January 2013

Safety On A Drilling Rig: Is It Safety Culture?

Jonathan Wade Henson
Eastern Kentucky University

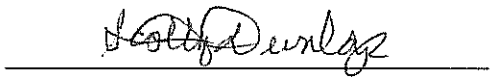
SAFETY ON A DRILLING RIG: IS IT SAFETY CULTURE?

By

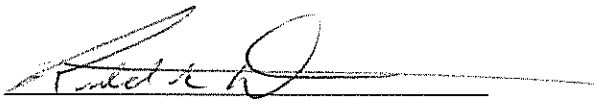
Jonathan Henson

Eastern Kentucky University

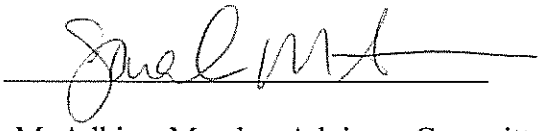
Thesis Approved:



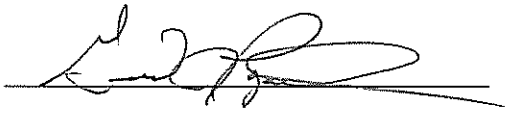
Scotty Dunlap, EdD, CSP, Chair, Advisory Chairman



Ron Dotson, Member, Advisory Committee



Sarah M. Adkins, Member Advisory Committee



Dean, Graduate School

STATEMENT OF PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a [Masters of Science/Occupational Safety] degree at Eastern Kentucky University, I agree that the Library shall make it available to borrowers under rules of the Library. Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of the source is made.

Permission for extensive quotation from or reproduction of this thesis may be granted by my major professor, or in his absence, by the Head of Interlibrary Services when, in the opinion of either, the proposed use of the material is for scholarly purposes. Any copying or use of the material in this thesis for financial gain shall not be allowed without my written permission.

Signature Jon Ron W. Hamm

Date 1 MAY 2013

SAFETY ON A DRILLING RIG: IS IT SAFETY CULTURE?

By

JONATHAN HENSON

Bachelor of Science

Excelsior College

Albany, New York

2006

Associates of Science

Tidewater Community College

Portsmouth, Virginia

1995

Submitted to the Faculty of the Graduate School of

Eastern Kentucky University

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

August, 2013

DEDICATION

This thesis is dedicated to my wife, Patty Jean Henson who has given me all the support I could ask for and encouragement during the low spots we all endure for such projects.

ACKNOWLEDGEMENTS

To my former employers, Maersk Drilling USA and present employer, BG-Group, for providing me with the time, survey pool and resources to complete this thesis. This subject matter is valuable to this author and hopefully to those who do the hard work of extracting hydrocarbons from the earth in hazardous conditions.

Crew of the Maersk Developer: Thank you for participating in the safety culture survey. The crew was the best in the U.S. Gulf of Mexico (US GOM) and the results prove it. Hopefully, the results can be used on a wider scale in the US GOM to aid other rigs. To Cor Selen, CEO and Rig Manager for the Maersk Developer at Maersk Drilling USA: Cor was the one who gave me the inspiration to conduct the survey on a drilling rig that had a robust safety culture and was the best performing rig in the USGOM.

Eastern Kentucky University Safety, Security and Environmental Management School and EKU staff. In particular, I would like to thank Professors Scotty Dunlap, Mike Collier; and EKU staff Jackie Levine, Retha Sandlin and Col. Brett Morris (USA-Ret.) for your support.

Finally, I would like to thank the Well Engineering staff at BG-Group. The staff experience, dedication to work, commitment to safety, and personal integrity are of the highest quality. The Well Engineering staff provided feedback, advice and support in the final stages of this thesis. BG-Group added a new dimension to my work and allowed me to see if my thesis worked in varying assets BG-Group operates around the world: it did. In particular, I would like to thank Mike Dyson, General Manager of Well Engineering for his support and challenges on the research.

ABSTRACT

Why do workers on a modern offshore drilling rig continue to make decisions leading to unsafe conditions, acts or incidents? In a perfect world, workers in any industry would go to work and come home in the same condition as they started the day: no incidents. Worker injuries and deaths are all too common in the workplace whether on land or at sea. On a modern drilling rig, operating hundreds of miles offshore, far from the nearest hospital, working in all kinds of weather presents an industry ripe with risks. The worker or rig hand holds the key to making safe or unsafe decisions. Numerous studies and research projects on worker safety on shore (factories) have been completed through the years. Studies and research on offshore workers has not been as active, particularly on drilling rigs working in the U.S. Gulf of Mexico as other locations. While rig safety has improved over the years through equipment improvement, safety management systems and an emphasis on safety culture (in other words process safety), injury rates have leveled. Understanding why rig hands make decisions that affect their safety or others may be the key to lowering the injury rates further. This research is designed to ascertain with all the management systems, training, safety leadership, and automated equipment in place, rig hands continue to make unsafe decisions that lead to near misses, unsafe acts, incidents and injuries on a modern drilling rig. A successful research design study might provide a model for further research within the company and offshore industry. Is it an individual choice? Is it Safety Culture? Is it a combination? What does a working rig with a robust safety culture look like?

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AB	Able Bodied Seaman
ACTIVE	Rig Contractor's BBS (observation card) system
BBS	Behavior Based Safety
BOERME	Bureau of Ocean Environment Resources Management and Enforcement
BLS	Bureau of Labor Statistics
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CRM	Crew Resource Management
DPO	Dynamic Position Officer
DART	Days Away, Restricted and Transferred
EPA	Environmental Protection Agency
FPSO	Floating Production, Storage and Offloading
GHQ	General Health Questionnaire
HSE	UK Health and Safety Executive
HSE/HSSE	Health, Safety, Security and Environment
HSL	UK Health and Safety Laboratory
IADC	International Association of Drilling Contractors
JSA (SJA)	Job Safe Analysis
LTI	Lost Time Incident
LTIF	Lost Time Incident Frequency (200,000 man hours)
Macondo	Deep Water Horizon/BG Incident; April 2010
NEBOSH	UK National Examination Board in Occupational Safety and Health
NIOSH	National Institute of Occupational Safety

NPT	Non-productive Time
OIM	Offshore Installation Manager
OSHA	Occupational Safety and Health Administration
PSM	Process Safety Management
PTW	Permit to Work
SD	Standard Deviation
STOP	BBS observation (card) program
TBT	Tool Box Talk
TRCF	Total Recordable Case Frequency (One million man hours)[1]
TRIR	Total Recordable Incident Rate (200,000)[2]
USGOM	US Gulf of Mexico

[1] 1 recordable case (MTC, RWC) x 1,000,000 / total man hours = TRCF
[2] 1 rec x 200,000 / total man hours = TRIR

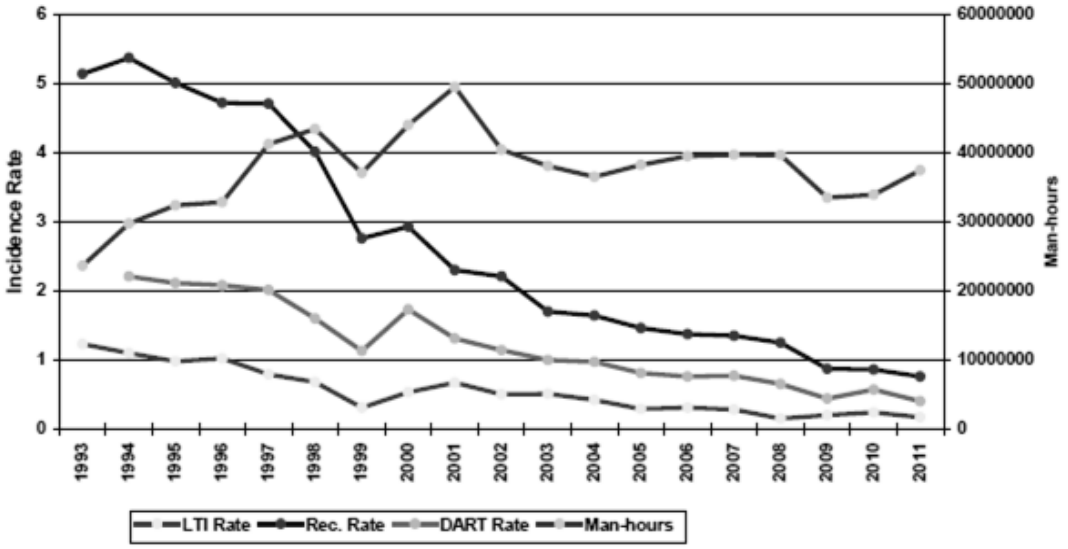
CHAPTER I

INTRODUCTION

Recordable Incident Rates

Why do workers on a modern offshore drilling rig continue to make decisions leading to unsafe conditions, acts or incidents? Is it safety culture? To be sure, working on offshore drilling rigs is hazardous but not unsafe. In fact, the rig employed in this survey had no Lost Time Incidents (LTI) for over two years. Since the early days of oil drilling offshore, the drilling contractor (company that owns and operates the drilling rig) and third party personnel injuries have dramatically declined. The International Association of Drilling Contractors (IADC) has been tracking injuries and incidents since 1962. From Table 1 below, it is clear LTIs have dramatically declined for the offshore industry (IADC, 2012).

Table 1.
US Water Total LTI and Recordable Incident Rates



Note: The graphs show the decline in the LTI, Recordable and DART rates from 1993 to 2011 for offshore drilling rigs. The top line (blue dots/gray line) represents the total man-hours worked.
Source: "IADC Incident Statistics Program." Trans. Array 2012 Incident Statistics. IADC, 2013. Print.

The decline in LTIs is due to three factors: improved equipment, safe systems or work (procedures), and culture. This is commonly referred to as Process Safety (OSHA,

2000). Whereas Occupational Safety deals with slips, trips and falls and things that can happen to an employee in the performance of his work, process safety is focused on the operation of manufacturing, processing or transportation facility and its impact on the worker. OSHA defines process safety elements as employee participation, process safety information, process hazardous analysis (effects of incompatible material), operating procedures, safe work practices, mechanical integrity, and management of change, pre-startup reviews, emergency response plans, incident investigations and audits (OSHA, 2000 at 1910.199 (b)) .

In the early days of drilling, equipment was not conducive to preventing injuries to oil field workers. It is not uncommon to witness older rig workers with missing fingers or worse. Engineering better equipment reduced LTIs through the industry. Once LTIs began to decline the industry began to review 'systems' on board drilling rigs. Systems include procedures, safe work practices, effective incident investigations and hazard analysis. Safety management systems, safe job analyses, and permit to work systems were a large part of the process movement in the drilling community. Finally, LTIs were further reduced by applying cultural aspects to safety on board drilling rigs. Cultural aspects include employee participation as in observation or STOP cards. So what does a modern drilling rig look like if there is an active safety culture? Conversely, what would a rig without a similar safety culture look like?

Hypothesis

A safe, high performing drilling rig in the US Gulf of Mexico is the result of a robust safety culture. Or, what does safety culture look like on a high-performing rig?

History of Offshore Drilling and Statement of Problem

In 1896, the first offshore well was drilled off the coast of Summerland, California (Congressional Digest, 2010). The following year, Mr. H.L. Williams had an idea of constructing a wharf from land extending into the sea and putting an oil rig on the end of it. Mr. Williams first offshore well extended 300 feet into the ocean. The first well was a good producer of oil and others began constructing similar wharves with oil rigs at the end.

The first successful oil industry's move to offshore waters was a 1938 discovery of the Creole Field in the Gulf of Mexico. A Pure Oil/Superior Oil exploration well was drilled from a 300 foot drilling platform secured to a foundation of timber piles set in 13-

14 feet of water. In November 1947, a well was drilled almost out of sight of land. The water depth was 16 feet approximately 12 miles south of Terrebonne Parish, Louisiana. This was the first open water oil well drilled from a fixed platform/drilling tender combination. This was a significant technological breakthrough in drilling-unit design for offshore use. The "Kerr-McGee Oil Company well produced 600 barrels a day and established a pattern for supporting offshore wells from onshore bases" (Congressional Digest, 2010, p. 163).

Since 1947, the offshore oil industry in the U. S. Gulf of Mexico (USGOM) has grown dramatically. Offshore oil rigs are drilling in water depths of 3000 feet and more and 25,000 feet beneath the sea bed. Drilling deeper and further off shore most likely increases exposure to the rig hand against the backdrop of a safe work environment. There is no data from the IADC that breaks down or suggests higher incidents are associated with rigs working further offshore and in deeper water.

As the demand for oil and gas increases each year, the technology, equipment and people are challenged to drill further offshore, deeper into the earth, as efficiently as possible, with greater logistical coordination and increasing risks to the rig hands, equipment and environment. In 2004, the US Department of the Interior's Minerals Management Service (MMS) estimated that the deepwater regions of the USGOM may contain 56 billion barrels of oil equivalent, or enough to meet US demand for 7–7.5 years (Minerals Management Service, 2004).

