



# THE WORKFORCE CRISIS IN THE UPSTREAM OIL AND GAS SECTOR

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## Introduction

The upstream oil and gas energy industry has come a long way from individuals using blankets to soak up natural seeps of oil from water surfaces. More familiar are the images of gushing oil from oil derricks. Fortunately, the industry has experienced a number of technical improvements, driven largely by the increasing global demand for crude oil and natural gas. Improved methods of exploration, such as directional drilling, completion engineering, and purification technologies have all dramatically improved, thereby intensifying the need for highly qualified technical specialists.

### The Industry is Facing a Well Documented Impending Crisis

Due to increased demand and industry cyclicality, technical specialists have grown scarce and a well documented workforce crisis has emerged. This crisis is mostly attributed to a significant loss of talent over the past few decades combined with increasing energy demand. Not surprisingly, the crisis has been studied and documented by a variety of organizations.

Deloitte estimates the loss of jobs in the sector at approximately 1.1 million since the 1990s. According to The Independent Petroleum Association of America, 40% of the industry's skilled professionals will reach retirement age by 2010. These figures, coupled with a decrease in the interest on the part of North American recruits in the upstream oil and gas industry (as seen in a sharp reduction in enrollment in college geosciences programs) warn of the impending crisis.

To date, industry studies on this issue have provided valuable insight into the underlying causes of the workforce shortage. They also have identified the specific areas that have been affected the most. These studies often provide tactical solutions to address the immediate impacts of this shortage. However there is a lack of analysis on the financial impact of this employment crisis on industry.

Under the sponsorship of the executive search firm Boyden and University of Houston's Global Energy Management Institute (UH-GEMI), the Program for Applied Strategic Finance at the University of Houston's C.T. Bauer College of Business has conducted a survey of top upstream oil and gas exploration and production and oilfield service companies in an effort to research and quantify the financial impact and lost opportunity cost of this workforce shortage. This comprehensive study investigates the long-term strategic impact of the crisis and also



provides insight into how managers can estimate the financial impact of this crisis on their own company.



The survey included ten top companies with median latest 12 month revenue of \$7.7 billion and the smallest company had latest 12 month revenue of \$1.9 billion.

## Financial Impact Analysis Criteria

### Areas of focus:

- Direct Employee Cost
- Lost Profits from Lack of Experienced Staff
- Strategic Opportunity Cost

The financial impact analysis focuses on quantifying the effect this shortage of skilled staff has on two key areas within the industry:

- Direct employee costs
- Lost profits from lack of experienced staff

In addition, survey results provide insight into a third facet, the strategic opportunity costs related to a lack of skilled experienced staff.

### These 'bins' are defined as follows:

#### Direct Employee Cost

**Direct employee costs** are the costs related to identifying, hiring, training, and retaining qualified employees and include the following components:

- Hiring and replacement costs
- Training and lost productivity costs
- Compensation; including the cost of:
  - Signing bonuses
  - Salary increases
  - Annual and long-term bonus increases

#### Lost Profits from Lack of Experienced Staff

**Lost profits from lack of experienced staff** includes the lost profits as a result of:

- Delayed or cancelled projects
- An inability to implement growth and expansion plans
- Costs related to safety issues
- Costs of alternative staffing methods (consultants)

The analysis utilized historical rig counts and the current demand for additional rigs as one of the drivers to quantify lost profits as a result of delayed or cancelled projects. Rig count indicates the number of active exploration and new production wells. New wells and wells requiring

major workover drive the demand for equipment and a technical workforce.

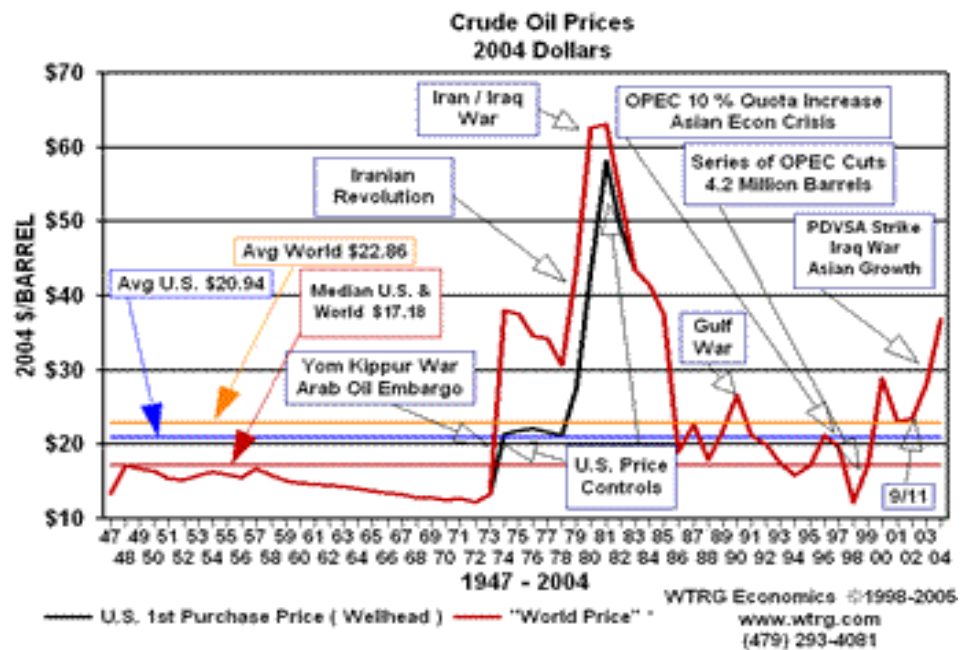
**Strategic Opportunity Cost**

**Strategic opportunity cost** is related to lost profits associated with a lack of long-term strategic vision and a short-term tactical approach to management, especially given the current pace of demand on the energy industry. The current high level of demand, along with voluntary and involuntary attrition in the industry since the 1980s, has created an environment which lacks strategic vision.

**Industry History and Economics**

**Oil Prices and Employment Levels are Highly Correlated**

The oil and gas industry’s financial performance is directly linked to crude oil and natural gas prices. The impact of large shifts in supply and/or demand may extend over several years and has historically responded to changes in supply driven by key world events such as the Yom Kippur War leading to the Oil Embargo of 1973-1974, the Iran/Iraq war in the late 1970s, the Gulf War in the late 1980s and 9/11. Additionally, increased demand as a result of economic expansions such as the current industrialization of the East has a significant impact on pricing and employment levels.



Source: WTRG Economics



### OPEC Unable to Enforce Member Quotas

OPEC's ability to control oil prices is a key market driver. However, OPEC does not have a mechanism to enforce member quotas. Additionally, during periods of high energy costs consumers have changed their short-term consumption, often through technology changes which can lead to reduced long-term consumption.

As the Middle East and Far East have become more politically unstable, there has been an increase in exploration and production outside of OPEC. The period from 1973 to 1980, for example, saw an increase in non-OPEC production of 10 million barrels per day. The resulting high growth phase of the U.S. upstream market led to attractive employment opportunities and a flood of young petroleum engineers, geologists, field engineers and drillers were hired by U.S. companies. OPEC, on the other hand, was faced with a decrease in demand and increased supply from outside the organization.

