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Mortality Statistics for the US Upstream Industry: An Analysis of Circumstances, Trends, and Recommendations

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Abstract

Introduction: The U.S. oil and gas extraction industry has an elevated occupational fatality rate when compared to other industries, and this rate is correlated to the level of activity in the industry. This paper presents an analysis of worker fatalities in the U.S. oil and gas extraction industry for the years 2003-2008 and suggests strategies to prevent fatalities among the groups of workers most at risk of being killed on the job. **Description of Processes:** Fatality rates were calculated by year, company type, and company size. The frequency of fatal events onshore and offshore, by occupation, age group and contributing factors are also reported. **Results:** There were 648 fatalities in the oil and gas extraction industry during 2003-2008; the majority (91%) occurred to onshore workers. Transportation-related events were the leading cause of death for all workers. Drilling contractors and companies that employed fewer than 20 workers had the highest fatality rates. **Conclusions:** This study found that the fatality rate in the oil and gas extraction industry remained elevated through 2008. Many of the fatalities were associated with three risk factors: seat belt non-use, workers being employed by small companies, and workers having been employed less than one year by their current company. Concentrating attention on these three risk factors could significantly decrease the number and rate of occupational fatalities in the oil and gas extraction industry. The recommendations made in this paper can be implemented by companies at low or no cost and can be incorporated into existing safety and health policies and procedures.

Introduction

The U.S. oil and gas extraction, or “upstream”, industry continues to have one of the highest occupational fatality rates of any U.S. industry. During 2007, 122 oil and gas extraction workers died on the job, resulting in a fatality rate of 28.5 deaths per 100,000 workers. This rate is over seven times higher than the rate for all U.S. industries (4.0 per 100,000), and almost three times higher than the fatality rate in the construction industry (10.8 per 100,000) during the same time period (U.S. Bureau of Labor Statistics 2010). The high fatality rate in the oil and gas extraction industry may be a result of many factors, such as exposure to hazardous environments and conditions, physically demanding work, frequent contact with heavy tools and equipment, inexperienced workers, and long hours.

According to the U.S. Bureau of Labor Statistics, the number of workers in the oil and gas extraction industry increased every year between 2003 and 2008, occurring in parallel with an increase in the number of active drilling and workover rigs. Between 2003 and 2008, there was a 62% increase in the number of workers employed in the oil and gas extraction industry (U.S. Bureau of Labor Statistics 2009) and a 46% increase in the number of active drilling and workover rigs (Baker Hughes and Guiberson 2008). Since 2003, the oil and gas extraction fatality rate has varied from year to year, making it difficult to see a clear trend of increased or decreased fatality for workers in this industry. It has, however, been demonstrated previously that the fatality rate for oil and gas extraction workers is correlated with an increased level of activity in the industry, reflected by more active drilling and workover rigs (Curlee, Broulliard et al. 2005; Mode and Richardson 2006; Mode and Conway 2007; Mode and Conway 2008). The reasons for this correlation are thought to be the result of more inexperienced workers, longer work hours leading to worker fatigue, and work on more hazardous, older rigs in times of high demand.

Company size has also been shown to be correlated with fatality rates in several industries, including oil and gas extraction (Hill, Conway, Somervell 2009). Research shows that the smaller the company, the higher the fatality rate for their workers is

likely to be. In addition to oil and gas, this has been shown to be the case in construction (Buskin 1987; Derr, Forst et al. 2001), mining (National Institute for Occupational Safety and Health 2008), landscape and horticultural services (Buckley, Sestito et al. 2008), and logging (Scott 2004). Research shows that the type of extraction company also plays a factor in fatality rates. Previous research found that, during 2003-2007, drilling contractors had the highest rates of fatality (48.8 per 100,000), followed by service companies (34.1 per 100,000), and operators (15.4 per 100,000). The purpose of this paper was to explore the current trends and circumstances of death in the oil and gas extraction industry, to identify risk factors, and to suggest possible strategies to prevent additional fatalities.

Description of Processes

Data from the Bureau of Labor Statistics' (BLS) Census of Fatal Occupational Injuries (CFOI) program were used to describe occupational fatalities. CFOI is a cooperative program between Federal and State governments to collect information on, and counts of, all fatal work-related injuries. Multiple data sources are used by CFOI, including OSHA reports, death certificates, workers' compensation reports, police reports, news media, and State and Federal agency administrative reports. Cases are determined to be work-related only when confirmed by at least two independent data sources. For a death to be included in CFOI, the decedent must have been employed at the time of the event and engaged in a legal work activity, either on or off the employer's premises. Deaths that occur during an employee's regular commute to and from work are not included.