The bounds of technology and maintaining safe work environments shall always be present in drilling. The offshore oil industry demands safe work for their crews and environment. As technology increases to meet the demand for oil, the rig hand will remain central to creating and maintaining a safe work environment.

In all industries there are major incidents and catastrophes that effect change. The *Exxon Valdez* grounding and subsequent spill in 1989 prompted the Oil Pollution Act of 1990. The 1988 *Piper Alpha* explosion and fire in the North Sea created new safety and risk evaluation processes such as the Health, Safety and Environment Safety Case. The *Challenger* and *Columbia* space shuttle disasters made changes in safety data collection and safety cultures. In 2006, the HSE commissioned the UK Health and Safety Laboratory (HSL) to review existing literature on the causes of major incidents. The HSL's report was entitled "The Causes of Major Hazard Incidents and How to Improve

Risk Control and Health and Safety Management: A Review of the Existing Literature" (Bell & Healey). This was a scholarly review of all major incidents and their causes throughout the world in recent history. The authors provided an overview of major incidents with their causes and recommendations to the HSE for incorporation (Bell & Healey, 2006). The research involved exhaustive review and collection of data and used logic and reasoning to establish recommendations. Unfortunately, it takes a catastrophe to change perceptions on safety, in particular, safety culture.

CHAPTER II

HISTORY, SAFETY CULTURE AND PURPOSE

Significant Events That Changed Safety Cultures

The Deepwater Horizon/BP (Macondo) tragedy profoundly affected the US offshore drilling industry. All the changes have not been felt to date. New regulations came into effect soon after the incident. The time it takes for a permit to get approved for drilling has taken much longer now than before Macondo occurred. One question raised is whether the incident is a "symptom of systemic safety problems in the deepwater drilling industry or a result of one single company operating outside the industry standard" (Skogdalen et al., 2011, p. 1187). The Deepwater Horizon's BOP played a major role in the Macondo disaster. Figure 1 below is a photograph of the rig's BOP mimic panel.

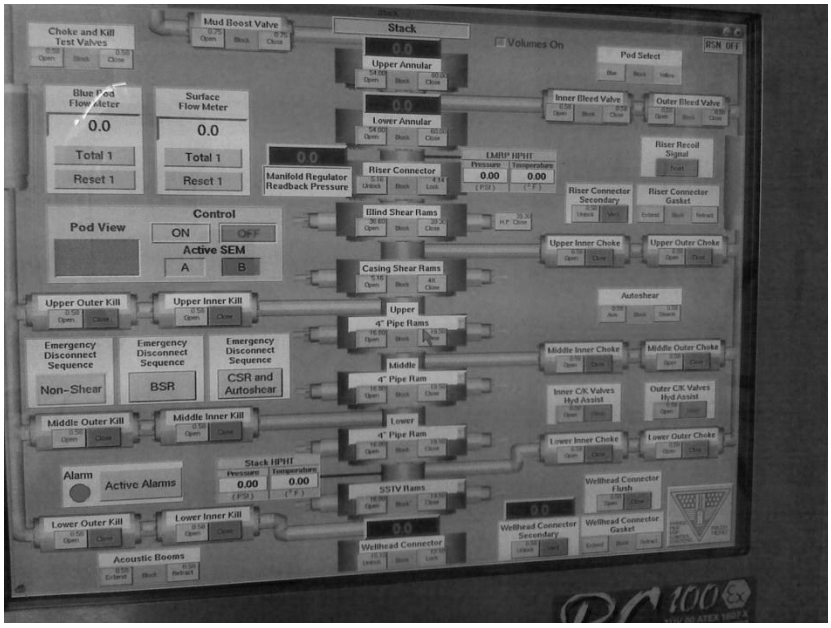


Figure 1. Blow Out Preventer Mimic Panel.

Skogdalen examines research completed in Norway on predicting and preventing well control incidents. The Norwegian equivalent to the US Bureau of Safety and Environmental Enforcement (BSEE) conducted surveys and required reports from oil and gas operators on leading and lagging indicators. Well control events evolve around well integrity and not allowing subsurface gases or oil to reach the Blow Out Preventer (BOP) or further up the drill string. Skogdalen refers back to the Presidential Commission on

Macondo with a question whether the incident "was a result of specific problems with the safety culture in BP internally, or if it reflects an entire deepwater drilling industry operating in an unsafe manner" (p. 1189). While reporting on well control incidents was considered good by the Norwegian government, there is little correlation between well control incidents on safety culture.

Skogdalen defines safety culture as the employees' perceptions, attitudes and beliefs about risk and safety (Skogdalen et al., 2011, p. 1191). There has not been much research in the correlation between well control events and safety culture. However, a recent study in Norway analyzed safety climate and gas leaks and concluded with significant correlation. A safety climate questionnaire accounts up to one-fifth of hydrocarbon leaks reported by a platform. This provides a relationship between the number of employees responding negatively to the questions with respect to safety climate and number of leaks. In other words, if the crew responds poorly to the safety culture on the platform, there are probably more well control incidents. Skogdalen's article is an indicator of what the research design hopes to prove: a correlation to safety performance and safety culture. If the perception of the safety culture is poor, there may be a link to more incidents on board the rig. In order to get the root of the poor safety culture, you must as those working on the platform or rig.

Safety Culture

What role does a person have in their own safety? What role does the organization have in providing a safety culture? Research used by Michael Christian, et. al in the *Journal of Applied Psychology* article described four goals to produce a qualitative study on safety culture and its effects on workers (2009). The data analysis was very interesting in that it examined many studies to come to documented conclusions on safety culture. What factors do safety climate, personal factors, safety performance and participation have with outcomes (accidents and injuries)? Christian, et al complete a comparison of antecedent studies on safety as they have focused on "individual differences and contextual factors" (p. 1103). This is valuable to the research design conducted on the rig. The authors made established four goals:

1. Illustrate the benefits of developing clear operationalization's of safety constructs
2. Build on existing theory and research studying the relationships between antecedents and safety criteria

3. Estimate hypothesized relationships using conceptual framework
4. Use meta-analytic path modeling to test and exemplar model of the integrated conceptual framework (p. 1103)

An important discussion in the article is on distinguishing between safety compliance and safety participation. Christian, et al referred to reference that found "safety motivation was more strongly related to safety participation than safety knowledge, whereas the converse was true for safety compliance" (p. 1104). On board a drilling rig, there is constant discussion on compliance, conformance and following the rules. When workers make a decision that leads to a safety related incident, is this because they failed to comply with a rule or procedure or did they believe safety participation was less important? These are questions for the rig hands before, during and post-incident. The journal article discusses a process from "distal" situation related factors and person related factors to safety outcomes. How far (distal) or close (proximal) the relationship to a safety outcome relies on many factors valid for research questions? Broadly, Christian, et al. includes subjects such as leadership, job affiliation, safety motivation, safety knowledge, safety compliance and participation to predict safety criteria (2009).

A modern drilling rig is a complicated piece of machinery with highly technical personnel operating equipment that has been engineered to fine science. A dual derrick is a graphic example of today's technology. From drilling on barges in the 1940s to drilling in thousands of feet of water and into the sea bed for miles, technology as exhibited by Figure 2 demonstrate the need for a robust safety culture. A dual derrick rig is capable of drilling two wells simultaneously. On the surveyed rig, but dual drilling outside of the USGOM is becoming common place. Instead, the rig used the two derricks to drill and prepare equipment for drilling. For example, the 'main' side would drill the 'auxiliary' side would prepare the drill string for the main side.

Figure 2. Rig's Dual Derrick

To evaluate the accuracy and validity of the research on this subject, Christian, et al. examined 88 studies and collated them according to various factors such as management commitment, supervisor support, and risk; and work pressure. Consequently, there appears no subjective bias except for the conclusions of the findings. Again, with more time, it would be possible to reach a conclusion on bias.

Each report was classified by its design: concurrent and longitudinal. The Journal Article provided a table which list "Results for Meta-Analysis of Person- and Situation-Related Factors with Safety Performance Composite, Safety Compliance, and Safety Participation." From this list, there is clear evidence the authors evaluated the studies and were able to qualify the results with respect to conclusions. One of the findings from the comparative study was "safety motivation was related to safety knowledge" and safety performance was correlated with accidents and injuries (Christian, Wallace, Bradley, & Burke, 2009, p. 1121). The authors further explained that they were unable to replicate the models but believe it should "hold" for other antecedents. The report went on to state the key to research design: that "safety performance behaviors, in turn, influence accidents and injuries" (p. 1121). The report concluded that the person and the situation are important factors related to workplace safety. This means any survey developed for the research design should include factors considered in the author's study.

Comparisons between work groups are used to evaluate safety cultures and response to safety factors such as leadership, management priority, worker competency and safety culture. In this study, the comparisons of like values are made between rig

workers and offshore divers. This was a qualitative study that involved surveys of differing groups to capture the impact of safety cultures. Knowing what the impact of a safety culture can mean to an organization should lead to research on its getting workers to make safe decisions on their own.

Safety culture was the basis for the study was defined in section 1.1 (Adie, Cairns, MacDiarmid, Ross, Watt, Taylor, & Osman, 2005). The authors stated that safety culture helps control accident risk and has become highly important to industry. The authors provide two sources for the definition of a safety culture: social anthropologists and the Advisory Committee on Safety in Nuclear Installations (ACSNI). Both are consistent with one another. ACSNI provides an excellent definition: *a safety culture is characterized by mutual trust, shared perceptions of safety and confidence in the efficacy of preventative measures* (emphasis added). This was the basis of questions for the rig hands: how important was safety culture and what did it mean to them?

To determine the differences between offshore rig hands and divers, Adie, et al created paired comparisons. The authors provided graphic demonstrations on five factors with dimensions ranging from low (competency) to excellent (safety culture) for nine scenarios. Participants from both industries consisted of 353 subjects comprised of 233 divers and 120 offshore workers. The authors excluded some participants as they "violated the principle of 'expected reasonable choice'" (Adie et al., 2005, para. 3.8.1). The results of the study were offshore divers were "significantly more likely than offshore workers or non-offshore divers to have had a Lost Time Accident" (p. 138). Note: a Lost Time Accident is the same as a LTI.

The hazards of professional diving and short contracts affect the integration of a work team. They are less likely to have participated "normative dialogue leading to internalization of behavior" (Adie et al., 2005, p. 140). Offshore rig workers were more likely to refer to individual responsibility in their definition of safety culture than divers (46% vs. 35%) according to Adie, et. al. Divers (offshore or non-offshore) were significantly more likely to refer to equipment/facilities/emergency procedures (39% vs. 24%), the role of supervisor/management (36% vs. 23%) and the role of team (21% vs. 8%) (p. 8). There is a suggestion by the authors divers have a different attitude rather than workers on rigs which seems evident by their research. This is may be due to the diver holding a rugged individual attitude than a rig worker as part of a team.

The authors conclude that the level of the group or organizations safety culture influenced the perception of accident risk for all three occupational groups studied. In other words, the study provided insight on how far the "survey participants accepted the concept of safety culture as an influence on accident risk" (p. 140). The safety culture findings in the report are linked to the research design used on the rig. These will lead to better questions and understanding why (perhaps) rig hands deliberately work unsafe. The research team used a reasonable approach to surveys of like work groups yet different in their approach to safety.

Safety climate and safety culture appear to be synonymous. In the United Kingdom, human factors are considered by some as the same as safety culture. There are safety cultures in any work group. It has nothing to do with one's culture or upbringing or even sensitivity to manners. For this discussion, safety culture means values, norms and practices of an organization. A safety culture also teaches others how a person is expected to work within the culture (Cullen, 2011). Another simplistic way of defining culture is "how we do things around here" (p. 40). A mature safety culture would show anyone in the work group who goes against a group culture is distrusted and may include banishment.

Within the workforce, a culture defines how a group will work, or won't work. Many workers in high risk industries don't typically define themselves by who they work for but by what they do for a living. A person who studies cultures is an ethnographer. According to Cullen, ethnographers study three things: what people say or jargon, what people do and what they choose to create (Cullen, 2011). While there is little data on safety culture for US offshore workers, safety cultures do exist good and bad. Cullen suggests getting immersed in the culture may require story telling as a means to gain trust. For example, in the administration of the survey for the rig, it was completed by the OIM and rig administrative officer not anyone from the shore base. The author of this study did not contact the respondents only managed the status of the survey returns with the OIM and rig administrative officer.

Purpose of the Study

Research Question: The purpose of the study is to understand how the rig hand, given all the latest technology and safer equipment still gets hurt. There are no single answers to the question. However, there are common factors which run through a drilling

contractor/oil company operation which can manage risks and create a work environment that induces safe work practices. Working offshore is safe compared to many other industries. The idea is to make it safer. As oil becomes more precious and offshore drilling challenges rig workers, it is important to understand what works and doesn't work in creating a culture of safety.