What followed laid the foundation for the current crisis in the upstream oil and gas industry labor market.

### Mid 1986 Oil Prices Plummeted to Below \$10 per Barrel.

OPEC's response to the increase in exploration and production outside of the cartel from 1982 to 1985 was an attempt to set production quotas low enough to stabilize prices. History repeated itself and the members of OPEC paid no heed to these quotas. Saudi Arabia was the swing producer adapting its production to stem the free falling prices, but in August of 1985, the Saudis linked their oil prices to the spot market for crude and increased production significantly. By mid-1986, crude oil prices responded by plummeting below \$10 per barrel.

### Lack of Confidence in the Future of the Industry

Not, surprisingly, a bleak year for employees in the upstream oil and gas industry was 1986. The industry laid off technical employees in droves, largely in response to the impact of oil prices on profit margins. Additionally, many key employees voluntarily left due to a lack of confidence in the future of the industry. As a result, the industry is still perceived by many as an undesirable, unstable segment for a long-term career.

This exodus of employees was exacerbated by the fact that prices remained weak throughout 1987. Despite a spike in crude oil prices in 1990, due to the uncertainty associated with the Iraqi invasion of Kuwait and the ensuing Gulf War, crude oil prices entered a steady decline until February 1994 when it reached \$13.88 a barrel on the New York Mercantile Exchange (NYMEX).

On March 28, 2000 a \$22-\$28 price band for the OPEC basket of crude oil prices was adopted. Until that time, the price only exceeded \$23 per barrel in response to war or conflict in the Middle East. It wasn't long before OPEC abandoned this price band. By March 2005, oil reached an all time high of \$57.60 per barrel on the NYMEX. Political instability in the Middle East and Russia, and growth in the Asian economic demand for oil, especially non-Middle Eastern oil, combined with a 50% increase in energy supply all resulted in current oil prices of between \$49-\$78 a barrel, with about two-thirds of this growth in the form of oil and gas. In connection with this increase in demand for non-Middle Eastern oil, employment in the oil and gas sector was also on the rise.

**In July 2006, Oil Traded at \$78.40 per Barrel**

## Rig Counts

**Rig Counts as a Measure of the Oil and Gas Industry's Confidence in its Own Future**

Relating the collapse in the crude oil price to its impact on rig counts will provide a good indication of the broader industry impact.

Rig count is the number of drilling rigs actively drilling wells in search of oil and gas. Drilling is a primary indicator of the amount of current capital being invested in the industry. Therefore, it is a measure of the oil and gas industry's confidence in its own future.

**1982 Industry Peaked**

As the Arab Oil Embargo ended in 1974, U.S. rig counts were at or below 1,500. Regulated crude oil prices created a steady increase in the rig count to over 2000 by 1979. The growth period from 1978 to the beginning of 1981 was in response to the sharp increase in domestic crude oil prices resulting from the rapid growth in world energy prices and deregulation of domestic prices. By 1982, a year after oil prices started to decline, the industry peaked and the rotary rig count indicated that the number of rigs had more than doubled. The rotary rig count is the average number of drilling rigs actively exploring for oil and gas.

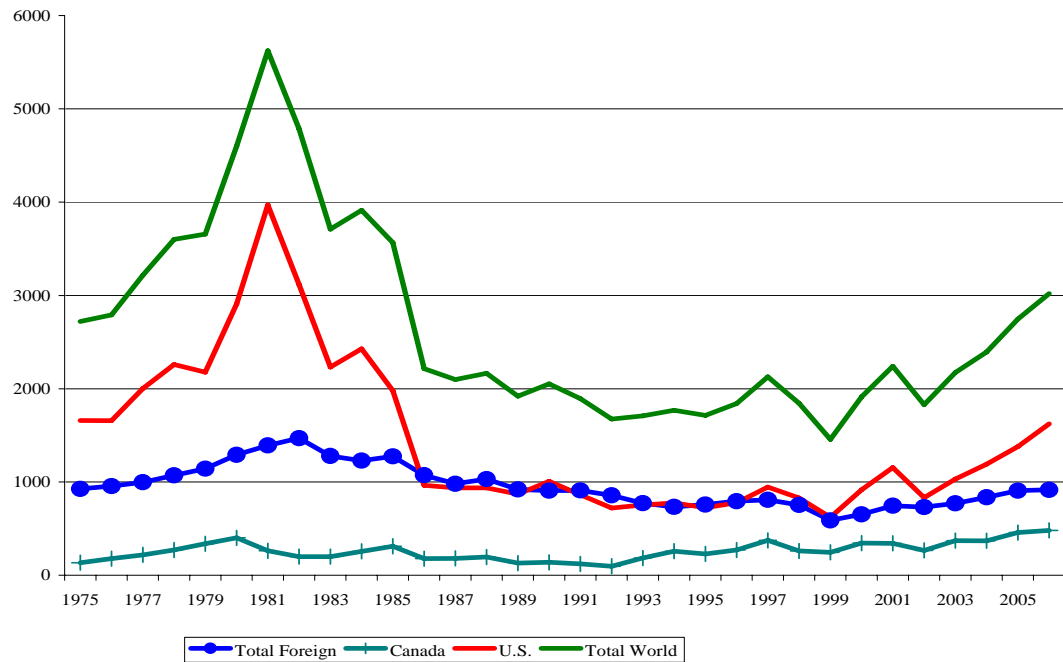
**Industry Response to 1986 Price Collapse**

The 1986 oil price collapse was followed by a sharp reduction in rig utilization resulting in high unemployment in the sector. This collapse, coupled with a significant slow down in exploration and production, drove an economic downturn for the industry. The industry responded to the 1986 price collapse by making advancements in technology with the main focus on reducing drilling risk and improving production rates.

Due to the increase in oil prices and desire to reduce dependency on Middle Eastern oil, the worldwide industry rig count rebounded to just above 3,000, slightly higher than the halfway mark when compared to the 1981 peak.

Currently Rig Counts are at 50% of their 1981 Peak.

World Rig Count 1975 - 2006



Source: Baker Hughes

As the price of oil increases, more exploration and production sites become economically viable and drilling increases. The manpower and technical expertise associated with drilling is significant and quickly increases the need for additional highly skilled employees. Unfortunately, given the cyclical nature of the industry, the demand for these skilled employees often exceeds supply. Historically, employees are trained during periods of high and increasing oil prices and laid off during slow periods. Since most workers cannot wait for the next peak period to get their jobs back, they naturally opt for different industries. These employment practices have created a negative image for the industry partially related to its cyclical and volatile nature.

