

The difference is important, but subtle. In training, the trainer is responsible for what the person learns. That is the essence of pedagogy, or teaching children. This is also the philosophy of vocational training.

There is an industry bias against the use of the term ‘training’. In some cases, the one term simply replaces the other.

Training at this level cannot be pedagogy, however, if the required level of performance is to be achieved. Learning is a choice. The person must choose to learn. There must be intrinsic motivation (emotional) to learn. It’s the difference between pedagogy – teaching children – and andragogy – adult learning.

Highly motivated people seek out knowledge beyond their job role, and beyond organized learning. These learners are practicing heutagogy – self-directed learning. These are characteristics of leadership.

In the Oil and Gas industry, the level of performance required on any job role demands people choose to learn, at least. This is a required facet of an HRO. Far better is for the person to actively seek to learn.

D. Motivation and Performance

In terms of performance, especially high performance, leaders motivate by emotion, not logic. Another way of saying the same thing is Motivation is an emotion. Emotions are intrinsic; logic and money are extrinsic. Performance is driven by intrinsic motivation, or emotions.

Logic becomes the rationale for performance. In these terms, the difference between managers and leaders can be discerned: Leaders motivate by emotion. Managers use logic to make things happen.

\textsuperscript{49} The chairman of the committee is Donald C. Winter, professor in the University of Michigan’s Department of Naval Architecture and Marine Engineering.
E. Leaders and Leadership

Leadership is one of the most commonly misunderstood qualities. Recently on LinkedIn the question was posed to the ‘Readers of The Economy’ (magazine) group: “One word or phrase to characterize your leadership style?”

Some of the answers were: “Visionary,” “Motivating,” “Inspire confidence through effective communication,” “Inspire,” and “Mentor.” These words describe many aspects of leadership.

US Army Officer Candidate School (OCS) teaches some interesting perspectives on leadership. A couple of them are:

- Leaders don’t always lead from the front. This is not about Generals or commanding officers, but a statement that a leader will reveal themselves in any situation.
- Good leaders are also good followers. A leader doesn’t have to be in command. S/he will see the goals of the mission and work under the command of someone else to accomplish the mission. Leaders realize they can accomplish much more as part of a team.
- Leaders lead by example. They do the things they want others to do - whether in command or as part of the team.

A legitimate question is How do you identify a leader?, or How can you tell if someone has leadership qualities? The answers are right there, above. The person may not even consciously be seeking a leadership role, but others in the team will recognize the qualities of a leader. Just ask them.

Using organizational network analysis (ONA), these answers can be converted into metrics.

Consider a professional sports team.

- Individuals have to keep themselves fit and strong. The individual must maintain certain skills.
- They have to learn the strengths and weaknesses of the people who play around them. This group that does similar things.
- Then they have to learn to work with the whole team, whether for defense or offense.
- The whole defines a system, even though only one part of the team may be on the field at a time.
- At different points in the game, the goals of the part of the team on the field may change priorities, which may in turn change the way they play. (For example, if the team is behind towards the end of the game, it may be more important to get possession, rather than just defend against the other team moving the ball.)
- Ultimately, the success or failure of the team depends upon the decisions and actions of each individual.
Intuition and training

- Asked about David Pritchard’s phrase, ‘Coaching and training’ from the cartoon:

  *Good progress can always be subverted by people not doing what they should be doing. The secret to desirable quality and reliability are good, capable, experienced people doing the right things at the right time.*

David M Pritchard’s Elephant in the Room cartoon

Further observations by David M Pritchard and Wayne Needoba, both professional drilling engineers with long experience – over 40 years each – in the Oil and Gas industry:

- Critical systems are heavily people dependent. Yet the industry expects to be safe and successful with a relationship model between Operators and Drilling Contractors that denies this obvious fact. The best way to describe this relationship is disjointed and dysfunctional, allowing very little feedback.

- Regulatory Agencies are undermanned and technically thin in deep water experience. Most often, inspectors are drawn from the ranks of new graduate engineers with little industry experience, or from semi-retired engineers or drillers who are not familiar with current equipment.

- Even Operators and other service providers fail to recognize that the Operator is fully accountable.

- The most common and important means for managing complexity during Planning and Design - technology, integrated disciplines, and careful planning - is passed on to the Execution phase as a series of lists in printed or spreadsheet form.
Figure 6.1), Wayne Needoba replied:

“Leadership is often a check list approach. Creativity and innovation across a team is missing due to the process of selecting teams... That focus gives cutting corners a justification to the leadership culture. (Coaching and training are) ... done superficially, not transparently and across the industry.”

Wayne Needoba

Taken superficially, the answer seems to not speak to the question. In court, a lawyer might move to strike the reply as unresponsive.