Surprisingly, there has little research regarding safety culture on offshore drilling rigs in the USGOM. During the research design phase, an exhaustive research for data on safety culture surveys or any type subject was made over several weeks. Nothing of consequence was found for the USGOM. There were like-surveys completed in the United Kingdom sector (Health and Safety Executive) and in Norway. These surveys will be discussed in the thesis.

Potential Significance: The survey of a drilling rig operating in the USGOM is of value for several reasons. First, the survey will show what a safety culture looks like on a rig with high safety performance. Second, conclusions may be drawn for a rig with poor safety performance and provide the tools to improve their safety performance. Third, the results should provide rig management and oil operators a formula to safe and successful drilling operations in the USGOM. Fourth, and most important, it will help operator and rig leadership to create a high performing and safe rig in the USGOM.

CHAPTER III

LITERATURE REVIEW

The literature review selected works from a graduate thesis to scholarly journals. The logic behind the selection of the thesis and journals was to form a basis of inquiry design for use on board the drilling rig used for the surveys and worker influences on safety decisions. It is critically and logically important to build a case for learning of worker perceptions from other research work before actual research begins on the rig. A good pool of questions for workers, already tested by other research, will lead to results that can possibly reduce safety incidents. This also enhances the chance the study will provide results that are actionable.

At the end of this review, the reader should show why the findings are related to the research question. The review provides sources, facts, consequences, implications and why the information is relevant to the design question. There is little research available relating directly to the design question in the US offshore drilling industry. External sources that could contribute to the design question will benefit the program.

Safety leadership cannot be undervalued. Interactions between senior management, line managers, supervisors and the workforce are critical for successful operations in any industry. "Safety behavior presents a paradox to practitioners and researchers alike because, contrary to the assumption that self-preservation overrides other motives (Maslow, 1970), careless behavior prevails during many routine jobs, making safe behavior an ongoing managerial challenge" (Zohar & Luria, 2003, p. 3). The authors established baseline rates of safety-oriented supervisory interaction and safety behaviors. Management interventions are "based on the idea that supervisory monitoring and contingent rewarding (or punishing) will modify the cost/benefits ratio associated with safety behavior, which is initially biased against safe behavior in routine work situations" (Zohar & Luria, 2003, p. 16). As a result of the interventions, "a steady increase in frequency of safety-oriented supervisory interactions in both sections, rising in the refinery section from an average base-rate of about 35% to 50% by the end of intervention" for the oil refinery surveyed (p. 11). The authors concluded that the safety performance could not succeed without continued management commitment (Zohar & Luria, 2003). As pictured below in Figure 3, loading casing is a major undertaking as well

as setting casing during drilling operations. Supervision and teamwork play a major role in successful landing or loading of casing.

Figure 3. Rig's Riser Bay. Risers connect the rig to the ocean floor via the BOP and well head.

Within the human element, changes to industry safety culture are driven by major incidents and catastrophes. The *Exxon Valdez* grounding and subsequent spill in 1989, the 1988 *Piper Alpha* explosion and fire in the North Sea, and *Challenger* and *Columbia* space shuttle disasters made changes in safety data collection and safety cultures. In 2006, the HSE commissioned the UK Health and Safety Laboratory (HSL) to review existing literature on the causes of major incidents. The authors provided an overview of major incidents with their causes and recommendations to the HSE for incorporation (Bell & Healey, 2006). The research involved exhaustive review and collection of data and used logic and reasoning to establish recommendations. Bell & Healey provide an excellent summary to base the research on for the rig. The research design question revolved around why rig hands make safety decisions that can affect their and others safety. The HSL report also discussed behavioral modification approaches. Some of the findings are important to this research such as goal setting, ownership of the safety program, long term safety policies, and the (little) impact of safety training (Bell & Healey, 2006).

The second part of process safety triad, after equipment, is safety management systems. Even though safety management systems have been part of the decrease in LTIs offshore, it remains to be improved. So what does it take to make a safety management system "first in class" (Hekmat, 2011, p. 30). Trust is an important issue for safety professionals which are leaders in their organizations. Hekmat states that a safety professional must be adept in problem-solving and understanding the organization's safety culture. A safety road map is defined as a company that has high incident rates or failures of the management system. A good safety roadmap includes a "good values" and constant values for constant reference (p. 30). Heckmat provides data on what an effective management system is not and should be compared to the rig's management system. The reasoning presented for a safety roadmap appears sufficient.

Safety culture was the basis for the study which was defined in section 1.1 (Adie, Cairns, MacDiarmid, Ross, Watt, Taylor, & Osman, 2005). The Advisory Committee on Safety in Nuclear Installations (ACSNI) states safety culture is characterized by mutual trust, shared perceptions of safety and confidence in the efficacy of preventative measures. This was the basis of questions for the rig hands: how important was safety culture and what it meant to them with respect to performing their work safely and consistently.

Safety climate, motivation and behavior for workers on individual and group levels were provided in the *Journal of Applied Psychology* in 2006 by authors Neal and Griffin. Previous studies have concluded that perceptions of safety climate and safety behaviors are positively correlated and both are negatively correlated with accidents (2006). The authors discuss the term *psychological climate* which refers to a person's perceptions of their work climate. This also includes a person's perception of policies, procedures and practices regarding safety in the workplace. The study employed a direct consensus model over a period of four years on hospital workers. There were two hypotheses for direct causation: (1) group safety climate will exert a lagged effect on *individual safety motivation* and (2) individual safety motivation will exert a lagged effect on *individual safety compliance and safety participation* (emphasis added). Safety compliance is defined as following rules, regulations, policies and procedures. Regarding hypotheses one, there was some support in that it suggests lagged effect of group safety climate. Hypotheses two found support as well since those with high safety motivation in year two were more likely to show increased safety participation two years later (Neal & Griffin,

2006). The authors discuss limitations primarily from the aspect the study was conducted in one hospital.

"We can design the best safety controls, but they must be maintained, and that falls on management [such as] enacted policies and procedures—not formalized ones but those acted upon—define a climate of safety" (Sorrow, 2012, p.1). There is growing evidence, according to university professors there is increasing evidence in the past 20 years that management and organizational factors also play a critical role in an organization's safety climate. Simply put, actions or inactions at a company's organizational level can either set the stage for injuries or help prevent them. The paper's author stated "We can design the best safety controls, but they must be maintained, and that falls on management," (Professor John) Smith said. "Enacted policies and procedures—not formalized ones but those acted upon—define a climate of safety" (p. 2). In other words, if a company allows workers to work within the bounds of a safe environment, they work safer. How does a rig hand on a high performing rig maintain high safety performance? Did management have a part in the high performance?

Safety culture and safety climate appear to be synonymous for some researchers. There are safety cultures in any work group. It has nothing to do with one's culture or upbringing or sensitivity to manners. For this discussion, safety culture means values, norms and practices of an organization. A safety culture also teaches others how a person is expected to work within the culture (Cullen, 2011). Another simplistic way of defining culture is "how we do things around here" (pg. 40). Within the workforce, a culture defines how a group will work, or won't work. For the purposes of the rig evaluation, Cullen suggests requires immersion of the researcher of the work culture. This means gaining trust because one cannot simply walk into a work group and expect trust. For the rig project, it is clear to find understanding of the work groups, and there are several on board a drilling rig. Working with the rig crew before its arrival in the USGOM was this researcher's means of immersion.

Group membership as discussed in Cullen's (2011) article above is part of the culture of a group. Trust within any workgroup is important for the success of the group. In Tharaldsen, et al. article in *Safety Science*, there is a construct of functional or "creative" mistrust which is important for a "sound safety culture" and "blind trust" or too much distrust would be detrimental for a safety culture (Tharaldsen et al., 2010, p. 1063).

Since the rig in the survey consisted of 24 nationalities, trust and conformance within a work group finds importance. Tharaldsen's surveys included questions as follows: self-reporting for behavior and safety performance; trust in colleagues and management, and commitment to safety. One question the authors suggested based on the findings was how the client and worker relations were built. Another question came from client-contractor supply chains and organizational borders. For the rig's study, trust appears to be important part of the questionnaire for determining why rig hands make safety decisions.

Nordine stated that leading indicators are predictors of poor safety performance (2007). If a company can predict or plan for incidents via leading indicators, the theory suggests occupational injuries or incidents are preventable. The end result of the finding leading indicators can properly adjust a safety program by eliminating unrecognized hazards, unsafe conditions, reckless behavior or other safety program deficiencies. The author concluded there were "few concrete examples or methods of proactively measuring and monitoring health and safety program performance" (p. 35). To bridge the gap, the author used the major elements of OSHA's safety and health management program guidelines. Leading safety indicators in the project were tabulated from such dimensions as management commitment, communication, compliance and corrective actions. Nordine states leading indicators are important to preventing incidents. Using this information is important to test how rig hands on the rig use leading indicators in their safety decisions.

Ford & Tetrick examined psychological empowerment and organizational identification as occupational outcomes and leading indicators for safety performance (2011). Two dimensions of safety performance (protective equipment and participation) were measured by the authors as well. The authors tested their results against seven hypotheses. Ford & Tetrick found common sense results: employees in the same institution but different workgroups showed varying scales of empowerment. Hazardous positions typically meant differences in employee attitudes; positions with hazardous work felt less empowered. For the rig's study, the results of surveys should be measured against the occupation of the rig hand. One of the findings from the study showed employees in hazardous occupations tend to feel less psychologically empowered and identify less with their organization than do their counterparts in less-hazardous situations within the same worksite. One can conclude the incident rates to these employees are higher than less

hazardous occupations. In the research for the rig, the occupation or position of the rig hand compared to the perceptions of the rig's safety culture should prove interesting. What if the floor hands (hazardous occupation) have a favorable view of their empowerment and believe their supervisors are concerned for their safety? This will go back to safety leadership and safety culture for the rig team. Lifting operations are hazardous operations with a great deal of risk involved. To limit risks to rig personnel, barriers (Figure 4) which prevent a member of the crew to walk under or near a load is critical to safe lifting operations. A rig in the USGOM can average over 50 lifts per day.

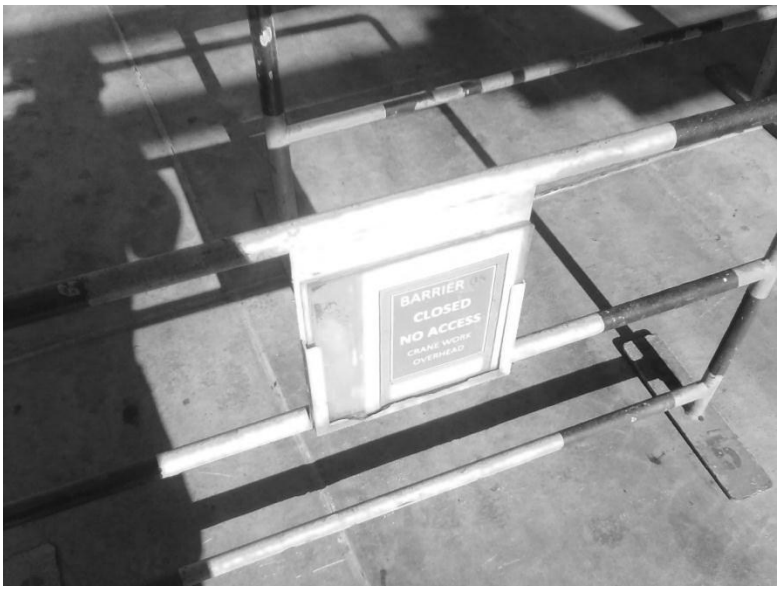


Figure 4. Typical Barrier for Lifting Operations. This is a typical barrier is used to close access to areas on the rig. Barriers restrict access due to overhead operations.

John Atherton and Frederic Gil wrote a book sponsored by BP and Center for Chemical Process Safety titled "Incidents That Define Process Safety." Some of the incidents that Atherton and Gil have reviewed deal with blind operations (Tenerife 747 collision in 1974, the NASA Challenger disaster in 1986, HF Release at Marathon's oil refinery in 1987 and the Exxon Valdez in 1989 (Atherton & Gil, 2008). The research design will take into account past incidents when assigning applicability to the rig's operation. Are there incidents that have happened in other industries that could apply to the rig surveyed? If so, what is the rig team doing to prevent such incidents?

In 2006, the UK Health and Safety Executive (HSE) commissioned the Health and Safety Laboratory (HSL) to carry out a review of the existing literature on the causes of

major hazard incidents and the relevant control measures and behaviors that can prevent incidents occurring (Bell & Healey, 2006). While many of the subjects in the paper are worth exploring, the focus of the literature research is focused on safety culture. A dozen papers were reviewed in the research. All of the papers appear to find common behaviors in safety culture: leadership, two-way communication, employee involvement, learning culture, and attitude towards blame. The authors state, "Effective leadership is for the management's commitment to safety to be highly visible; senior managers should demonstrate visibly and repeatedly show their commitment to safety throughout all areas of the organization. This will create a shared vision of the importance of safety" (para. 3.2.1.1.2).