## The Current Workforce

The demographics of the current workforce contribute to the current crisis in the upstream market. The following are key components of demographics that have an impact on the industry’s ability to grow and develop its workforce:

- Aging workforce
- Dwindling number of graduates
- Negative image
- Demand

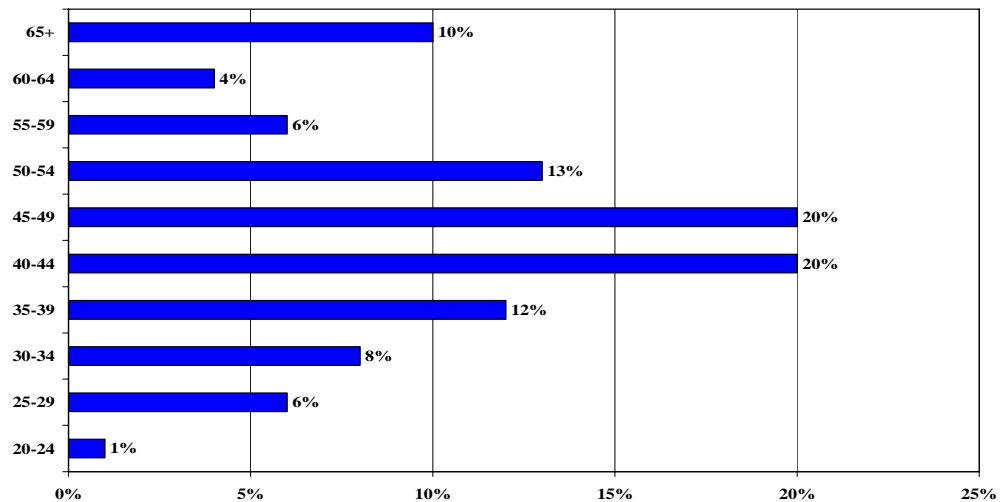
**The Average Age of a Technical Employee is 48-50 Years**

### *Aging Workforce*

The petroleum industry lost almost half a million jobs between 1982 and 2000 (API 2004 survey). The cyclical nature of the industry contributed to increased layoffs while hiring has been at an all time low since the early 1990s. Currently, the average age of an experienced employee in a management or technical position (e.g. petroleum engineer) is approximately 48 to 50 years.

As evident in the graph below, the impact of workforce reductions is not being addressed from the strategic viewpoint of long-term succession planning. The current domestic workforce composition reveals that the majority of employees are Baby Boomers.

**Oil and Gas Workforce Age Distribution**



Source: Society of Petroleum Engineers, 2003



## Impact of Baby Boomers Retirement

In 10 years, the first wave of 77 million Baby Boomers will start retiring. This wave of retirements could trigger the first decline in the white collar labor force in our nation's history; however, it is anticipated that many of them will continue to work even after they retire. There is an air of expectation and likely hope that these baby boomers will become consultants to their former industry.

## Generation X and Y

Unfortunately, many view this as a short-term fix that does not address the problem of replacing the Baby Boomer Generation with a Generation X workforce. Generation X totals only 46 million people. As a result, the industry may need to attract and cross-train the 30-something Generation X worker and encourage the Generation Y (those born from 1977-1994) to obtain a petroleum focused degree to avert the impending shortage coupled with increase in demand.

Ironically, one of the most significant employment perks of the energy industry, the pension plan, has accelerated the current crisis. These generous retirement packages have made early retirement a viable opportunity for a large portion of the workforce.

## Dwindling Graduates

### *Dwindling Number of Graduates*

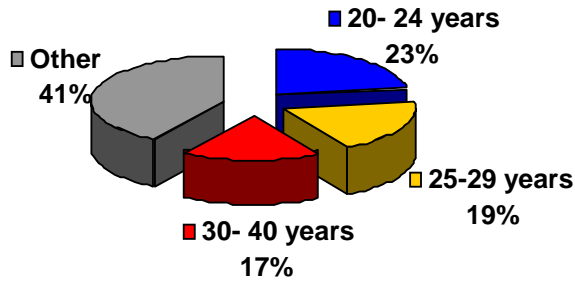
Still another challenge in today's market is recruiting candidates with the qualifications that are necessary to be successful and productive in the industry. The lack of graduates with the right qualifications has forced the market to hire individuals without the background needed to be immediately productive within an organization. This has added a significant cost component to the hiring costs in the upstream industry.

The cost cutting measures of the 1980s and 1990s eliminated broad bands of the Generation X and Y employees who would have otherwise been the natural choices for today's senior technical and management roles.

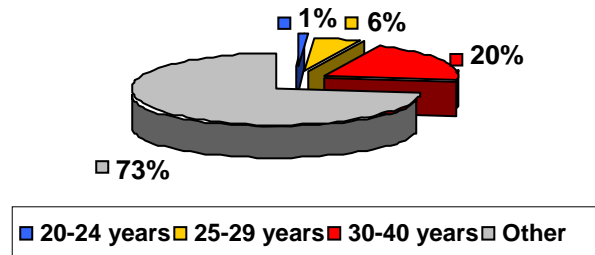
## An Industry Age Group Comparison

A comparison of the percentages of selected age groups in the energy industry and other technology industries provides compelling evidence for this case.

### Similar Technical Industries



### Oil and Gas



Source: Society of Petroleum Engineers, 2003

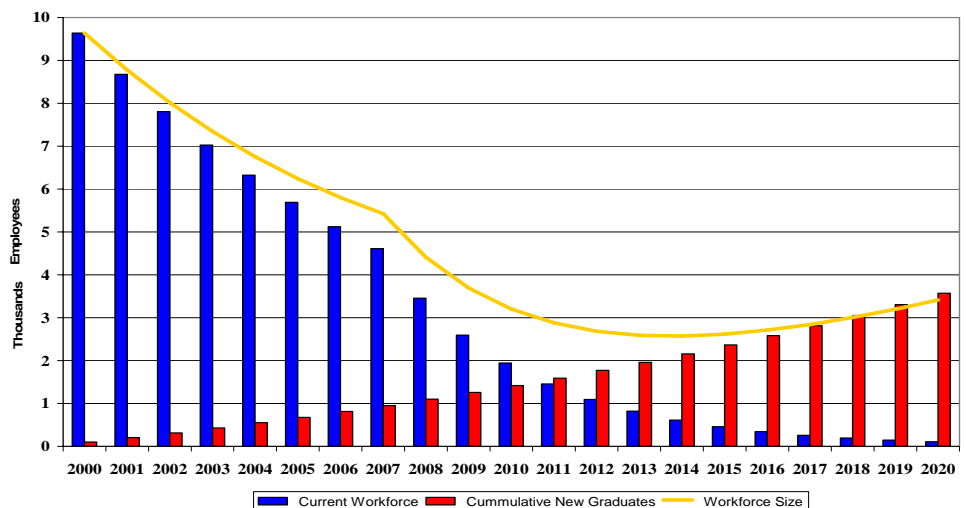
Only 27% of the Workforce is between 20-40 Years Old

The composition of the sector’s workforce is such that only 27% of the oil and gas workforce is 20–40 years old compared to 59% in corresponding technical fields such as the software industry.

In response to the ‘soft’ energy employment markets in the 1980s and 1990s, students had little, if any, interest in the energy industry. In fact, most schools eliminated their energy-related educational programs.

### U.S Petroleum Engineering Workforce

The Demand Supply Gap for Employees will Continue to Increase Over Time



Source: Petrostrategies, Inc



According to the previous graph, the first year the number of new graduates will exceed the number of skilled employees in the market is 2011. Experts agree this projected trend will not meet the industry's employment demand.