The answer is intuitive, a heuristic rule, short-cutting rationales to the heart of the matter. In an on-the-job-driven training system, leadership is expressed as mentoring and coaching. Heuristics may become Best Practices. However this sort of intuition is difficult to evaluate.

Interpreting intuition requires combining meaning across as many other thoughts as possible. As you can see from the response, Mr. Needoba includes other phrases from the list in his response. Mr Needoba is calling for a standard to measure interpersonal skills—such as coaching, mentoring, and communication—that can be translated across the industry; and expressing frustration with the interpretation of cost cutting (‘cutting corners’) as a measure of leadership.

In an on-the-job-driven training system, mentored examples of cost cutting introduce increased risk that is nearly impossible to uncover. This sort of risk is either part of the business culture or
climate. This is a risk factor encouraged by the existing financial metrics; and because of the lack of human factor leadership metrics. Again, how the goal is defined is how it is achieved. These risks may be revealed using organizational network analysis (ibid).

F. Individuals as Leaders, and Learners

How should someone learn to work on an offshore rig? This plan is based on resources available today to anyone. In a better system, the person will have many more resources and all stakeholders can have more confidence in the results. This section might be an email to a friend.

First, get a taste for what the work entails. Go to a Drilling Contractor. Get an appointment with someone who can give you permission to ask some questions. Explain what you’d like to do.

First steps

You will need to learn some of the terminology, and start getting used to acronyms. Roustabouts work on the deck handling cargo and pipe to the rig floor with crane driver. Rough necks work on the rig floor under the derrick with the driller.

There are often two crane drivers doing different things so the crews are in different areas but get tested first on the deck.

Schools and Simulations

You can sign up for a school, but make sure they have simulators. Not every simulator is effective. Some just simulate normal operations. That’s not good enough. You want simulators and trainers to simulate errors and problems.

Reading and Communication Find a rig manual and read it. It’s usually drawn up by Safety Officers.

A great way to improve your skills is to solicit feedback from people who know more about the subject than yourself, and to learn from the wisdom they share with you.

If possible, find a couple of Safety Officers online and connect. Start with safety, not drilling. Safety skills are applicable to whatever job you take on. And you need to learn how to read regulations and apply them.

Socialize

You can find Drillers, Drilling Engineers, Safety Officers, Geologists, and any other profession on sites like LinkedIn. If you’re interested in working in another country, there may be one or more professional social networking sites for that country. Connecting with active professionals in the field has a lot of advantages. They’ll have their own opinions, of course, and will direct you to other forums and sites to read and learn.

They may not always agree with each other, but if they are worth your respect as good drillers, what they have to say should at least prompt you to think about new ideas and to think about old ideas in
There are many ways to solicit feedback. Here are three possibilities:

- Find a strong, helpful community,
- Pair with another learner,
- Get a mentor.

**Practice mindfulness.** Practice mindfulness in everyday life. Mindfulness is a habit you can form. The habit of mindfulness is helpful in many other things you do. Games like chess and pinochle require mindfulness.

- Chess requires that you are aware of a whole system and unpredictable changes in it. You have to think 3-5 moves ahead for both your own pieces and anticipate the moves of your opponent.
- Pinochle requires the same ability to plan ahead and anticipate, and incorporates the element of unpredictability, with another of the skills required of a driller: to communicate. Communication in pinochle is part verbal, part action, and part non-verbal. You have to anticipate and react to the unpredictable actions of others, both your partner and the other team. All of these skills will translate well into being a part of a drilling team, and leading it.

Make practice lists of hazards before doing daily tasks or work, either in your head or on paper.

This is a skill that will apply to many things. You will need to learn what can be anticipated, and how to plan your reactions to those things without letting your anticipations dictate all your decisions. You will need to learn to read the situation accurately.

**Math skills and technology**

You’ll need some math skills, too. You’ll have to understand how a project is rated for difficulty, and how that affects costing the project. Difficulty ratings have become increasingly standardized, but may still change. Different companies may use different formulas.

There are some calculations using formulas you’ll have to do while working. You’ll find with practice some of the figures stick in your head, and that you’ll be able to do the calculations quickly. But then you still have to communicate your calculations to engineers, geologists, and newly-hired roustabouts and roughnecks.

If this sounds like a lot, it is. To be a professional driller in a highly competitive field, you’ll need all these skills, and contacts. And you’ll need to keep up on the technology. It’s constantly changing and improving.

**G. Suggested Role Levels**

These suggested roles define levels of remuneration independent of contributing heuristics to the overall training and simulation system. These suggestions are examples. They are intended to illustrate the role of leadership in learning. Similarly named levels may apply to any job role.

- **Novice**
Operator

Mentor

Master

Novice
This is not the keep-your-mouth-closed level. If the feedback, simulation and training system is successful, this person may bring new skills to the team.