The Deepwater Horizon/BP (Macondo) tragedy has deeply affected the US offshore drilling industry. One question raised is whether the incident is a "symptom of systemic safety problems in the deepwater drilling industry or a result of one single company operating outside the industry standard" Skogdalen et al. (2011, p. 1187). The research completed in Norway on predicting and preventing well control incidents. The journal article referred back to the Presidential Commission on Macondo with a question whether the incident "was a result of specific problems with the safety culture in BP internally, or if it reflects an entire deepwater drilling industry operating in an unsafe manner" (p. 1189).

Again, in the Deepwater Horizon incident, carrying out drilling operations by the operator are controlled from the dog house as shown in Figure 5. Dog houses have come a long way from brakes and levers to electronic cyber chairs. On the surveyed rig, the dog house has four cyber chairs for the driller and assistant driller for the main and auxiliary drill floors. The main and auxiliary sides of the drill floor are identical.

Figure 5. Cyber Chair. View from inside the dog house to the drill floor. Drillers are sitting in Cyber Chairs.

Skogdalen et al. stated there has not been much research in the correlation between well control events and safety culture (2011). However, a recent study in Norway analyzed safety climate and gas leaks and concluded there provides a relationship between the number of employees responding negatively to the questions with respect to safety climate and number of leaks. In other words, if the crew responds poorly to the safety culture on the platform, there are probably more well control incidents. Skogdalen's article is an indicator of what the research design hopes to prove: a correlation to safety performance and safety culture. If the perception of the safety culture is poor, there may be a link to more incidents on board the rig.

The BP/Deepwater Horizon disaster of April 20, 2010 has had, and still does hold far-reaching effects on the drilling industry in the US and world. There were two investigative reports published by the US Government on the BP/Deepwater Horizon (better known as Macondo for the well site name). One was published by the National Commission of the BP Deepwater Horizon Oil Spill and Offshore Drilling and the other was the joint US Coast Guard and BSEE's investigation report. The Commission's report (National Commission on the BP Deepwater Horizon Oil Spill, 2011) will be cited in the research design as a lagging indicator and what challenges rig crews have in ensuring another Macondo does not occur again. Also, the research design will also deal with

changes to regulatory processes in the Gulf of Mexico and how this has affected operations from the management side, operator and down to the rig hand.

There is considerable data within the Commission's report on the crew and their culture on board the Deepwater Horizon before the blow out. This data can be compared to the Rig's safety data and establish comparisons and deviations. What did the crew of the Deepwater Horizon do right and wrong? What are the Rig's crew doing that is similar or different to the Deepwater Horizon?

CHAPTER IV

FINDINGS

Surveys, Assumptions and Organization

Two surveys were conducted simultaneously on the rig over a period of four months, from February to May 2012. The length of time was required due to the crew rotation. The rig has availability of 180 persons on board[3]. Of the 180 total persons allowed, 99 were core crew on board at any given time. Rig contractors were excluded from the survey as they are transient in nature meaning they may work on the rig for one day to four weeks. The only constant was the core crew. The core crew consists of company employees hired to operate the rig. This included the senior staff positions of Offshore Installation Manager (OIM), Senior Toolpusher (STP), Maintenance Supervisor, Barge Engineer and Camp Boss. Other positions include driller, roustabout, able-bodied seaman, crane operator, deck pusher, dynamic position officers (DPO) and other positions to support rig operations. Each of the crew had a back-to-back which relieved the position every 28 days. In other words, 99 crew are on board at any given time and 99 are at home.

Using the three core values of process safety (equipment, procedures and people), two surveys were developed based on the literature review to ascertain what a high performing drilling rig looks like within the context of safety culture.. The first survey focused on how the rig hand viewed the rig's safety culture and the second survey focused on how the rig hand saw himself within the rig's safety culture. The surveys asked no names but did ask about position, age, time in the (drilling) industry, time on board the rig and education.

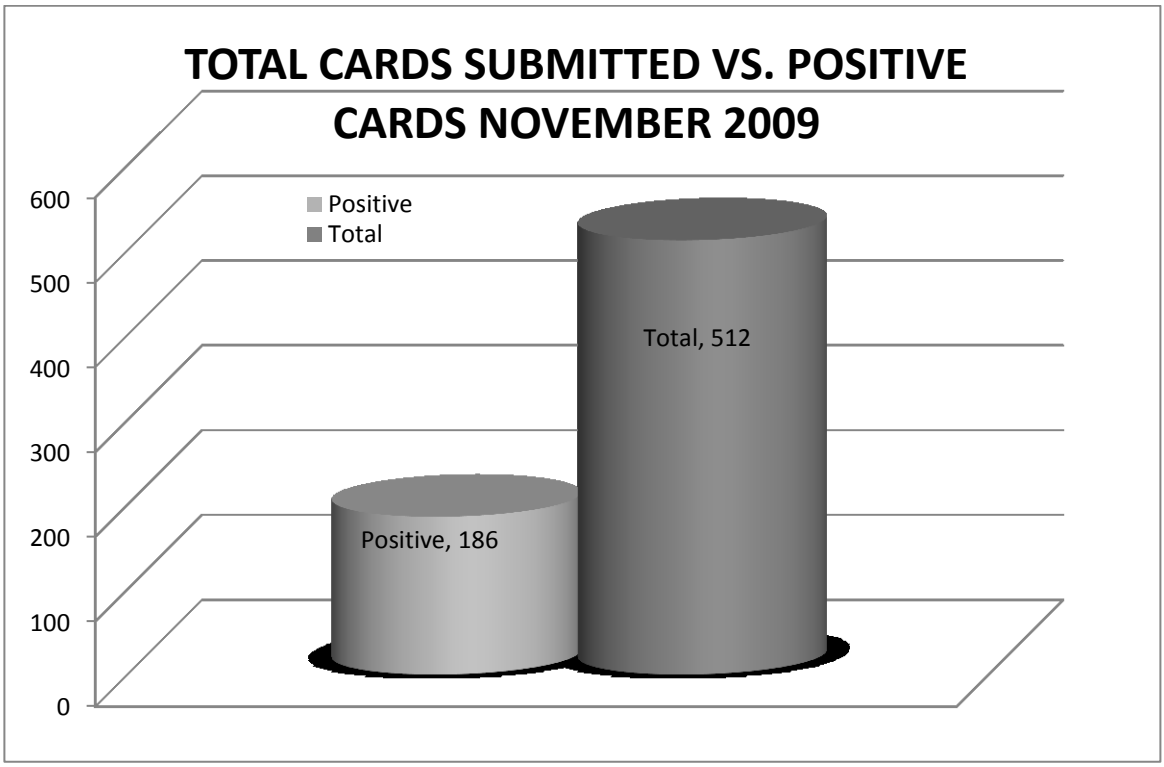
When the rig came to the USGOM in September 2009, there was little or no safety culture on board even though it took over two months to transit from Singapore. There were over 30 nationalities on board. Of the crew total, approximately 30% were American with the balance coming from around the world. This was a new build rig, first in its class for the rig company, and a new contract with a new operator to the US. The first well was one of the most complicated to drill. There was a lot going against the rig crew and it took several months for the crew to gel. In fact, the crew did not really come

[3] Maximum allowed by the lifeboats (180) capacity.

together as a team until the fall of 2010. Even so, the rig did not suffer a lost time incident from September 2009 through May 2012.

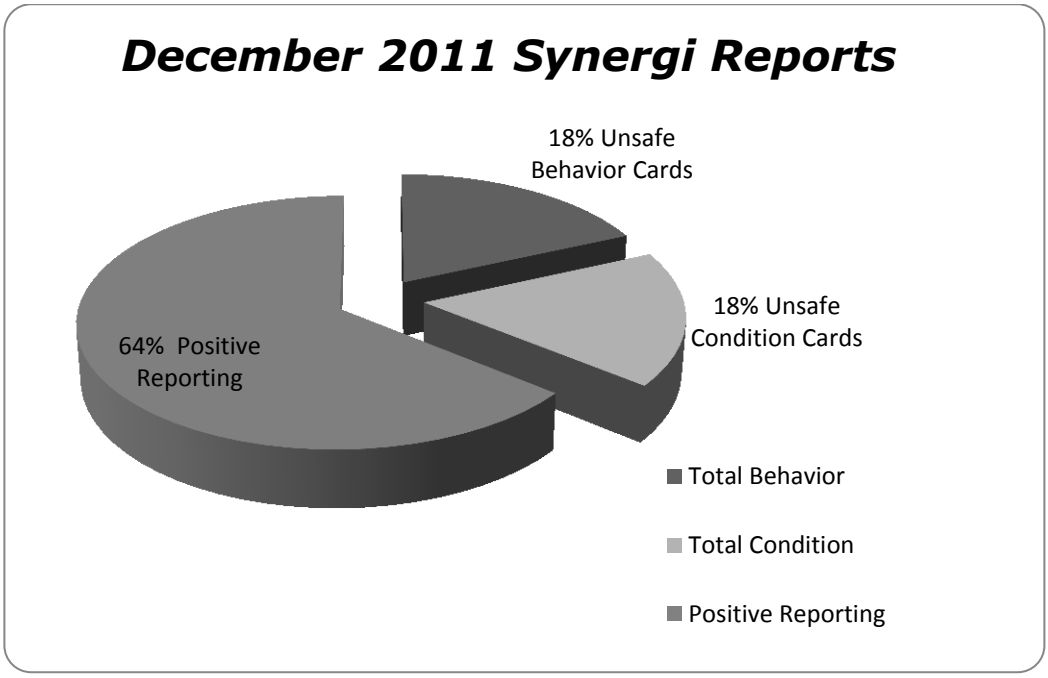
Within the drilling industry, non-productive time (NPT) occurs when the rig is shut down for mechanical failures, serious incidents, or unplanned maintenance (pulling the Blow Out Preventer from the well head). During the first few months of the rig's operation the rig's NPT was significant as the crew and equipment began working together. There were also high-potential incidents where the operator shut down operations (NPT) until the investigations were completed. Unfortunately, data from this period is not available to public review due to proprietary reasons. However, there are safety performance statistics that will show a steady change in the culture aboard the rig. Tables 2 and 3 provide an indication of where the rig's safety culture was from 2009-2011.

Table 2.
Observation Card Submissions 2009



Note: There were 326 total Reactive or Red cards in November 2009.

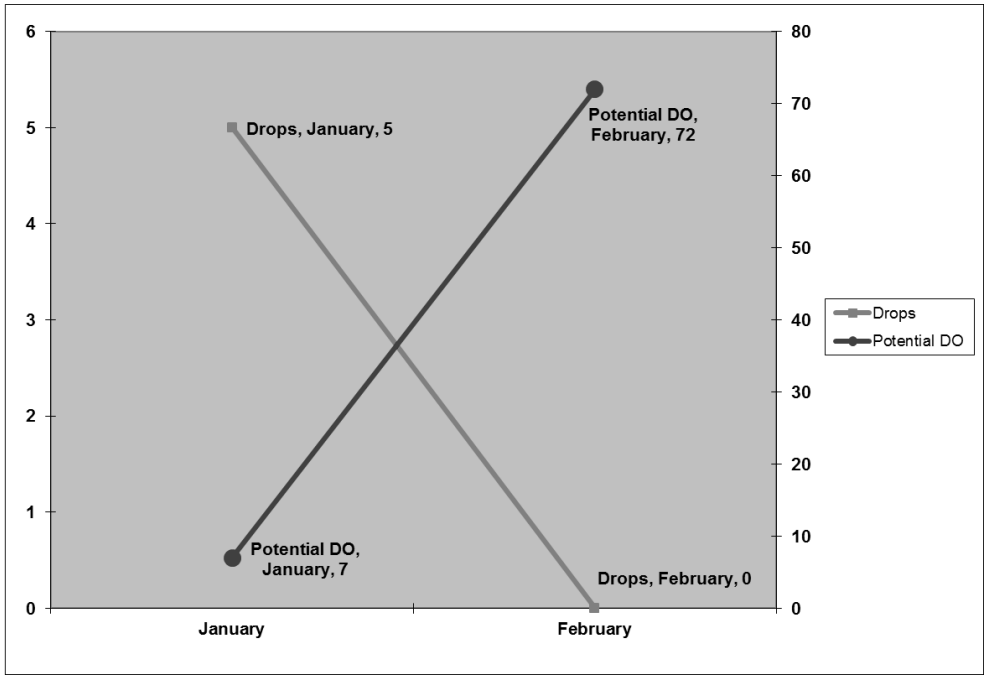
Table 3.
Observation Card Submissions 2011



Note: In December 2011, a total of 2860 observation cards were submitted by the rig crew. There were 496 behavior cards, 472 condition cards (968 total) and 1737 positive/green cards. The participation in the observation card program nearly doubled. Observation card feedback is and prevention is an important key to a safety culture. According to Snodgrass, Scott and Lee, "feedback is based on the outcome of the behavior (e.g., oil on the floor, or stacked pallets too high), the worker learns to read the feedback directly from the environment and the behavioral initiative may be more likely to succeed (2005, p. 4).