Presently, there are only 16 schools that offer petroleum engineering programs in the nation. Enrollment in U.S. universities for petroleum engineering programs stands at 1,500, which is down by 85% from its peak in 1982. Only approximately 8% of engineering graduates become petroleum engineers.

### Negative Image

#### *Negative Image*

The reduction in enrollment in energy programs has had an unexpected impact on the image of the industry. The energy industry reduced its profile as a competitive employer in the media and on college campuses across the country during downturns in the economic cycle. Without the need to hire, the industry allowed other voices to speak to generations X and Y. Unfortunately, the loudest voices were deeply critical of the energy industry. This backlash tainted the industry's image and continues to plague recruiting efforts today.

### Perceived as Low-Tech and Harmful to the Environment

As a result, the upstream oil and gas sector is perceived as a low-tech industry that harms the environment. The industry has not been able to turn this perception around despite the fact that the energy industry has played a major role in promoting health, safety and environmental development programs over the last 20 years. In addition, the industry is now more automated than ever.

Despite these advances, the word is not reaching college campuses. Upstream oil and gas graduates are unaware of the high tech focus of the energy sector primarily because information has not been effectively communicated at the college level or in many cases to the broader public.

### Increasing Demand

#### *Demand*

Presently, the industry is experiencing a period of explosive growth in demand driven by unprecedented modernization in China, and to a lesser extent, the entire Indo-Asian Pacific region. Geopolitical uncertainties including wars in the Middle East, shifts in South American politics, and increasingly aggressive Russian energy policies have driven price speculation to a near all time high.

Another factor in the rising demand for western oil is the dominance of national oil companies. According to one analyst report, about 77% of the world's 1.1 trillion barrels in proven oil reserves are controlled by

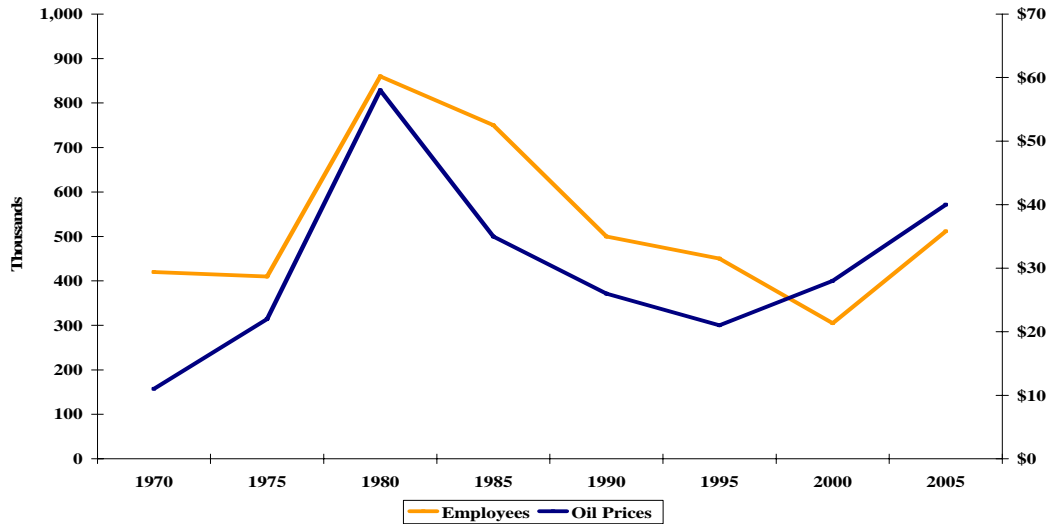
**90% of Rigs Drill for 6% of the World's Oil**

governments that significantly restrict access to international companies like Exxon Mobil, Shell etc. Over 90% of rigs are drilling for 6% of the world's oil in an effort to reduce dependency on the Middle East and other unstable, less developed countries. To put it in perspective, many of the wells in the U.S. produce as little as five to ten oil equivalent barrels per day. The more difficult it is to extract hydrocarbons, the more technical expertise is required; additionally, the price of oil dramatically impacts the financial viability of these low producing wells.

The impact that oil prices have on employment levels within the sector is well documented. The following graph reflects this relationship with a correlation coefficient of 0.78.

**Oil and Gas Industry Workforce and Oil Prices Relationship**

**The Correlation Coefficient Between Oil Prices and Industry Employment is 0.78.**



Source: Society of Petroleum Engineers, U.S. Bureau of Labor Statistics and WTRG Economics.

**Financial Impact Analysis**

The historical economic and operational conditions within the upstream oil and gas sector provide valuable insight into the reasons for the current workforce deficit. Now the intention is to estimate the financial impact this crisis will have and is currently experiencing on the upstream oil and gas industry. Additionally, this analysis will provide a framework for estimating the financial impact the employment crisis is having on individual companies or divisions.

#### Financial Impact Analysis:

- Direct Employee Cost
- Lost Profits from Lack of Experienced Staff
- Strategic Opportunity Cost

The financial impact analysis focuses on the following two areas:

- Direct employee cost
- Lost profits from lack of experienced staff

In addition, this analysis examines, at least anecdotally, the strategic opportunity costs associated with the employment crisis.

### Direct Employee Cost

Companies have adapted their human resource management strategies to cope with the challenges presented by the critical shortage of personnel, which has increased the cost of obtaining and retaining key personnel such as senior management, technical professionals, highly skilled field labor, and corporate staff.

#### Key Components of Direct Employee Cost

The following areas were identified as key components of direct employee cost:

- Hiring and replacement costs
- Training and lost productivity costs
- Compensation including the cost of:
  - Signing bonuses
  - Salary increases
  - Annual and long-term bonus increases

Estimating the increases in competition, the costs to train and obtain new employees, and the number of new employees will help to at least estimate the direct employee cost from the shortage.

#### Poaching and Hiring from Outside the U.S.

The lack of experienced professionals to fill the current industry demand has led to an environment of talent poaching within the industry. In order to retain experienced professionals, firms have various medium- and long-term incentive strategies to act as “velvet handcuffs.” Companies have responded by using “selective premiums” such as larger salary increases, increased bonuses, equity (typically restricted stock and not options) and long-term bonuses for highly valued jobs. Across the board, there has been an increase in bonus compensation and salary increases in many companies.

A company that loses employees despite “velvet handcuffs” enters into a recruiting and training cycle that has direct cost implications and a significant impact on operations.

Survey respondents indicated that current demand for skilled staff equates to an employment level increase of 10%. This 10% estimate already takes into account the 25%–30% attrition rate of their new hires.

**Positions Targeted by Talent Poachers**

Based on survey results, the following positions are often targeted by talent poachers. To estimate the financial impact, the analysis focuses on the direct costs associated with the hiring and retaining of these skill sets.

- Petroleum Engineers
- Petroleum Geologists
- Field Engineers
- Drillers

***Petroleum Engineers:***

The following table reflects the employment and compensation environment relating to petroleum engineers.