Operator
This person has achieved the level of competence to be able to function independently in the role. This is the level assumed in the present certifications. The person needs mentoring to build intuition, but is technically competent. This is not a leadership role, however the person may mentor another Operator or Novice informally.

Mentor (M2)
This is a formal mentor. This is the first leadership role. A mentor should be available to any Novice or Operator whenever they are on duty. The Mentor has achieved a level of intuition and skill.

Master (M1)
Formal Mentoring only describes part of the skills necessary to fulfill this leadership role. This role is primarily leadership.

H. Risk
Mature heuristics, cutting through many layers of rationale, are too easy to be misinterpreted, not understood, or confused, which in turn damages the trust relationship essential to the on-the-job-based system. Even as the person learns new skills and techniques, they may increase the Residual Risk.

In management terms, this can be interpreted as a network. Trust is an essential element.\textsuperscript{42}

The lack of transparency destroys any trust in the relationship between employer and employees, and makes it far less likely to achieve any useful outcome. Too often, managers think their work is done after they communicate the high-level vision. This is the current theme of Leadership training in business schools. Management is leadership, but this theme does not communicate well into an on-the-job system.

Fail to understand the nature of the system means failure to identify and effectively communicate desired behaviors is the root cause of numerous problems. Management are perceived in terms of the on-the-job system as people who set an example, as the leaders - mentors and coaches - within the system are perceived. When management is perceived as being hypocritical or intentionally superficial, the effect is much worse. This failure to communicate is a source of resentment and confusion that introduces Residual Risk into the system.
It’s difficult and time-consuming to construct good performance objectives quantitatively. Qualitative measures express goals better, and provide the basis for measuring performance in interpersonal skills.

I. Organizations as Leaders

Sometimes you can identify a leader by what they don’t do.

For example, leading organizations - of any size - don’t do things to keep them from seeing a crisis evolving. Again from Dr Robert Bea’s research, here is a list of identifiable key issues:

1. Treating dynamic situations as static.
2. Assuming a single general principle accounts for all observations.
3. Seeing different entities as more similar than they are.
4. Treating multidimensional phenomena as unidimensional.
5. Treating continuous parameters as discrete (univalued).
6. Treating the whole as the sum of its parts.
7. Treating highly interconnected elements as separable.
8. Failure to revise assessments based on new information.
9. Wishful thinking (believing the desired outcome is likely when it is not).
10. Overestimating your control over developments and their outcomes.
11. Overestimating the predictability of the sequence of events.
12. Garden path problems, which involve reacting to strong signals that suggest plausible but incorrect answers while ignoring or not detecting weaker signals that suggest plausible and correct answers.

For an organization, however, the roles of intrinsic and extrinsic motivations are reversed. Organizations are driven by logic and monetary reward. Emotions are considered unprofessional or disruptive. As illustrated above, it’s clearer to characterize an organization by what it doesn’t do rather than what it does.

This dichotomy illustrates an element aspect of the public perception of organizations: Negative news is more readily accepted and believed. Every organization faces the challenge of overcoming that aspect of human nature. This is too often true of regulators, too.

11. Bibliography


12. Endnotes
1 The basic premise in the system approach is that humans are fallible and errors are to be expected, even in the best organizations. Errors are seen as consequences rather than causes, having their origins not so much in the perversity of human nature as in “upstream” systemic factors. These include recurrent error traps in the workplace and the organizational processes that give rise to them. James Reason, *Human error: models and management*, BMJ 2000; 320(7237): 768-770.

2 International Petroleum School, *Ch 10: Well Control Management*. This chapter describes the common roles and functions on a rig. “Well control management is a critical component to achieving reliable responses to every action in drilling, evaluating, constructing and completing a well. The prevention of kicks requires that all aspects of well operations be carried with an awareness of the impact of drilling outcomes to the well’s pressure integrity.”

3 It would be very speculative indeed to conclude that the DPO could have prevented the 11 casualties. Firstly, according to her and his testimony, he was not very far from her but was right there silencing the audio part of the alarms at a separate console at the same time she was working at hers. There was no 5-10 minute hunt for him. She testified that she had enabled the General Alarm shortly after a few of the magenta gas detector lights lit up. The only place her supervisor said she stalled was making the announcement over the PA that “This is not a drill.” Neither she nor her supervisor enabled the ventilation shutdowns. (Gary Marsh email to Paul Donley 12 Dec 2010)


5 ‘Upstream’ in Oil and Gas industry jargon refers to getting the petroleum products from the refinery to the consumer. Ms. Meyer is using the phrase euphemistically to refer to full length of Chevron’s integrated business model. The key phrase is emphasized. There is no certainty Ms Meyer understood the wider importance of mindset vs technology.