All deaths in CFOI are assigned an industry code based on the North American Industry Classification System (NAICS) to classify the industry that employed the decedent. For this analysis, all fatalities that occurred during the years 2003-2008 and were assigned one of the following NAICS codes were included: 211 (oil and gas operators), 213111 (drilling contractors), and 213112 (service companies). These three NAICS codes make up what is frequently referred to as the "exploration and production" or "upstream" part of the oil and gas industry and will be referred to as the oil and gas "extraction" industry in this paper. Variables which were analyzed included year, company size and type, event type, age, race, Hispanic origin and source. To be consistent with other similar research, "small" companies were those with fewer than 20 employees, "medium" companies employed 20-99 employees and "large" companies were those with 100 or more employees. A key word search in the narrative for "offshore", "ship" or "boat" was used to identify fatalities to offshore oil and gas extraction workers.

To calculate fatality rates, worker estimates from the BLS' Quarterly Census of Employment and Wages (QCEW) program were used. The QCEW program publishes employment counts by NAICS code. These counts are tabulated from monthly employer reports and include all workers covered by state unemployment insurance laws or for federal workers, the Unemployment Compensation for Federal Employees program.

This study has several limitations. First, the rates presented in this paper were calculated using the number of workers as the denominator rather than the total number of hours worked, which provides a better estimate of a worker's exposure to occupational hazards in industries where overtime is common. Hours worked data were not available for the three NAICS codes described above. As a result, the fatality rates presented in this paper may be slightly higher than if calculated using an estimate for the total hours worked as the denominator. Another limitation of this analysis is the number of fatalities for which company size data were missing. There were 105 fatalities (16%) for which company size of the decedent was not reported. If this information were complete, there might be more or less dramatic differences in the fatality rates between companies of different sizes. A final limitation is the lack of available data describing the characteristics of the workforce. For example, the number of workers by age group, ethnicity, and length of service for the industry were not available. As a result, rates were not calculated for these variables, which might have shown differences in the risk of fatality within these groups.

Presentation of Data and Results

A total of 648 oil and gas extraction workers were killed on the job during 2003-2008, resulting in an occupational fatality rate of 29.1 deaths per 100,000 workers for the entire time period. The annual occupational fatality rate for the oil and gas extraction industry remained elevated between 2003 and 2008, but experienced a slight decrease during 2007-2008 (Figure 1). The total number of rotary rigs increased every year during this time period, as did the number of workers employed to work those rigs. There was a concomitant increase in the number of fatalities as well; fatalities increased 41% from 85 deaths in 2003 to 120 deaths in 2008. The authors found a statistically significant correlation between the annual average number of rotary rigs and the annual fatality rate during 1993-2008 (Figure 1; Pearson correlation coefficient $r=0.57$; $p<.05$) indicating a possible direct relationship between the number of active rotary rigs and the industry's fatality rate.

Of the 648 fatalities that occurred in the oil and gas extraction industry during 2003-2008, 592 (91%) were to onshore workers and the remaining 56 (9%) were to offshore workers (Table 1). Almost one-third of fatalities to onshore workers

were due to highway motor-vehicle crashes (32%), which include crashes on all public roads but not in parking lots or on industrial premises. Of the 190 highway crash fatalities, half (50%) occurred among workers operating pick-up trucks and over one-quarter (28%) occurred among workers operating large trucks including dump trucks, semi or tractor trailers or trailer trucks. The majority of fatal crashes (65%) occurred on rural state/US highways excluding interstates, freeways or expressways. Over one-third of the crashes (38%) were non-collision events where the vehicle jack-knifed or overturned. In 40% (76) of cases, no seat belt was worn by the decedent. Another 19 fatalities resulted from the worker being ejected from the vehicle; which would indicate by inference that the victim was likely not wearing a seatbelt. Excessive speed was noted as a factor in 19 (10%) deaths. Poor weather such as ice, rain and fog were a factor in 17 (9%) deaths. Another 12 (6%) fatalities occurred among workers who fell asleep at the wheel. For offshore workers, the most frequent fatal events were also related to transportation. Helicopter crashes resulted in 23 (41%) of the offshore fatalities during 2003-2008.