From September 2009 to March 2010, there were several dropped object incidents. The rig company defined a high potential dropped object incident as any object generating over 40 Joules (a unit of energy, heat, or in the instant case, work). After six high potential dropped objects from November 2009 to January 2010, an emphasis on potential dropped object reporting by the crew was initiated in January. The following is a result of the campaign. From the graph below, the number of drops is inversely proportional to the number of observation cards submitted. In January, there were five dropped objects. In February, there were none but 72 potential dropped objects reported via observation cards. Table 4 demonstrates rather graphically the effectiveness of the crew using observation cards.

Table 4.
Observation Cards vs. Drops 2010



Note: Potential drops compared to observation cards compared between January and February 2010.

Lagging indicators are important to measure how a rig or work group has done regarding safety. This can be considered safety performance but does not tell the entire story on a rig or work group. Table 5 demonstrates the movement from poor safety performance in 2009 (10.92 TRCF) to very good safety performance in 2012 (1.35 TRCF). This study provides several reasons via the rig crew survey why this change in performance occurred.

Table 5.
Lagging Indicators 2009 to 2012

Period	Accidents	Near-Miss	Unsafe act/cond	Obs	External spills	Spill type	Spill volume	Man-hours	TRC	LTI	FAC	MTC	RWC	LTI	FTL	Last 12 months TRCF	Last 12 months LTIF	Year to date TRCF	Year to date LTIF	Overall TRCF	Overall LTIF
Oct-2009	2	2	91	252	1	Oil, Hydraulic	1	53,469	0	0	1		0			10.93	0.00	26.30	0.00	10.93	0.00
Nov-2009	3	5	44	300	0		0	50,817	0	0	2		0			7.03	0.00	7.03	0.00	7.03	0.00
Dec-2009	4	6	56	330	0		0	49,894	0	0	3		0			5.20	0.00	5.20	0.00	5.20	0.00
Feb-2012	1	1	5	819	1	Oil, Hydraulic	15	42,679	0	0	0	0	0			0.00	0.00	0.00	0.00	0.74	0.00
Mar-2012	2	2	28	994	0			45,201	1	0	0	1	0			1.82	0.00	7.22	0.00	1.44	0.00
Apr-2012	1	0	4	1100	0			43,420	0	0	0	0	0			1.82	0.00	5.49	0.00	1.40	0.00
May-2012	1	1	15	1212	0			47,944	0	0	0	0	0			1.82	0.00	4.35	0.00	1.35	0.00

Note: The data above shows the rig's safety performance over three years based on lagging indicators. Please observe the difference in overall TRCF rates between 2009 (10.93) and 2012 (1.35).

Data from the preceding tables shows there wasn't much of a safety culture aboard the rig in September 2009 until late 2011. According to an OIM the rig had a "bunch of Prima Donnas on board during the early days of the rig" (shipyard to the USGOM). In other words, the rig crew was a group of champions rather than a championship team. It took time for the team to mature and develop. Fortunately during this time, no one on the rig was seriously hurt and no significant damage to the environment or even security incidents were reported. Over time though, the crew and attitudes changed…for the better.

Survey One, as noted previously, was the rig hand's perception of how they viewed the rig management team, their safety and fellow crew. Essentially, Table 6 is an insight from the rig hand from the OIM down through the ranks.

Table 6.
Personal Safety Table; Survey One

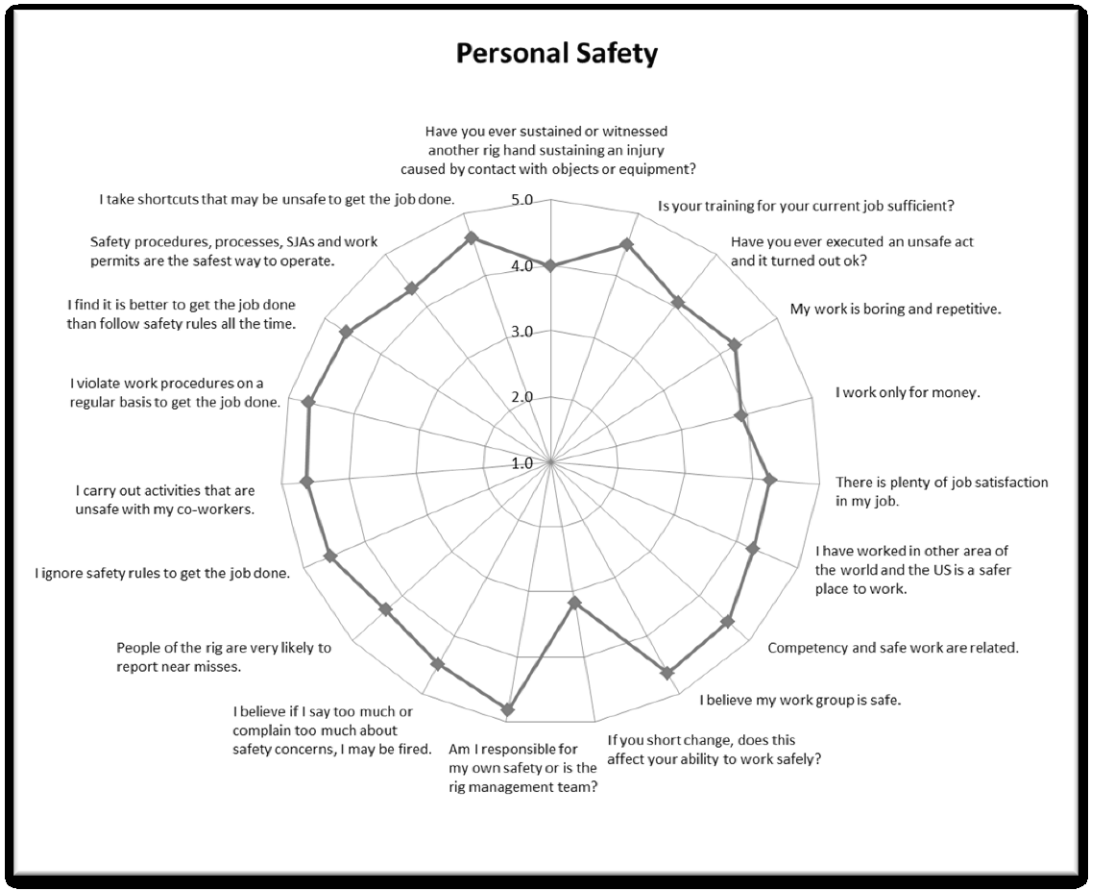


Table 6 (continued). Note: This is a summary of questions which fall under the category of Personal Safety from Survey One. The scale range (1-5) was used throughout the survey. One was the lower or negative response while five was the high or positive end of the question. For example the highest response in this table was to Question 29 of Survey Two; 4.8 (SD=.5). One meant the rig or others are responsible for my safety and five meant I am responsible for my own safety. The lowest response in the table is to the question about short changing and if it affects the rig hand's ability to work safely (Survey Two, Question 28. The mean was 3.2 (SD=1.6). On the scale, one meant "I wish I didn't have to short change as it directly affects my ability to work safe" and five meant "there are no issues with short changing."

Getting To Know You (Survey Setting)

Like any workplace, a rig has a personality. Approximately 30% of the core rig crew was ex-patriots with the balance from the United States[4]. When the rig first arrived in the USGOM, the reverse was true with a majority of the core crew coming from outside of the United States. From September 2009, when the rig went on contract and commenced drilling in the USGOM, to May 2012, the rig crew evolved and changed personalities.[5] The rig crew also endured a six month hiatus from drilling due to the Moratorium in the USGOM after the Macondo incident. During the Moratorium, some of the core crew left the rig for other opportunities as it lay idle from drilling operations. The rig company did not lay anyone off which ultimately helped the rig company recruit employees after the Moratorium was lifted in October 2010.

Figure 6 shows a team of safety committee members from various work groups on the rig. For example, the safety committee members photographed may come from drilling, engineering, deck or catering. From time to time, the safety committee may conduct hazard hunts on the rig in a specific area. If a hazard, unsafe act or condition is found, they are recorded on an ACTIVE card and submitted for the rig management team on board to take action. Some unsafe conditions are resolved immediately and others may take time to repair. Unsafe acts are addressed immediately with the person who is committing the unsafe act and still recorded for action.

[4] This information was verbally provided to the author by the rig contractor's recruiter.
[5] Author's opinion.

Figure 6. Rig Crew. This is a picture of members of the rig's safety committee conducting hazard hunt on the rig. Hazard hunts are used to spot unsafe conditions and eliminate hazards that have gone unnoticed.

Another interesting point from the previous rig manager: one American driller was hired before the Moratorium and recommended several new employees for the rig. The driller brought many new, highly qualified employees to the rig that in turn brought other highly qualified employees to the rig before, during and after the Moratorium. While this is anecdotal evidence, human resources and rig crew who knew the driller confirmed the story. It is a success story in recruiting and evidence of a safety culture. The survey and the attitudes of the rig crew aboard a highly performing rig support this hypothesis.

Of the 99 core crew, there were 163 responses to the surveys[6]. There are 198 total core crew accounting for the back-to-back crew. In other words, there are 99 core crew on the rig at any given time with the other 99 at home. Some of the responses to the position, age, experience, schooling and time on board were not completed. Of the 99 core crew, the rig team is made of a command section and four departments: marine, drilling, engineering and catering. The OIM is in charge of the rig and ultimately responsible for all activities on the rig. The rig admin, SAP (maintenance software) planner, safety officer and medic work in the command section. The marine department

[6] There were two surveys numbered 84 received from the rig administration. Therefore, the second number 84 was renumbered 84A for Survey's One and Two.

is made up of the Barge Engineer (department head), Assistant Barge Engineer, Dynamic Position Officers and able-bodied seaman (AB). The Barge Engineer is second in command on the rig and stands the night tour his whole hitch. The maintenance department is led by the Maintenance Supervisor with technicians, oilers, mechanics and engineering officers working in the engine room and on deck (includes the derrick). The catering department is led by the camp boss that consists of cooks, stewards, and bakers. The largest department on the rig is drilling which is led by the Senior Toolpusher (STP). Under the STP, there is a night pusher, tour pushers, drillers, assistant drillers, crane operators, subsea engineers, floormen, derrickmen, roughnecks, and roustabouts.

Based on survey results, the mean average age was 34.8 (SD=10.2). A 21 year old rig hand was the youngest and 60 rig hand was the oldest on board. The mean average time aboard the rig was 1.8 years (SD=7.8). The mean average time in the industry was 8.5 years with 34 years as the longest in the industry and two months on board as the least (SD=12.5). Interestingly, there were crew in all positions without a high school diploma and crew with post graduate degrees. Of the 163 surveys completed, 135 listed their education. Of these, there were 55 crew that had some college, 38 were college graduates, 33 were high school graduates; seven held post-graduate degrees, and four did not have a high school diploma[7]. One driller with 14 years' experience had no high school diploma. A driller is a very technical job which requires high levels of math for drilling calculations. All the licensed officers in the marine and engineering department have college degrees including the OIMs. The OIMs are required to have formal marine training by most countries. Consequently, especially with the drilling department, education is not as important as ability, aptitude and leadership qualities.

Finally, within the US crew, many of the rig hands hailed from the 601 area code which is in Mississippi. The legend goes a man from the 601 area code decided to work offshore, came back to his home and told all his friends. After that, whole families have come from the 601 area code and worked offshore including this rig. Area code 601 was put into service in 1947 and has been split two times. In 1997 area code 601 was split to form area code 228. In 1999 area code 601 was split to form area code 662. In 2005 area code 601 was overlaid with area code 769. Area codes 601 and 769 serve central

[7] See Appendix B

Mississippi including the larger cities and communities of Clinton, Hattiesburg, Jackson, McComb, Meridian, Natchez, Pearl, Ridgeland and Vicksburg and smaller communities. Ask a rig hand if he's from the 601 area code and he may show the tattoo.

Rig Statistics vs. Industry Statistics

One of the challenges in developing this thesis was finding like sampling, surveys and evaluations of offshore drilling rigs in the US Gulf of Mexico. They may exist but were not found readily available during the research. Fortunately, Darryl Attwood completed a doctoral dissertation entitled "A Reliability Approach to the Quantification of Occupational Accidents in the Offshore Oil and Gas Industry" for the Memorial University of Newfoundland (2006). While the object of the dissertation was to discuss the quality and quantification of oil and gas industry safety statistics, the study provided a great wealth of information regarding systems which demonstrate safe working cultures. Compared to the oil and gas extraction industry safety statistics, the rig has done well.

In section 2.4 of Attwood's dissertation, he offers a discussion of literature "through relevant model development, did not fit well into any of the three foregoing sections" meaning safety culture (Attwood, p. 81). Attwood cites the definition of safety culture as provided in 2003 by the Advisory Committee for Safety in Nuclear in Installations as "the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviors that determine commitment to, and the style and proficiency of, an organization's health and safety management. Organizations with a positive safety culture are founded on communications founded on mutual trust, by shared perceptions of the importance of safety and by the efficacy of preventive measures" (Section 2.4.1).