13 This term, ‘virtual’, has changed its meaning over the past 30 years or so. In the 1970s, a virtual company was one which leased core capital and services, and contracted important support services. An example was the virtual airline which leased planes and terminal space, and contracted maintenance. The virtual company proved a more competitive model. In
contemporary terminology, where service industries predominate, any use of the word ‘virtual’
implies the use of internet or networked communications between business entities. Core
services are leased to attain the highest competency.

14 The Open Value Networks site is a non-commercial network that is leading value network
standards, taxonomies, visualization, analytics, vocabulary, methods, tools, and techniques. All
are welcome to review the diverse papers, practices, communities, and links at the site.

15 Martha Grabowski and Karlene H. Roberts, Risk Mitigation in Virtual Organizations, JCMC, 3

16 It’s probably unusual to refer to a YouTube video, but the presentation by Dr Andrew Lo for
the Research Channel is the clearest expression of these principles (http://www.youtube.com/watch?v=DhX0PGG-hal).
From Dr Lo’s homepage, there are references to Working Papers in far more technical language to illustrate the concepts in more
depth.

17 The bureau also is exploring how it can commit to invest in training and professional
development programs that could be a potent lure for some would-be regulators.
http://fuelfix.com/blog/2010/12/15/energy-bureau-hopes-to-hook-recruits-with-loan-
repayment-other-benefits/.

18 Robert Kaplan and David Norton, The Balanced Scorecard: Translating Strategy into Action (Boston:

19 Chevron has been tracking online discussions about energy since 2008, using webcrawler
searches looking for specific energy-related keywords in places like blog posts, Twitter feeds and
YouTube videos. The crawler catalogs the posts by topic and scores them for sentiment based
on a “semantic dictionary,” creating a score between 1 and 5, according to Chevron. This is the
second time Chevron has released the data. http://fuelfix.com/blog/2010/10/04/trending-
topics-energy-resources-is-no-justinbieber-but-its-hot-online/.

20 Michael Dulworth, “The Connect Effect: Building Strong Personal, Professional, and Virtual

213.

22 J. Rasmussen, & I. Svedung, Proactive risk management in a dynamic society. (Karlstad, Sweden:

Risk Analysis (SoTeRiA),” PSAM10, Seattle, WA, June 7-11, 2010.


28 The Republican Party Whip serves as an example of crowd sourcing compliance. “Thank you for your submission to the first YouCut Citizen Review, this time focusing on the National Science Foundation; please continue to look for questionable grants and submit them to this webpage.” [http://republicanwhip.house.gov/YouCut/review_thx.htm](http://republicanwhip.house.gov/YouCut/review_thx.htm).


31 “The unique aspects of an operation of any kind needs to have the "designers" recognize the character and the hazards, and only then can the risks be managed competently, and that is a team effort. So the paradigm is that the culture must be such that uniqueness becomes transparent, then let the planning begin. Also, from RCM training I learned that one can assess whether an individual has the "paradigm" (5 levels) to handle various levels of position and responsibility.” – Wayne Needoba, email October 14, 2010 to Paul Donley.

32 “Training, and mentoring, is always important, and thus has been part of our industry from its conception. During the business cycles of our industry there has been different emphasis and energy into training and mentoring, but it has always been there.”

“I want to focus on deepwater drilling operations specifically. David Pritchard and I have studied this subject for a number of years now. The data that you’ve all seen indicates that the "lack of learning" in drilling performance is evident only in the deepwater complex wells, but is clearly there in the less complex wells. So improving training (learning) is not the general solution to improving deepwater performance.” Ken Kotow, Successful Energy. cc email from Wayne Needoba to Paul Donley September 29, 2010.

33 “Certification is unfortunately a hazard. People die for certification as it gets jobs and is a status symbol. I've been doing it and the only certification I've see really work is when there is a simulator and people have to fly it. When you see the look in their eyes that they got it, you give them a certificate knowing they know what to do and what the hazards are. The rest of the time (it's) a money game in the industry. Training for profit is one part of the elephant in the room.”  

… “..Re the term “training” … tends to refer to a group activity and pretty much one person presenting, where interactivity is limited. Its represents a rote thing process and seldom provides an experience, and retention of content after the event is about 15 % if its used in the first couple of weeks after the course. The exception is at the rig site where sometimes a drill gives greater return on the first one or two times.”

“Conclusion, new technology, interactive multimedia, … to present situation’s(sic) that must be responded to by the individual, taken when they are ready, and involving people and operations relative to what they are doing, in their native language give an 80% retention that doesn't degrade.”– Wayne Needoba, email October 14, 2010 to Paul Donley


- Define the core value proposition of a network
- Identify the critical relationships that must exist
- Conduct an organizational network analysis to assess existing collaborations
- Put in place an organizational context