Being struck by an object was the second leading type of injury fatality for all oil and gas extraction workers, resulting in 20% of deaths for onshore workers and 23% of deaths for offshore workers. Among those workers who were struck by an object, 30 (23%) were struck by metal or other heavy pipes and another 25 (19%) were struck by machinery or other equipment. For onshore workers, the third most common fatal injury events were explosions (9%), followed by being caught or compressed in machinery (8%), and falls to lower levels (7%).

The occupational fatality rate in the oil and gas extraction industry varied by both company type and size during 2003-2008 (Table 2). Overall, drilling contractors had the highest fatality rate (45.8 deaths per 100,000 workers), followed by service companies (33.3) and oil and gas operators (15.0). Likewise, small companies experienced the highest fatality rate (65.5 deaths per 100,000 workers), followed by medium (23.4) and large companies (13.4). When both the company type and size were examined (cross-tabularly), it was the small drilling contractors that were found to have the highest fatality rate (211.7 deaths per 100,000 workers), a rate more than 7 times higher than the rate for the entire oil and gas extraction industry.

Other risk factors related to these fatal events were examined. Of those deaths where length of service with the employer was reported, more than half of those workers who died on the job had been with their employer for one year or less. Almost one-fifth of workers who died were of Hispanic origin (19%) or under the age of 25 (18%). Occupation of the worker was listed for 80% of fatalities. Truck drivers had the largest proportion of deaths (69, 11%), followed by first-line supervisors (52, 8%), rotary drill operators (49, 8%), roustabouts (49, 8%) and derrick operators (47, 7%).

Conclusions

The oil and gas extraction industry continues to have a high fatality rate that is correlated with the level of activity in the industry. During the time period examined here, there was a dramatic increase in both the number of active rotary rigs and the number of workers employed in the industry. This increase in drilling activity resulted in an increase in the number of fatalities and an elevated fatality rate, particularly among small companies and drilling contractors.

Although the fatality rate in the industry remains elevated when compared to other U.S. industries, opportunities for readily preventing fatalities and reducing the industry's fatality rate do exist. This paper has identified the recent trends in fatalities in the industry as well as key risk factors that should be targeted by safety and health professionals. The three key measures that should receive additional attention by both industry and other agencies with an interest in occupational safety and health in this industry include: 1) assuring the routine use of seatbelts by all workers; 2) increased attention to the safety and health of workers employed by small companies; and 3) increasing training and/or more attentively supervising workers with less than one year's tenure with their current employer.

Our analysis found that nearly half of all motor vehicle-related fatalities in the oil and gas extraction industry occurred to workers who were not wearing their seat belt at the time of the crash. Seat belts have been proven to substantially reduce injury in a motor vehicle crash (NHTSA 2008) and are readily available in all recent vehicles, and retrofittable to older ones. Their lack of use points to a continued need for initiatives targeting the use of seat belts in the oil and gas extraction industry. Although many oil and gas extraction companies have seat belt policies in place or have incorporated seat belt use into larger transportation safety programs, the persistence of these preventable tragedies demonstrates that there is a need for increased attention and enforcement of seat belt use by all workers. Companies that have installed in vehicle monitoring systems should use the data collected by those systems to identify the workers that need additional coaching about their seat belt use behavior. Companies should include all drivers in their motor vehicle safety programs, as our analysis has shown that the most common type of vehicle involved in fatal crashes were pickups, rather than large trucks driven by commercially-licensed truck drivers.

Increased attention must also be paid to workers employed by small companies in the oil and gas extraction industry. Workers employed by small companies were almost five times more likely to have died at work during 2003-2008 than those workers employed by large companies. In addition to being exempt from many federal occupational safety and health

regulations (U.S. Department of Labor 2008), small companies (those with 10 or fewer workers) may lack the resources to employ full-time safety and health professionals. Workers at small companies may also work on older rigs with fewer safety controls and drive older motor vehicles lacking airbags or rollover protection. Therefore, oil and gas companies who hire small contractors should recognize that workers employed by these companies may need additional training to safely complete the job that they have been hired to do. Oil and gas companies should work with their small contractors to identify the hazards that their contractors may encounter, ensure that appropriate pre-job training is provided, and make their safety and health professionals available to provide outreach and assistance to those small contractors that do not have a safety and health professional on staff. Finally, oil and gas companies should encourage their small contractors to stop a job if they identify safety and health problems and bring them to the attention of the company man or rig supervisor without retribution from the company that hired them.