In the April 2010 Bureau of Labor Statistics (BLS) fact sheet on the oil and gas industry, contact with objects and equipment consisted of 25 percent of the total fatal occupational injuries for industry and the second most frequent event (BLS, 2011). The rig had no such incidents. Furthermore, the oil and gas industry, according to the BLS is grouped in with mining operations. The report showed traffic accidents were the most frequent fatal event for the oil and gas extraction industry. On an offshore oil rig, there are no traffic accidents as all hands are transported by helicopter to and from the rig.

Other authors were cited and of interest in this study were a paper delivered in New Orleans in 1996 by authors R.H. Flin, et. al on "Risk Perception in the UK Offshore Oil and Gas Industry". In section 2.5 of Attwood's dissertation, Flin, et. al were quoted regarding workers views on accident causation and safety culture (2006). 60% or more of the surveyed workers ***disagreed*** with the following statements: (a) sometimes it is necessary to take chances get the job done, (b) the permit to work system is just a paper work system, (c) sometimes it is necessary to ignore safety issues to keep production going, (d) accidents happen, there is little one can do to avoid them; (e) the use of machines and technical equipment makes accidents unavoidable; and (f) I think about the risks now that I am used to work.

For a better assessment of safety statistics between the rig and its counter parts is to review the International Association of Drilling Contractor (IADC) statistics. The BLS Fatal injury data includes oil and gas extraction, drilling oil and gas wells, and support activities for oil and gas extraction. Nonfatal injury and illness data only include drilling oil and gas wells. The IADC collects safety data from member drilling contractor companies and provides this data publicly. In Table 7 shows IADC statistics for the US offshore published in 2010.

Table 7.
IADC US Overall Safety Statistics 2010

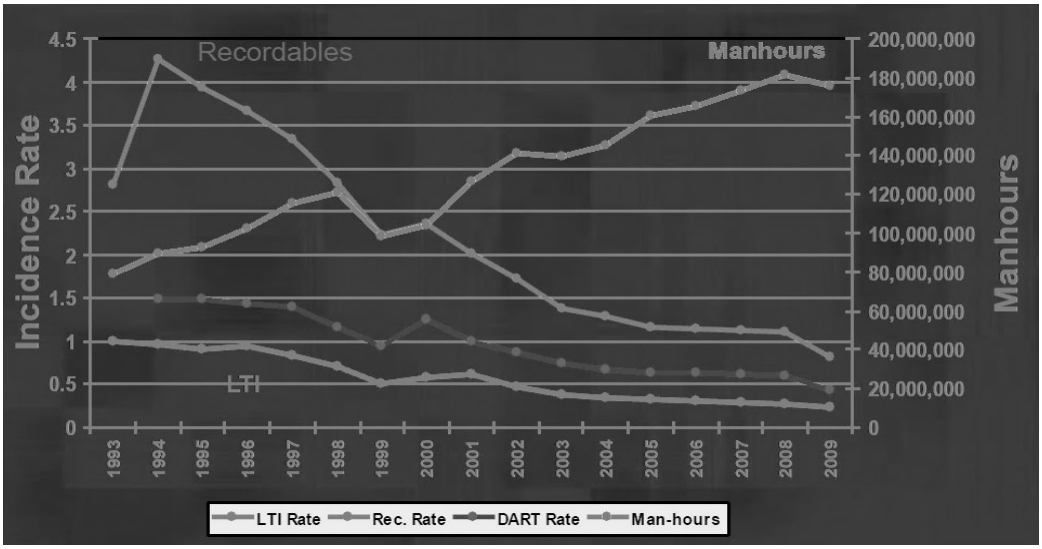


Table 7 (continued). Note: Incident data from offshore rigs in the US.

Source: Spackman, Alan. Drill Safe [Online forum comment]. February 2010. Web. http://iadc.org July 2, 2010.

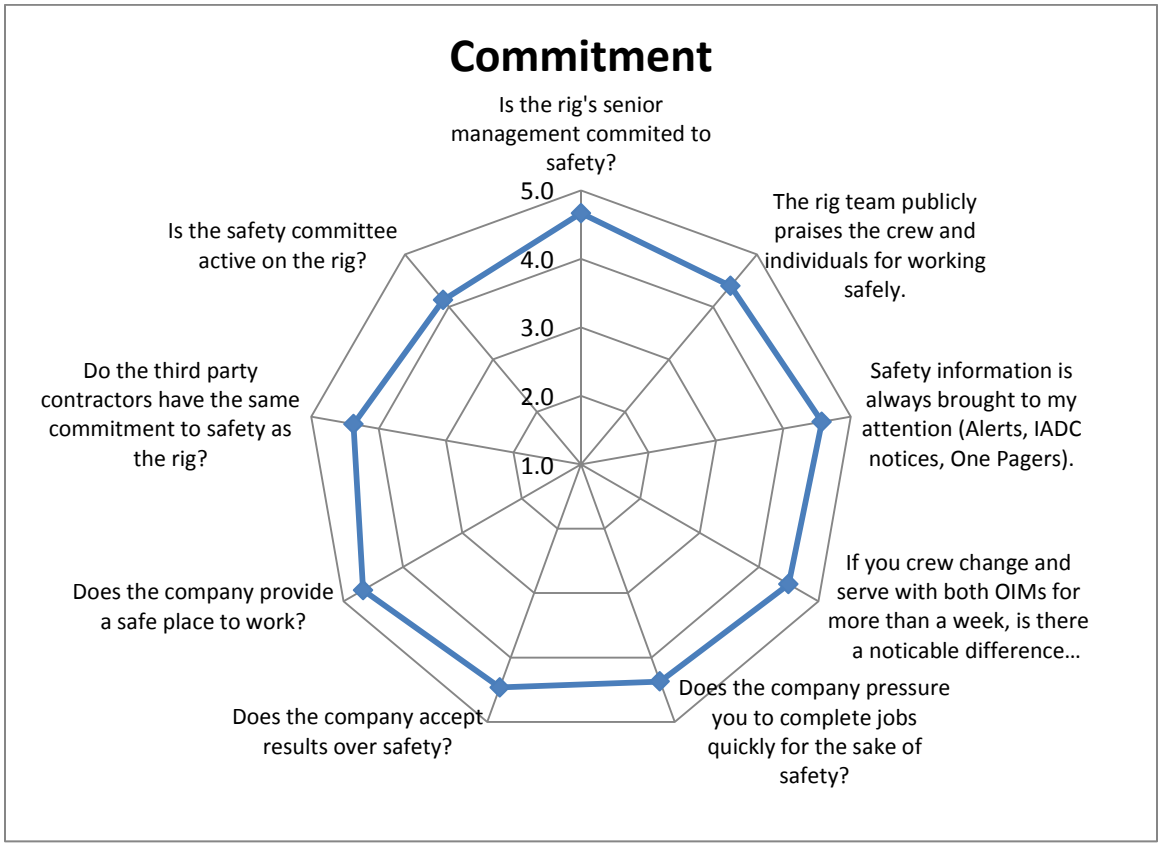
The man hours increased which means more exposure to the worker. Simultaneously, recordable incidents (medical treatment cases and restricted work cases) as well as Lost Time Incidents (LTI) also decreased. LTIs and recordable incidents have plateaued which indicates a gap where future incidents will occur. In other words, as the exposure increased, incidents decreased. In many ways, this proves the theory of process safety: take care of the plant and ensure procedures are followed, incidents decrease. Involve the rig hands with observation cards and other leading indicators, the incidents continue to trend downward. The rig sustained no recordable incidents from September 2009 through the survey period. This demonstrates, in simple terms, the rig's safety culture matured.

Table 8 demonstrates rig management team's commitment to safety from the crew's perspective. In all the research conducted for this thesis, one thing is clear: Leadership starts at the top which means senior leadership in a company, shore base or rig starts at the top of the organization. The table demonstrates how the crew views this commitment for the rig management team off shore and on shore.

The scale for answers was one to five with one being the low end and five being the high end. For example the question about the rig's management commitment to safety and a safe place to work both averaged 4.7 (SD=.6). In the former question, one meant low commitment and five meant high commitment. In the latter question, one meant an unsafe place to work and five meant a safe place to work. This clearly demonstrates the crew believes the rig management team is committed to safety. If the crew believes their OIM and department heads, there is a great chance the rig will have a great safety culture.

For example, if the crew believed the rig management team either in corporate or on the shore base believed in profit over safety, the challenge to prove otherwise by the rig management team would be difficult to overcome. In Table 8, the high mean average for this questions shows the rig crew believe through words and action, the company believes in safety before profit.

Table 8.
Commitment Table; Survey One



Note: From Survey One: a synopsis of the rig hand's view of the commitment to rig safety.

Survey Results

While the questions are largely related to safety culture, there are questions regarding sleep/rest, management, supervisory roles, training, and stop job authority. The first survey deals with how the rig hand perceives safety performance and attitudes within the rig management team and outwards. The second survey is more personal and deals with the rig hand's perceptions on safety and culture. Each question has a 1 – 5 rating system, with 1 indicating negative perception and 5 indicating positive perception.

Only the 99[8] core crew members (including catering) working directly for the rig contractor were asked to respond to each survey. There are 99 core crew members on the

[8] See comments on core crew on page 27.

rig at one time since the other 99 are at home. However, the number is 198 *total crew*. The total crew that responded to the surveys was 164.

There were 163 surveys in the Excel workbook vice 164. This is because survey number 84 was used twice. An identifier of 84A was used to account for this in Survey One and Two. In Survey Two, respondent's 69 and 87 did not complete their surveys. This did not impact on the overall data summary.

No contractor, operator, operator contractors, or shore base personnel were asked to participate. All positions were surveyed from the most senior position OIM to the lowest roustabout. The OIM and rig administration officer ensured the surveys were completed by the crew. OIM and rig administration were asked to provide occasional updates on the status of rig surveys. The goal was to obtain a response to both surveys from each of the 99 or 198 core crew members.

There were 30 questions for survey one and 43 for survey two. Survey questions were broken down into subsets. For survey one: commitment, actions and understanding. For survey two: management, personal safety and supervisors were the subsets. This was done to provide star diagrams to demonstrate averages within the subsets.

Survey respondents put their replies on a paper survey. Please see Appendix A for blank samples of survey's One and Two. The data was entered onto an Excel spreadsheet. Survey questions were broken down into sections as noted on the spider diagrams.

The rig contracting company conducted surveys of its approximately 30 rigs around the world in years previous to 2012. This rig was part of the previous surveys. The survey, called a Safety Climate Survey, was last produced in 2009 which was the last year the company conducted the survey (Maersk 2010). The company survey consisted of 20 questions with categorized under seven dimensions: Policies and Strategies, Procedures, Continuous Control, Communication and Training, Audit, Reviews and Assessments; Hazard and Risk Management, and Safety Leadership. Each question had a similar dimensions in the rig survey; 1 (fully disagree) to 5 (fully agree). The highest point in the company survey was Safety Leadership; 4.3 while the lowest was Audits at 3.9 from the company survey.

Compared to the surveys conducted on the rig, the results were reasonably similar. In Survey Two, Question 36 asks if the participant ignores safety rules to get the job done. This is similar to the company survey questions. The 2012 rig survey averaged for this answer was 4.6 (SD=.6). The answer rate was 90% favorable which exceeded the results cited by Flin in Atwood's dissertation (2010). Question 41 of the 2012 survey asked if safety procedures, processes, SJAs and work permits are the safest way to operate. This is similar to question (b) in the 2010 company survey; the average was 4.3. Question 43 asks if the participant takes shortcuts that may be unsafe to get the job done. The average was 4.6 (SD=.6) which is a high result suggesting shortcuts are not part of the safety culture. Following procedures appear to be an embedded part of the rig's safety culture.