Petroleum Engineers Years of Experience	Industry		Survey	% Salary			Replacement Cost	
	Average Salary 2004	Average Salary 2005	Average Salary 2006	Increase 2005 2006	Signing Bonus	Incentives 2005	% of Salary	Cost
0-5 years	\$75,420	\$79,191	\$91,748		\$5,000	9,175	80%	\$73,398
5-10 years	\$75,420	\$79,191	\$91,748	16%		9,175	100%	\$91,748
11-15 years	\$95,930	\$100,726	\$116,699	16%		17,505	150%	\$175,049
16-20 years	\$111,374	\$116,942	\$135,486	16%		27,097	150%	\$203,229
21-25 years	\$113,889	\$119,583	\$138,546	16%		34,637	150%	\$207,819
26+ years	\$120,208	\$126,218	\$146,233	16%	\$150,000	43,870	150%	\$219,350

Sources: Society of Petroleum Engineers, Survey participants

**Average Salary Increase for 2006–16%**

Survey results indicate that salary increases for a petroleum engineer ranges from 10%–25%, dependent on the level of experience. The average salary increase in 2006 was 16%. Furthermore, the average attrition rate for a petroleum engineer with 10–15 years experience is 10% per year.

In the survey responses, many companies mentioned certain skill sets that were in high demand such as completions engineers, subsea engineers and reservoir engineers. A company surveyed responded that they were willing to pay a 50–60% salary increase in order to retain completions engineers. A service company reported that engineers with

specialized skills related to operations in the Gulf of Mexico were in high demand and were often poached by exploration and production majors for almost double their present salary.

**Anticipated Lack of Qualified Geologists**

***Petroleum Geologists***

The oil industry will continue to supply the world’s energy needs for many generations to come. Thus, there will always be a need for geologists. The industry is anticipating a lack of qualified geologists and geophysicists over the next five to ten years.

The following table reflects the employment and compensation environment for petroleum geologists.

Geologists Years of Experience	Industry		Survey	% Salary	Replacement Cost			
	Average Salary 2004	Average Salary 2005	Average Salary 2006	Increase 2005-06	Signing Bonus	Incentives 2006	% of Salary	Cost
0 - 2 years	\$67,800	\$74,400	\$82,770	11%	\$15,000	\$8,277	80%	\$66,216
3 - 5 years	\$75,600	\$81,300	\$90,446	11%		\$9,045	100%	\$90,446
6 - 9 years	\$77,500	\$95,400	\$107,325	13%		\$10,733	100%	\$107,325
10 - 14 years	\$107,500	\$114,400	\$132,132	16%		\$19,820	150%	\$198,198
15 - 19 years	\$116,000	\$119,600	\$139,633	17%		\$27,927	150%	\$209,450
20+ years	\$112,800	\$139,000	\$162,283	17%		\$40,571	200%	\$324,566
25+	\$128,300	\$134,100	\$156,562	17%		\$46,969	200%	\$313,124

Sources: Society of Petroleum Engineers, Survey participants

As an increasing number of employees retire over the next ten years the need for young, technologically oriented professionals in this dynamic industry will grow significantly.

A recent salary survey indicated that many major oil companies are paying up to \$15,000 in sign-on bonuses to hire entry level geologists with only a master’s degree. This increase in the compensation level for new hires has increased pressure to adjust the compensation packages for existing geologists with more experience.<sup>1</sup>

Survey results indicate that salary increases for geologists range from 10%–25%, based on the level of experience.

A geologist with 10–15 years experience earns \$135,000 per year and incurs training costs of approximately \$500,000. It takes at least three to four years to train an entry level hire to replace a geologist with this level of experience.

<sup>1</sup> Source: Society of Petroleum Engineers

**The Number and Quality of Field Engineers Employed has a Direct Impact on Annual Revenue**

**Field Engineers**

The number and quality of field engineers employed by a company has a direct impact on annual revenue. The demand for field engineers has increased significantly over the past few years. This increase in demand has had an impact on the hiring and compensation practices of the industry.

The following table reflects the current field engineer workforce market:

Field Engineers Years of Experience	Survey	% Salary	Annual Bonus	Replacement Cost		
	Average Salary 2006	Increase 2005 - 2006	During High Demand	Overtime	% of Salary	Cost
0-3 years	\$30,000	20%	\$50,000	\$54,700	100%	\$30,000
3-5 years	\$40,000	20%	\$50,000	\$54,700	200%	\$80,000

Source: Society of Petroleum Engineers, Survey Participants

The average base salary of a field engineer with two to three years experience is around \$30,000 per year, but under present conditions with increased activity an engineer can make \$350-\$400 per day in bonuses, working offshore. With fringe benefits are 30%-35%, the total cost to the company is \$150,000 per year.

**Significant Attrition Rate**

The attrition rate for field engineers is significant at 20%-30%. A factor that contributes to the high attrition rate is the fact that field engineers do not stay in these positions for more than five years. It takes one year to train a replacement and the cost of training an engineer with two to three years experience is \$200,000.

A service company reported that they plan to hire 6,000 employees in 2006 compared to 4,000 employees in 2005 and almost all of these employees will be field engineers and field technicians.

A drilling company reported that to encourage retention of their drilling engineers, they are offering a \$25,000 bonus after three years of service; furthermore, they offer a 20% salary increase after five years of service. The company also pays 100% of the healthcare costs of all employees.

**Drillers**

Companies reported significant shortages in experienced drilling personnel. There is a strong correlation between demand for drillers and a cyclical increase in the oil price.

Drillers Position	Experience level		Salary			% Increase from 2005
	Historical	Current	2004	2005	2006	
Driller			\$36,000	\$43,500	\$58,000	33%
Supervisor	5-6 years	2-3 years				
Accelerated Rig Development Programs	7-8 years	less than 4 years				

Source: Survey Participants

**Drilling Supervisors Lack Experience**

When the market is not in an upswing, as we are currently experiencing, a drilling supervisor would be required to have five to six years experience. However, due to the present shortage of experienced staff, drilling personnel are promoted to drilling supervisor within two to three years.

In response to the current upswing in the cycle, companies have started accelerated rig development programs. These development programs have historically been staffed with drillers with seven to eight years of drilling experience. Currently, these programs are staffed with drillers who, on average, have less than four years experience. The increased cost due to inexperience that is discussed in the next section.

Companies reported that the average salary increase for a driller ranges from 20%–50%.

**Quantification**

**Total Direct Employee Cost Estimated at \$2.2 Billion**

Two industry cost elements are quantified. The first is the total cost to retain an employee in the market today; the second is the cost associated with recruiting and training a new employee.

The first step to quantifying the industry cost to retain an employee in the market today is to calculate the incremental cost increase from 2005 to 2006, based on current compensation components. This incremental increase is multiplied by the total workforce.

The total cost to retain staff in 2006:

	2005 - 2006		2005 Total Workforce	Total Cost 2006 (000)
	Incremental Cost Increase			
Petroleum Engineer	\$40,011	7,280	\$291,281	
Petroleum Geologist	\$39,470	8,880	\$350,495	
Field Engineer	\$57,000	8,200	\$467,400	
Driller	\$14,500	18,440	\$267,380	
<b>Total Cost to Retain Staff in 2006</b>			<b>\$1,376,556</b>	

Sources: U. S. Bureau of Labor Statistics, survey results

The second cost component is the total industry cost to replace staff. This is calculated by multiplying the average replacement cost in 2006 by the sum of the attrition rate and new demand. Companies have reported sign-on bonuses for various highly valued skill-sets varying from \$5,000 to \$150,000, depending on experience and position.