Another group of workers that require additional attention are those with less than one year of service with their current employer. Workers meeting this criterion made up over half of all fatalities in the oil and gas extraction industry during 2003-2008. Oil and gas companies should recognize that new workers may be more at risk of being killed on the job and should take measures to provide those workers with additional training, education, mentoring, and active supervision. Standardized, industry-developed training programs have been developed and are readily available for the oil and gas contractor community (Remisio and El-Farmaoui 2008; Ingram and Smith 2009). Workers that successfully complete such programs will have achieved a minimum level of competency in key safety and health topics related to their industry. Identifying an experienced mentor for each new employee is a strategy that can be used to provide job and site-specific training to new employees. If a formal mentoring program is not realistic, assigning an experienced worker to help ‘watch out’ for a new employee during their first year with the company may be a useful alternative.

Concentrating attention to seat belt use and better supporting key safety proficiencies in workers employed by small companies and workers employed less than one year with their current company could significantly decrease the number and rate of occupational fatalities in the oil and gas extraction industry. Most of the recommendations made above can be implemented by companies at low or no cost and can be incorporated into existing safety and health policies and procedures.

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Tables

Table 1: Number of Fatal Injuries by Type of Injury Event, Onshore and Offshore, U.S. Oil and Gas Extraction Workers, 2003-2008

Onshore

Injury Event	Fatalities	% Total
1) Highway crash	190	32.1
2) Struck by object	118	20.1
3) Explosion	52	8.8
4) Caught/compressed in machinery	45	7.6
5) Fall to lower level	40	6.7
Other	147	24.8
Total	**592**	

Offshore

Injury Event	Fatalities	% Total
1) Helicopter crash	23	41.1
2) Struck by object	13	23.2
3) Water vehicle incident	8	14.3
4) Other	12	21.4
Total	**56**	

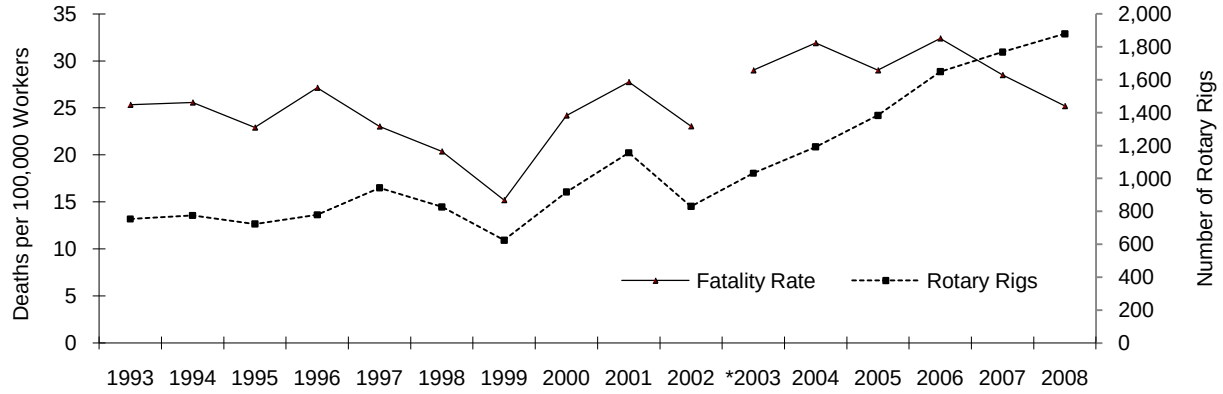
Table 2: Rate of Fatal Injury by Company Type and Size, U.S. Oil and Gas Extraction Workers, 2003-2008[1-4]

Company Type	Small (0-19 workers)	Medium (20-99 workers)	Large (100+ workers)	Total
Operator	28.2 (47)	9.6 (18)	5.3 (23)	**15.0 (121)**
Service Company	72.0 (136)	25.2 (90)	18.1 (69)	**33.3 (329)**
Drilling Contractor	211.7 (72)	47.0 (39)	20.8 (49)	**45.8 (198)**
Total	**65.5 (255)**	**23.4 (147)**	**13.4 (141)**	**29.1 (648)**

[1] Company size is derived from the BLS/CFOI field "Establishment Size", which identifies the number of workers employed by a company in a specific region and is not necessarily the size of the entire company. [2] Rates calculated per 100,000 workers. [3] Data in parentheses are the number of fatalities. [4]The total column includes 105 fatalities for which the company size is unknown.

Figures

Figure 1: Rate of Fatal Injury and Rotary Rig Activity, U.S. Oil and Gas Extraction Workers, 1993-2008[1-3]



[1]Break in line during 2003 indicates change from Standard Industrial Classification Codes (SIC) to NAICS. [2]Fatality rate per 100,000 workers.