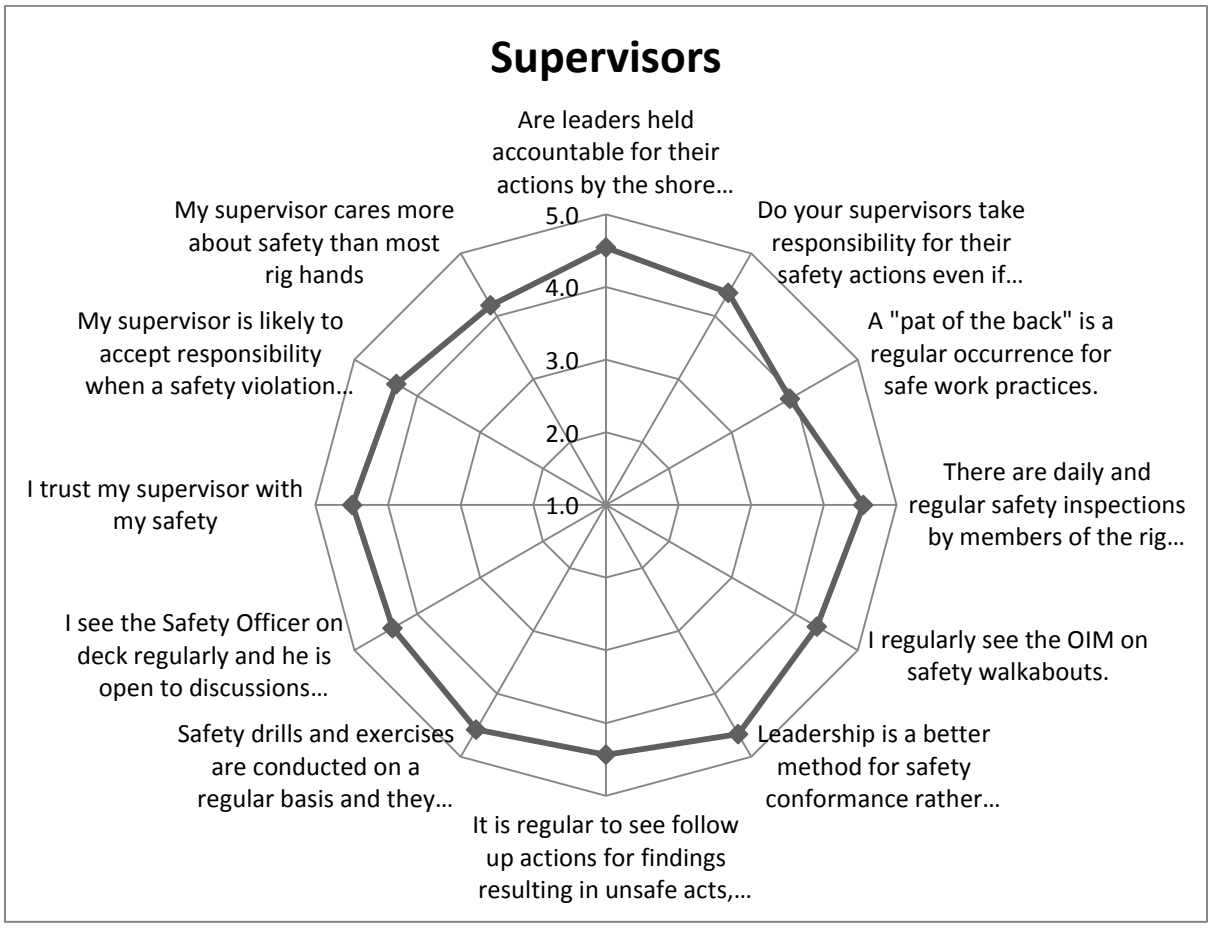
There is consistency between front line leadership in preventing simple incidents such as slips, trips and falls as well as more devastating incidents. "Foremen have been identified as key to accident prevention because their job is to guide and control the workers. Salminen and Saari (1995) commented how production managers and foremen are mainly motivated by production goals, and therefore safety must be integrated into these goals to maintain their motivation" (Snodgrass, Scott, and Lee, 2005, p. 9). It appears from the surveys that management level rig hands understand the impact of incidents and the consequences. The rig teams also appear to understand the connection between up time and down time or as Snodgrass, Scott and Lee state, economic and production losses (2005).

For the rig survey, the second survey which focuses of the rig hand and more specifically, safety leadership via supervisor perceptions provides a companion to the company survey. There were 12 supervisor-related questions. The star diagram noted below provides a positive insight into how the rig hand perceives safety leadership on board the rig.

Table 9 is a great example of how the crew views their supervisors. Imagine if a work team thought their supervisors were not concerned with their safety and demonstrating this by covering up incidents or did not accept responsibility for safety violations. Table 9 expresses how the crew and supervisors worked as a team. Leadership is a better method for safety conformance rather than violations or

punishment except for deliberate violations of safety rules had the highest mean and lowest SD of this group (4.6; SD=.6). In this question, one meant disagree and five meant agree.

Table 9.
Supervisors Table; Survey Two



Note: This table shows the average of questions within the Supervisors part of the questionnaires.

There are commonalities between the company's 2009 survey and the rig surveys with respect to recognizing rewards in 2012 by the rig crew (Maersk, 2010). The lowest average for the rig hand was the question regarding a "pat on the back". 'Leadership is a better method of safety' was the highest average. By a pat on the back, this means compliments or recognition by crew's supervisors. It can be as simple as a literal pat on

the back or formal recognition. Recognition is an integral part of a healthy safety culture. There are many parts to a safety culture which are important for any organization.

In NEBOSHs "Introduction International Health and Safety at Work" (2010, p. 69), a safety culture consists of:

- Leadership and commitment to health and safety throughout and at all levels of the organization;
- Acceptance that high standards of health and safety are achievable as part of a long-term strategy formulated by the organization;
- A detailed assessment of health and safety risks in the organization and the development of appropriate control and monitoring systems;
- A health and safety policy statement outlining short and long term health and safety objectives.
- Relevant employee training programs and communication and consultation procedures;
- Systems for monitoring equipment, processes and procedures and the prompt rectification of any defects;
- The prompt investigation of all incidents and accidents and reports made detailing any necessary remedial actions.

In Survey One, question one, how the rig hand perceives safety performance and attitudes within the rig management team and outwards, the rig hand was asked in several different ways how "committed" to safety. The average was 4.7 out of 5 (value range 1-5). In other words, a significant majority of the respondents believed rig management was committed to safety. (The SD=.6.) Other questions (Question 27) were "Does the company provide a safe place to work?" 4.7 out of 5 of the respondents believe this is true (SD=.6). Question 18: "Does the company accept results over safety?" In this question, which relates to the acceptance of high standards, 4.5 out of 5 agree (SD=.8).

In Survey One, several questions related to actions by the rig management team. The questions revealed a high level of trust with the rig management team. These are the questions with average responses on trust as found in Table 10:

Table 10.
Level of Trust

QUESTION FROM SURVEY ONE	AVERAGE RESPONSE/SD
4. The shore management team demonstrates the company's Safety and Health Policies. (Five means that you see evidence of the shore base management team living the company's Safety and Health Policies.)	4.5/.7
6. How do the company's policies match its actions regarding health and safety policies? (Five means the company's actions and policies match a majority of the time.)	4.4/.7
13. Do the rig and shore base management teams place an emphasis in productive time over stopping the job for safety concerns? (Five means safety is more of a concern.)	4.3/.8
15. Do you believe the goals and policies align with actual practices on board? (Five means I agree.)	4.1/.9
16. Are rig management safety priorities and shore base management priorities consistent? (One means I see no consistency.)	4.4/.8

Note: Level of Trust: Rig Management Team. The scale of the responses was 1 to 5, with one as the lowest value and five as the highest. This demonstrates a consistent high response from the rig crew for the questions posed.

Simply put, the crew sees the rig management team as committed to safety, policies, leadership on board the rig. There is a clear acceptance of high standards of health and safety has been achieved on the rig.

A robust safety culture has systems for monitoring equipment, processes and procedures and the prompt rectification of any defects. In Survey Two, question 19, perceptions of the rig hand, one question speaks to prompt rectification of defects: Is the ACTIVE card system (Behavior Based System-BBS) effective? 3.7 out of 5 respondents agreed (SD=1.1). Does this mean the monitoring system (ACTIVE cards) does not

support identification and rectification of defects? Not really. The answer can be attributed the ACTIVE system and how well the crew like the reporting system. As noted in Tables 2 and 3 previously, the participation in the ACTIVE card system aboard the rig was very good; actions taken by management were excellent. These are all indicators of a positive safety culture as proved in Table 11.

Table 11.
Safety Management System

QUESTION FROM SURVEY TWO	AVERAGE RESPONSE/SD
36. I ignore safety rules to get the job done. (5 means the respondent did not ignore safety rules.)	4.6/.6
37. I carry out activities that are unsafe with my co-workers. (One means this is true on a regular basis.)	4.6/.5
38. I violate work procedures on a regular basis to get the job done. (Five means the respondent did not violate work procedures.)	4.7/.5
39. I find it is better to get the job done than follow safety rules all the time. (Five means this never happens.)	4.6/.6
41. Safety procedures, processes, SJAs and work permits are the safest way to operate. (Five means I agree.)	4.3/.9

Note: Survey Two asked questions regarding the rig's safety management system which, according to OSHA and EPA, are integral to the rig's process safety.

This was the lowest of the entire series of questions regarding procedures and processes. Nonetheless, the overall opinion of the rig management team and the management system is favorable as Hekmat suggests is a critical part of the organization's safety culture (2010).

Within the spectrum of closing out findings and actions in Survey Two Question 26, the rig and the team did quite well. It is regular to see follow up actions for findings resulting in unsafe acts, conditions and incident investigations: average 4.4 (SD=.8). The

crew felt the rig management regularly followed up on actions that resulted from observation cards findings (unsafe acts or conditions) and incident investigations. The ACTIVE observation cards also allowed the crew to make recommendations for safety. Compared to other responses, this was the lowest mark: Question 42: When safety improvement is recommended, it takes very little time to implement this on the rig. Average 4.1 (SD=.9). Like any complicated operating plant like a drilling rig and maintaining budgets, it does take time to make improvements. The rig team appears to manage this well.

Table 12 is a proper summation of how the rig crew views the leadership on board the rig from the OIM to the Company Man. There is a phrase commonly used in describing how to deal with praise and discipline: praise in public and discipline in private. Question 9 from Survey One demonstrates the crew regularly sees the rig management team publicly praising the crew (4.4 mean). One avenue this is seen by the crew is at weekly safety meetings. During the meetings, the OIM and Company Man award members of the crew for "cards of the wee" or "catches of the week" or other term used by the rig. ACTIVE or observation cards are reviewed by a group of senior staff on the rig given by the rig's safety officer. The best cards (2 or 3) are recognized by the OIM and a small token of appreciation is given to the crew member. The Company Man manages their award system. Other praises which are taken on the rig are spot awards for outstanding safety performance.

Question 16 from Survey Two in Table 12 demonstrate the rig management team's visible leadership (mean 4.4). Some may call this "leadership by walking around". No matter how one phrases it, visible leadership is a significant key to a rig or work group's safety culture. A member of the crew who sees the OIM regularly knows the OIM is interested in the rig crew's safety, performance and material condition of the rig.

Table 12.
Visible Leadership

QUESTION FROM SURVEY ONE	AVERAGE RESPONSE/SD
9. The rig team publicly praises the crew and individuals for working safely. (Five means the rig management team consistently praises the crew.)	4.4/.8
12. Does the rig team support a safe work atmosphere? (Five means the rig management team supports and actively participates in a safe work atmosphere.)	4.6/.6
20. How would you rate the rig management team's safety performance? (Five means a high safety performance.)	4.5/.6
QUESTION FROM SURVEY TWO	
9. The company man and staff are very involved in the safety culture on board this rig. (Five means the company men are very active participants.)	4.2/1.0
14. There are daily and regular safety inspections by members of the rig crew. (One means safety inspections rarely happen.)	4.5/.6
16. I regularly see the OIM on safety walkabouts. (Five means this is a regular occurrence.)	4.4/.9
21. Poor management and safety supervision are directly related to poor safety performance. (Five means I strongly agree.)	4.4/.9

Note: Visible leadership with a commitment to safety including a shared vision is also critical to the rig's safety culture.

From the responses above, the rig crew and management appear to have a shared vision for safety; leadership, two-way communication, employee involvement, learning culture, and attitude towards blame. Five was the highest value possible and the response averaged 4.47. Despite the high potential dropped objects which would have killed anyone in the way, the procedures were adhered to and no one got hurt. The rig management team understood the consequence of additional high potential drops and the

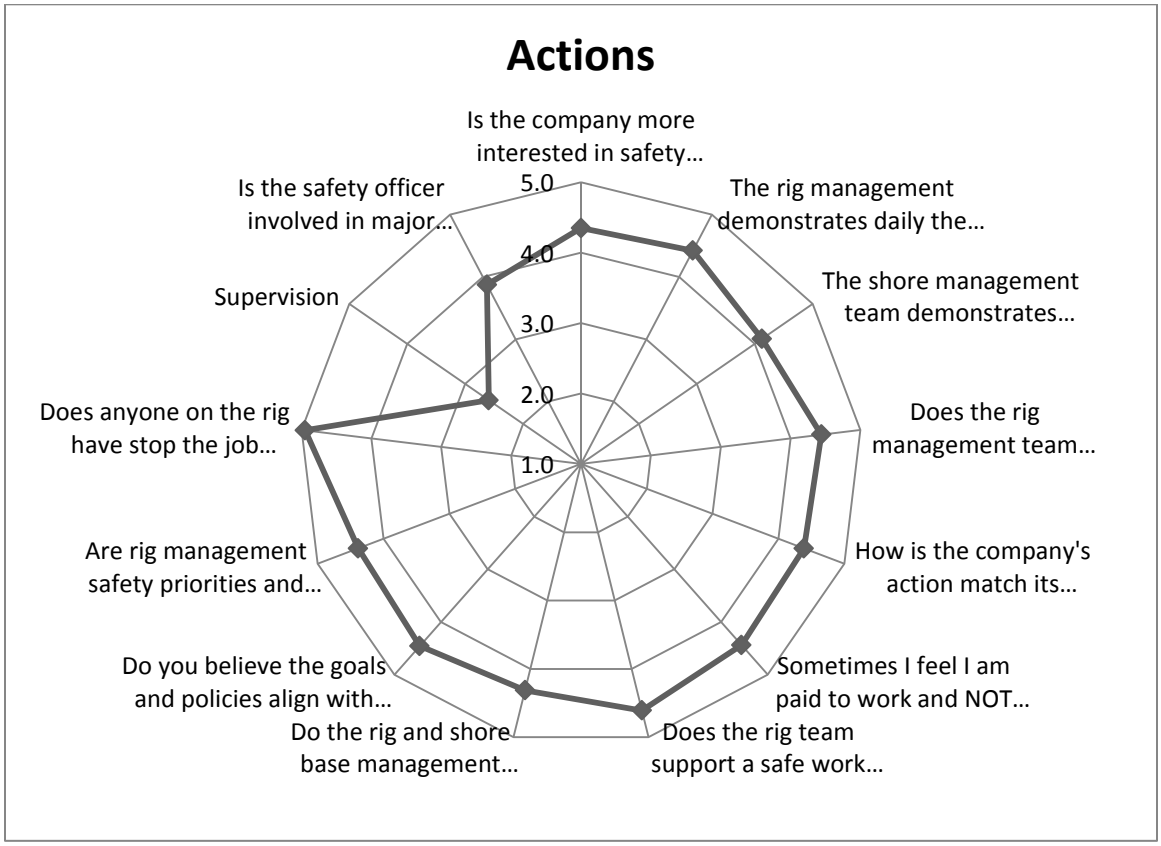
negative relationship with the operator (oil company) and made changes culturally, in equipment and procedurally. No one got fired, or run off, after any of the dropped objects.