The total industry cost to replace staff in 2006:

	2006 Average Replacement Cost	2005 Total Workforce	Attrition Rate	New Demand	Total Cost 2006 (000)
Petroleum Engineer	\$161,765	7,280	10%	10%	\$235,530
Petroleum Geologist	\$187,046	8,880	10%	10%	\$332,194
Field Engineer	\$55,000	8,200	25%	10%	\$157,850
Driller	\$46,400	18,440	10%	10%	\$171,123
<b>Total Cost to Replace Staff</b>					<b>\$896,698</b>

Sources: U. S. Bureau of Labor Statistics, survey results

We will add these cost components to the total cost analysis in the **Total Industry Cost** section on page 29.

## Lost Profits from Lack of Experienced Staff

### Costs Incurred Due to Operational Inefficiencies from Lack of Experienced Staff

The second category of costs included in the financial impact analysis is the cost incurred due to operational inefficiencies resulting from a lack of experienced staff. This includes the following:

- Lost and delayed projects
- Delayed geographic and market expansion
- Safety related cost
- Alternative staffing methods

While acknowledging the financial impact related to rig and other equipment shortages, the study’s main focus is on elements of project implementation and management such as project delay or cancellations, and related to the lack of geotechnical and other highly skilled labor as well as management expertise and lost profits from delayed geographic and market expansion. The delayed geographic or new market expansion component is primarily related to the oilfield service and equipment companies. An example of this might be delaying or cancelling an expansion into a new country or not executing a new product line expansion due to a lack of experienced staff. In addition, the study attempted to analyze the cost impact of alternative staffing methods such

as hiring consultants and contractors as well as the added costs associated with safety as a result of new hires with less training. These areas were a bit more challenging to quantify.

### Difficult to Quantify

While this category overall is difficult to quantify, we used survey results and industry averages to calculate a broad range that provides an indication of the magnitude of the lost profits. We utilized different analysis methodologies and approaches based on the data collected. Comparing the results of the different methodologies provided confidence that the magnitude of the estimates were reasonable.

### Project Cost

#### *Lost and Delayed Projects*

Combining findings from survey respondents with estimates of rig costs enabled us to estimate the cost of lost or delayed projects for both drillers and producers. The approach did not quantify the lost profits to the oilfield service providers that would provide services such as drilling fluids or drill bits. Additionally, this calculation assumes that project equipment did not present a barrier though many companies reported that obtaining equipment during periods of high activity was a challenge.

**“The best way to quantify the real cost of the problem is to imagine the industry without the shortage”**

There is an opportunity cost associated with a company’s inability to put one more rig in the ground as a result of limited supply of skilled staff. This cost can be measured by estimating the staff complement that would increase the employment percentage to close to 100%. While it is true that technological advances have led to reduced demand for human capital, survey respondents acknowledged that demand for highly skilled people to manage this technology is still significant. As one industry analyst stated, “the best way to quantify the real cost of the problem is to imagine the industry without the shortage.”

#### *Opportunity Costs for Drillers*

According to an industry analyst estimate, the market demand for additional rigs was 200 land rigs and 30 offshore rigs. Based on average rig rental rates per day for an inland rig of \$13,400 and average day rate for an offshore shallow water rig of \$85,000, and assuming a utilization rate of 85%, the revenue lost per year is \$1.6 billion. Applying the industry average profit margin of 14.6%, the annual pre-tax profits lost for drillers is \$237 million per year.<sup>2</sup>

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<sup>2</sup> Source: Capital IQ

Drillers	Margin (14.6%)	Avg. Day Rate/Rev	Rigs Needed	Rev/day (85% utilization)	Profits	Annual
Inland	0.146	13,400	200	\$2,278,000	\$332,588	\$121,394,620
Offshore (shallow water)	0.146	85,000	30	\$2,167,500	\$316,455	\$115,506,075
<b>Total Cost</b>						<b>\$236,900,695</b>

Source: Rigzones, Survey Results

### *Opportunity Costs for Producers*

If you assume every day a company is not drilling is a day of oil that is not generated following completion, the overall cost to producers is estimated to be \$1.9 billion per year. This calculation was based on \$59 per barrel oil price and an average rate of production of 30,000 barrels per day. Naturally, oil companies cannot take full advantage of this revenue potential if they do not have adequate human resources with the right types of skills. Therefore, companies are often faced with the choice of either losing the opportunity or placing unqualified people in charge of the project. Making a decision either way has a negative cost and operational impact on the company and industry.

**\$1.9 Billion per Year**

Producers	Margin (14.6%)	Avg. Day Rate/Rev	Rigs Needed	Rev/day (85% utilization)	Profits	Annual
Inland	0.146	\$25,000	200	\$4,250,000	\$620,500	\$226,482,500
Offshore (shallow water)	0.146	\$1,250,000	30	\$31,875,000	\$4,653,750	\$1,698,618,750
Off shore (shallow water)	0.146	\$1,212,329	30	\$30,914,384	\$4,513,500	\$1,647,427,500
Avg Shallow water						\$1,673,023,125
<b>Total Revenue to Producers</b>						<b>\$1,899,505,625</b>

Sources: Rigzones, Survey Results

### *Delayed Geographic and Market Expansion*

Service companies in particular have delayed expansion plans due to lack of trained employees to send into new markets. Producers have also delayed new fields due to a combination of a lack of resources from service providers as well as a demand for internal staff.

**\$3.6 Billion Opportunity Cost**

Based on survey results, most companies would like to increase their experienced workforce by 2.5%. When combining this with the fact that the average company generates \$1 million revenue per employee and has an EBITDA margin of 14.6%, the opportunity cost equates to \$3.6 billion<sup>3</sup>.

<sup>3</sup> Source: Capital IQ

	2.5%		<i>(workforce increase)</i>
x	1	million	<i>(workforce)</i>
x	1	million	<i>(average revenue per employee)</i>
x	14.6%		<i>(average operating income)</i>
<hr/>			
			\$3.625 billion

*Note: This analysis was based on total employees and not just U.S. based employees*

### ***Alternative Approach–Impact on Profit Margins***

Approaching the estimation of lost opportunity costs from a different perspective, results in a similar answer. Industry analysts estimated that these lost opportunity costs were costing the sector between 100–300 basis points of profitability (1%–3% of operating income). Assuming the industry generates revenues of \$1.5 trillion, based on publicly traded U.S. companies with a total enterprise value of more than \$500 million, the impact from lost and delayed project and expansions as well as efficiencies is between \$1.5 billion and \$3 billion annually.<sup>4</sup>

**\$1.5–\$3 Billion Annually**

### ***Summary of Lost Profits from Lack of Experienced Staff***

The analysis approach based on lost or delayed projects yielded a value of \$2.1 billion. The analysis approach based on shortage of employees multiplied by profitability ratios indicated a value of \$3.6 billion and the analysis approach based on the impact of profit margins yielded a value of between \$1.5 and \$3 billion. Although this is a broad range and these results are by no means precise, all of these analyses overlap in their result and provide some confirmation of the magnitude of the problem. On the conservative side, the impact of profit margins is more likely in the range of \$2–\$3 Billion per year in pre-tax earnings.

**\$2–\$3 Billion**

<b>Approach</b>	<b>Value</b>
Lost/Delayed Projects	\$2.1 Billion
Shortage of Employees	\$3.6 Billion
Impact of Profit Margins	\$1.5 Billion
<b>Pretax Earnings</b>	<b>\$2–\$3.2 Billion</b>

**Safety-Related Costs**

### ***Safety-Related Costs***

This is another area for which the survey and study did not quantify the financial impact. Data collected indicates that safety-related cost is a factor and the guidelines below may help management to quantify the internal impact on their organization.

<sup>4</sup> Source: Capital IQ

**51.9% of Work Related Accidents Involve Employees with Less Than One Year Experience**

Despite the introduction of aggressive health safety and environmental programs (HSE) in virtually all companies across the sector, there is still a strong correlation between the number of accidents and levels of employee experience. According to OSHA, 51.9% of work-related accidents in the oilfield service sector involve employees with less than one year of service experience.

**Contract Workers Impact**

The accelerated rig development programs for drilling supervisors, which have reduced the minimum training requirement from seven or eight years to less than four years is a prime example of the source of this problem. Integrated oil companies and even some service companies indicate that they rely more heavily on contract employees. Although these employees may have work experience, they do not have experience in the companies' safety procedures.

**Safety Record a Factor in Sselecting Vendors**

Many of the respondents stated that since their safety records for 2005 had improved and had been on a positive trend for the past few years, management did not think this was an issue; however, industry trends and requirements may be masking the real impact.

Over the past five to ten years, many oil and gas production companies have increasingly considered their drillers and other service providers' safety record as a major factor for selecting vendors. In response to this, and the overall heightened awareness and pressure from insurance providers, government agencies and even the community, companies have dramatically revamped and upgraded their safety training awareness and enforcement programs. These factors may be even more successful if the industry had not been forced to hire less skilled workers.

One survey respondent explained that in 2006, for the first time in five years, the company has seen a rise in its recordable accidents. When correlating this trend to the increased number of new hires, many with little or no experience, they found it highly likely to be the cause of the increased accident rate. Increased accidents increase both claims and insurance rates. Additionally, in today's environment it might cost service providers a project or job.

According to rigzone.com<sup>5</sup>, the day rate of a jack-up (rig) was \$35,000 (\$46,000 in 2006 dollars) at the start of 1996. It is estimated that the figure will increase to nearly \$73,000 by the end of 2007, a 100% increase. This analysis factors in increased utilization over the period. Revenue generated will vary according to utilization levels. While it is

<sup>5</sup> [http://www.rigzone.com/analysis/rigs/insight.asp?i\\_id=218](http://www.rigzone.com/analysis/rigs/insight.asp?i_id=218), April 2006.

true that safety-related issues may not bring a project to a standstill, they could affect profitability.

**Retention Programs May Reduce Accidents**

The strong correlation between inexperience and number of accidents indicates that the number of work related accidents can be reduced through improved retention programs.

**Consultants and Contractors**

***Alternative Staffing Methods***

The shortage of qualified employees has forced the industry to resort to alternative recruitment practices such as the use of contractors, consultants and outside vendors. While these strategies yield favorable results in the short-term, they are not sustainable and may hurt the industry in the long run.

**Cost to the Industry**

Certain survey respondents indicated contract employees command an hourly rate that is at a 50% premium to a full-time employee's compensation. One survey respondent indicated that vendors alone were costing them between 10%–15% of their project margins. It is a common trend in the energy sector for executives to retire but stay on as consultants at a higher hourly rate than they earned at retirement. This trend will continue for some time as the industry continues to age. However, in addition to the short-term costs, there is a significant shortage in the talent pool that may only increase, given the current demographics. The study was not able to capture enough data to quantify the financial impact of this area but it is a factor that should be considered.

**Strategic Opportunity Cost**

**Lack of Long-Term Strategic Vision and a Short-Term Tactical Approach to Management**

The workforce crisis is partially a result of a lack of long-term strategic vision and a short-term tactical approach to management. This analysis was not able to quantify the financial impact of the lack of strategic vision, but it attempts to identify some of the causes for it as well as point out the potential medium-term and long-term implications of a lack of strategic vision.

**Executive Management Narrow Focus**

***Shortage of Executive Management***

Given the current high level of demand combined with voluntary and involuntary attrition in the industry, strategic vision is lacking and the effect will be felt in the future. Experts say strategic vision is lacking as a result of executive management with a narrow focus, with little experience outside the energy industry and an industry history of compensating below what is considered market related. These factors not



only discourage executive level talent from entering the industry, but the industry itself is well known for hiring from within its ranks, thereby exacerbating the lack of strategic vision. Additionally, the industry is so stretched for resources that it does not have the resources to focus on long-term strategy and planning.

Survey participants reported a lack of experienced management professionals in the energy sector had increased limitations in the company's ability to thoughtfully invest in the future of their businesses. The near term requirements were so demanding with the available human capital that there was little ability to truly focus on the long term. In answer to the question, "If you could go back in time and change your strategic goals what would you change?", a survey participant simply stated "Hire from outside the industry".

### Hire from Outside the Industry

Our energy assets are aging and the technologies and methodologies required to continue to obtain cost-effective production need to change to account for the challenges associated with production declines and increasingly difficult geologies that are now being drilled. New technology and innovation are the most hampered by a lack of strategic vision or leadership. Hydrocarbon exploration and production is one of the most technologically challenging industries in the world and to continue to meet the challenges, leadership must be innovative and continue to develop and adopt these new strategies and look beyond hydrocarbons.

### *Executive Management Research*

An analysis of the educational and career background of executives in the Fortune 100 companies provides insight into the foundation for the lack of strategic vision in the oil and gas sector.

### Executives Lack Outside Experience

The research indicates a majority of the executives in the energy sector have backgrounds in chemical engineering, geology or petroleum engineering. Further, most of the executives have spent their entire professional careers in the energy sector, some in the same company with fewer than 10% having experience outside the oil and gas sector.

In sharp contrast was the educational and career background of executives from the balance of Fortune 100 companies. The majority of the executives had master's degrees in business or finance. Unlike the oil and gas industry, the executives of the Fortune 100 companies had experience in more diverse industries.

### Need Management/Leadership from Outside the Industry

This information confirms survey responses that bringing more management/leadership from outside the energy sector could alleviate the current and future issues in the workforce. Most of the companies responded that they would prefer their executive level managers and operational managers to be from within the industry and have a strong technical background. In light of the workforce crisis, these companies were willing to hire professionals in finance, accounting and human resources management from other industries. Some respondents did acknowledge that bringing in a different perspective in strategic roles could benefit the company and the industry as a whole.

### Feeling the Impact

#### *Summary*

The impact of the lack of vision is beginning to be felt due to aging pipeline assets that were not maintained at British Petroleum, the lack of ability to effectively drill in some of the more complex geological areas where significant oil and gas has been discovered, and the shortage of talent that has been exposed by the significant employment declines in the 1980s that was not repaired during the 1990s. Some of the impact will never truly be tangible; it is the inefficient cost structures that exist today in an attempt to meet demand. When profits are as high as they were in 2005 and 2006, employees and investors are not going to notice that an extra 2% of profit margin was not realized. However, it will be noticed if or when oil prices decline or other energy technologies are required and profits turn to losses. The fear is that the industry will react inappropriately because it did not have the vision to plan for the future and the work force crisis will further intensify as the remaining top performers leave the industry.

### Hydrocarbons and Declining Oilfields

The impact of hydrocarbons on global warming and declining fields in most developed countries implicates that the energy sector may need to change its business model more quickly than is expected. The vision needs to be well under way now or other players will fill the void left by today's hydrocarbon exploration and production companies.

## Potential Current and Long-Term Solutions

### Increasing International Workforce

#### *What is the Industry Doing Today*

**Increasing International Workforce**—Survey responses indicated companies with a global business and global access to employees were having an easier time recruiting qualified workers. Many were hiring a significant number of employees from abroad and mentioned Russia or the former Soviet Union, China, India, Nigeria, Indonesia, Egypt and Jordan. Domestic based companies with operations primarily in the U.S.

indicated the workforce shortage was much more severe than those that had access to or a desire to utilize an international workforce. Another practice mentioned was to target people who are leaving the military and recruit them into the oil sector.

### Increasing Compensation Rates

**Increasing Compensation Rates**—As these findings have indicated, many companies are increasing salary and overall compensation rates to attract and retain employees.

### Recruiting Practices and Industry Image

**Recruiting Practices and Industry Image**—Many survey respondents discussed an increase in recruiting efforts at universities with Engineering and Geology programs regardless of whether the programs were focused on petroleum. Others mentioned internships for students during their college career as well as co-sponsoring programs with universities to increase awareness of their companies and the industry overall.

### Promoting Earlier

**Promoting Earlier**—The trend is to promote field engineers to drilling engineers in half the time proposed in the 1980s. Today many drilling engineers are promoted with two to three years of experience instead of the more traditional five to seven years.

### *Other Potential Solutions*

Given the amount of money that is being lost as a result of the crisis the industry has the opportunity to be creative with potential solutions. Those in the industry are counting on executives to realize short-term savings from mass layoffs need to be carefully considered with the long-term impacts on the company and the industry. Although the purpose of this study is not to identify a solution, a few ideas collected through interviews and research seemed worthy of highlighting.

### Best in Class Recruiting and Training

**Best in Class Recruiting and Training**—Although some of the integrated oil companies have a fairly robust recruiting program at the college and graduate school level, it is not a major focus for the industry.

- The investment banking and consulting industries have created a world class recruiting and training “machine” at both the undergraduate and graduate levels. The energy sector might be able to identify some successful practices from studying these models.
- Transferring these approaches to the high school level, fostering students through college and utilizing them in the summer might really help to build the bench and improve the industry image.

- Partnering with Universities and sponsoring new programs, possibly even starting a few new petroleum based engineering and geology programs will help increase the number of trained new hires and increase awareness for the industry. On a smaller scale, many universities would be willing to partner with companies for employee training programs.

### Building the Bench Today

**Building the Bench Today**—Many companies have started to do this, but there may be some unique opportunities to cross-train younger employees from other industries. The industry has had a lot of success with ex-military employees and there are other possibilities as well.

- Capitalize on the reduction of employees in other industries such as automotive manufacturing and computer manufacturing and proactively hire and retrain these individuals.
- Hire mid-level managers from outside the industry to improve the management bench which is projected to be very bare within the next five to ten years. Often employees that have been retrained by a company feel more loyal to the company because the employee sees the investment the company has made in their future.

### Total Industry Cost

When the total costs from the first two conceptual categories are combined, the magnitude of the workforce crisis is evident, notwithstanding the record revenues of the industry.

**Direct Employee Cost** **\$2.2 billion annually**

**Lost Profits from Lack of Experienced Personnel** **\$2–\$3 Billion annually**

In order to translate these costs into a dollar impact on shareholders, the analysis utilized a valuation or trading multiple methodologies based on industry EBITDA multiples. The following assumptions were made:

- An industry average EBITDA of 7.8x – 8.8x<sup>6</sup>
- Analysis utilized the low end of the lost profit range

<sup>6</sup> Capital IQ, November 2006

**Impact on Shareholder Value  
is Estimated at \$33 Billion–\$46  
Billion**

Based on this methodology, the overall impact to shareholders in terms of overall market value is **\$32.7–\$45.8 billion** annually. This impact on shareholder value does not include the cost impact of the third conceptual area; strategic opportunity cost. Although this cost component is significant for certain parts of the industry, it was not quantified in this study.

The self-imposed workforce costs burdening the industry reveal the potential benefits of changing the long-term strategic industry focus. The most obvious strategic changes include ensuring a diverse workforce, continuous broad public relations, and focused investment in potential future employees. These concepts are not profound in nature, but represent the basic philosophy that responsible companies are managed to maximize shareholder value for the long term and not for a given period. This maxim includes the requirement to effectively manage the workforce.

## **Conclusions**

Should the energy industry fail to address the long term impacts of the workforce crisis, the damage will come in the form of market corrections and diminished domestic energy security. There is currently increased globalization of the domestic energy industry.

The increasing trend towards offshore functional operations begs the question, “Where will it stop?” The labor crisis is an international crisis; however, it might be an even bigger domestic crisis because the most severe shortages, especially for new hires, seem to be in the U.S. The move to shift operations overseas may continue until the U.S. and Houston are left with an inconsequential presence in the global energy marketplace. The implications of such a shift are too many to enumerate here, but it is certain that the damage to our domestic energy industry would greatly diminish our standing as a superpower. The effects would reverberate in the future as well. Without the human capital to maintain the current energy industry, we give up many of the critical tools necessary to shape the transition to the energy landscape of the future.

The returns on an investment in the workforce in the oil and gas industry are not just financial, but economic and social as well. A long-term approach to workforce management would have a stabilizing effect on market values of industry constituents and the price of energy itself. With the cost of responsible workforce management shared, the economic benefit of a stabilized market is a significant return.

The broader social impact of effective management may be of lesser concern to the industry management than the fiduciary responsibility they owe to shareholders, but an argument exists that the social impact of poor management decisions are ultimately the most costly. The negative image of the industry may be attributed to environmental or geopolitical causes, but those familiar with the industry know that energy is not unique in its impact on these issues. The energy industry stands out primarily because it has alienated itself. The lack of a relationship with the public has left the industry without defenders and a significant group of detractors in a political environment that thrives on victims and scapegoats.

Wealthy shareholders are notoriously poor advocates while a disgruntled former employee may carry a lasting message. This is unfortunate because the benefits of a strong and healthy domestic energy industry are vital to the country's shared domestic livelihoods.