Throughout the rig survey, the perceptions of the worker, no matter the position, did not change. The survey average for actions and safety were quite high. Note the low average for "Supervision" was related to a question ranking the causes of injuries. Supervision was ranked fourth after experience, training, safety culture and before age.

The findings above are consistent with the University of Georgia article on work-life balance and worker safety (Sorrow, 2012). The evidence suggests the rig management team is engaged with the crew to promote the safe systems of work, management systems, policies and procedures. The rig's operator (oil company) had a hand is this as well. If an operator comes on the rig and attempts to change the culture to their company, it will be reasonable to assume conflict will follow. Fortunately, the (four) operators did not impose their culture on the rig but allowed the rig to work as it had. The evidence suggested by Sorrow demonstrates how critical the rig leadership team is to the rig's safety culture and safety climate (2012). There is sufficient evidence to suggest the safety controls employed on the rig's parent company and management team were "maintained, and that falls on management" and the team "enacted policies and procedures—not formalized ones but those acted upon" (p. 2).

We have all heard that "actions speak louder than words" and this is demonstrated in Table 13. As noted below, the perceptions of the rig crew aligns with empowerment. Those in the most dangerous jobs felt no less safe than those in supervisory positions. Table 13 shows how the crew perceives the rig management team's actions such as stop work authority, priorities, supporting a safe work atmosphere and commitment to health, safety and environmental policies.

Table 13.
Actions Table; Survey One



Note: This table is a summary of questions asked in Survey One regarding actions perceived by the rig hand regarding actions by rig management including shore base. Supervision is one question in the Actions Table that relates with a question found in Table 21 regarding what will prevent an incident (supervision, age, experience and safety culture). Complete questions can be found in Appendix A.

The study concluded the direction of the relationships among safety-related theories and the levels at which these effects operate. Furthermore, the Neal & Griffin suggested there are new insights into the role of motivation in workplace safety and the dimensionality of safety behavior with their study (2006). Neal and Griffin believe from their study that positive motivation is a better means to get works to be safe rather than simply blaming and punishing them for failing to comply with standard work procedures (2006). When "individuals perceive there is a safe working climate, they will reciprocate by allocating effort to discretionary safety activities" (p. 952).

From the answers in Table 14, it is clear the rig crew meets the hypotheses suggested by Neal and Griffin (2006). The rig's safety climate has a positive lagging effect on individual safety motivation. The rig hand's safety motivation ensures compliance with rig safety procedures and participation. The reader is reminded of the safety participation of the rig crew in the safety observation program. The rig crew also believed safety leadership is more important for safety participation and compliance rather than punishment.

Table 14.
Safe Work Environment

QUESTION FROM SURVEY ONE	AVERAGE RESPONSE/SD
9. The rig team publicly praises the crew and individuals for working safely. (Five means the rig management team consistently praises the crew.)	4.4/.8
17. Does the company pressure you to complete jobs quickly for the sake of safety? (Five means this rarely, if ever happens.)	4.4/.8
18. Does the company accept results over safety? (One means safety is not as important as making hole.)	4.5/.8
20. How would you rate the rig management team's safety performance? (Five means a high safety performance.)	4.5/.6
21. Does anyone on the rig have stop the job authority? (Five = yes)	4.9/.5
27. Does the company provide a safe place to work? (Five means a safe workplace.)	4.7/.6

Table 15 is a mixture of responses to leadership and award questions. It is obvious the crew believes safety awards are effective and leadership is the best method for safety conformance rather and punishment.

Table 15.
Leadership and Awards

QUESTION FROM SURVEY TWO	AVERAGE RESPONSE/SD
17. Do safety awards work on the rig? (Five means safety awards are effective in reducing incidents.)	4.6/.8
23. Leadership is a better method for safety conformance rather than violations or punishment except for deliberate violations of safety rules. (Five means I strongly agree.)	4.6/.6
34. I trust my supervisor with my safety. (One means my supervisor is more interested in getting the job done.)	4.5/.8
35. My supervisor cares more about safety than most rig hands. (Five means this is very true.)	4.2/1.0

Note: Safe Work Environment. For the rig survey, when the rig hand believes they are in a safe working environment, they will make a concerted effort to work safer. The rig survey aligned with Neal and Griffin's study.

Within each survey, during collation of answers, it was found some of the questions were not worded well. For example, Survey One, Question 11 asks: "Sometimes I feel I am not paid to work and NOT think about safety." One means this is ***not*** true and five means [I] am paid to think and work safely. Some of the crew was confused by this question and this had to do with the word "paid". This goes back to some old rhetoric from the early days of drilling: "you are not paid to think but do." Perhaps a better question would have been: Does the rig management team expect you to think and act safely? Nonetheless, the average/mean answer for Survey One, Question 11 was 4.4 (SD=.9). Survey One, Question 22 did not elicit the responses intended. The selections followed the scale of 1-5 least to most importance. In other words, the rig hand was asked to rank order the five selections. This is different than the questions throughout the survey where perceptions/opinions were rated from 1 (low) to 5 (high). This could only mean the question was not worded properly. Nonetheless, the data gained was sufficient to make evaluations. While there is no substantive data to suggest

survey fatigue as noted by P. D. Chen, some of the written responses (made by the respondent in the survey; personal note) for defining safety culture may suggest some fatigue (2011). Fortunately, the rig's parent company did not require constant surveying of the rig crews. There was only one survey made mandatory by the corporate office each year. While this is not available for public consumption, it dealt with the employee's perception of the company from safety to training to leadership. Therefore, survey fatigue while not readily apparent or demonstrative and played a minor role.

Survey Notables

Throughout the survey compilation, a few survey comments stood out. Here are some comments from Survey One for the definition of safety culture in Table 16: The survey question asked what the respondent's definition of safety culture was. There was no right answer. The Literature Review demonstrated there were several definitions of safety culture. It is interesting to see how close some of the crew comes to definitions listed in journals and text. About half of the respondents answered the question with their definition of safety culture. Only the best answers in the author's opinion are presented in Table 16.

Table 16.
Crew Interpretation of Safety Culture

COMMENT	POSITION
Culture that is self-imposed.	Auxiliary Driller
Safety is of most importance.	No position given
An atmosphere in which all personnel on board work toward a common safety goal and at no time accept less from their peers.	Night Toolpusher
All items in question 22 were part of the safety culture.	No position given
Attitudes and values held by employees and management in regards to safety.	Electronics Technician
Question 22: One participant listed complacency as a cause for injuries.	No position given

Note: Crew Interpretation: Safety Culture. The summary comes from Survey One. There were several questions scattered throughout the survey asking the rig hand's impression or opinion on Safety Culture. These are just a few samples.

Question 22: One participant listed complacency as a cause for injuries.

Survey Two which measures the safety perceptions of the rig hand provided some interesting results.

Question 7 asked if the rig hand's work was boring and repetitive. While the average was 4.3 (SD=1.0), there were several responses in the low band or "my work is boring and repetitive". Perhaps a follow up would compare incidents on the rig to repetitive work. If there are consistent incidents an engineering solution may be sought.

Question 12 asked if a "pat on the back is a regular occurrence." The average was 3.9 (SD=1.1) but researched several surveys rated much lower which is not consistent with a mature safety culture. A follow up with the rig management team appears to be in order to evaluate leadership engagement with the crew.

Question 28 asked about short changing. This is when a member of the crew on a night tour (shift) stands an abbreviated tour to allow for his back-to-back to take his night

tour and the remaining crew takes the day tour. This question averaged 3.2 (SD=1.6[9]) which were the lowest of all the averages. Some crew even commented on the danger of this practice. Short changing is common to the drilling community much like standing two four-hour watches on a ship are common. See Chapter 5.C for more discussion on short changing and shift work.

Question 35 asks if the respondent's supervisor is likely to accept responsibility if there is a violation in the work group. The average was 4.3 (SD=1.0). Question 40 asked if the participant's supervisor cares more about safety than most rig hands. The average was 4.2 (SD=1.0). There is a small amount of dissatisfaction on board the rig for their supervisor's actions for safety. One participant stated, when responding to question 35[10], remarked that "[it] depended on which of the supervisors were on board." There were a few participants who rated both questions as one. Generally speaking, the surveys were positive and a good reflection on the rig management team. The rig's management team afloat and ashore should take the comments seriously.

[9] Largest deviation of the survey; 1.6

[10] My supervisor is likely to accept responsibility when a safety violation occurs within our workgroup. (Mean 4.3; SD=1.0)

CHAPTER V

PROCESSES AND PEOPLE

Process Safety and Safety Culture

Process Safety Management (PSM) is required by US regulation as the basis for major hazard regulation. The US Environmental Protection Agency (EPA) and OSHA enacted PSM regulations after a series of industrial accidents. In 1992, OSHA initiated 29 Code of Federal Regulations (CFR) 1910.119; Process Safety Management of Highly Hazardous Chemicals under Section 304 of the Clean Air Act. There are 13 elements of the regulation and one of the elements is a management system.

Process safety and safety management systems are integral to a successful safety culture. So what does it take to make a safety management system "first in class" (Heckmat, 2011)? According to Hekmat, "effective safety is not just about mechanics, programs and other prescriptive matters" (2011, p. 31). The following elements are part of any good safety system according to Hekmat. Metrics must include leading and lagging indicators, as well as daily and monthly metrics (Heckmat). If the rig management states that safety is number one, do they have the numbers to prove it? Teamwork and collaboration must be the cornerstone of all activities.

This thesis has taken into account past incidents when assigning applicability to the rig's operation as described in Atherton and Gil's "Incidents That Define Process Safety" (2008). Are there incidents that have happened in other industries that could apply to the rig surveyed? If so, what is the rig team doing to prevent such incidents?

From December 2009 to January 2010, the rig suffered six dropped object incidents. Each of the drop objects exceeded 40 Joules. While no one got hurt, it was unacceptable to the rig's performance, safety culture and the client's expectations. Improvement was the only option and to learn from the drop object incidents from the attending investigations. The consequences of failing to correct the dropped object situation would have put the rig operation in jeopardy.

For the rig's parent company, a dropped object is falling from a fixed position to a place of rest. A dropped object over 40 joules is considered to have enough energy to hurt, maim or kill a person. For example, an object weighing one kilo dropped from five

meters will generate 49 Joules of energy. Imagine dropping a bag of apples from five meters; you could really hurt someone. If you drop 100 kilos one meter, it will generate 981 Joules and certainly kill or maim.

The drops from December 2009 to January 2010:

1. While landing casing, a joint of casing was rolled from port to starboard to fill the last gap in the lower row. The wood spacer broke off and when then casing rolled past, the wood flew over the hand rail falling into the welders work area. The piece of space wood (8ft x 2in x 4in) generated 470 Joules of energy.
2. During a lifting maneuver to handle 16 inch casing, a joint of the casing slid thru the Vee Door Machine (VDM) head and back down onto the Riser Pipe Shuttle (RPS). The casing weighed 1905KG and generated 203,699 Joules of energy. The investigation revealed there was a similar incident in May 2009 and the manufacturer was aware of a possible software issue with the controls. A Failure Mode Analysis and produced several software changes to prevent the same incident from occurring. Figure 7 shows the dropped casing.

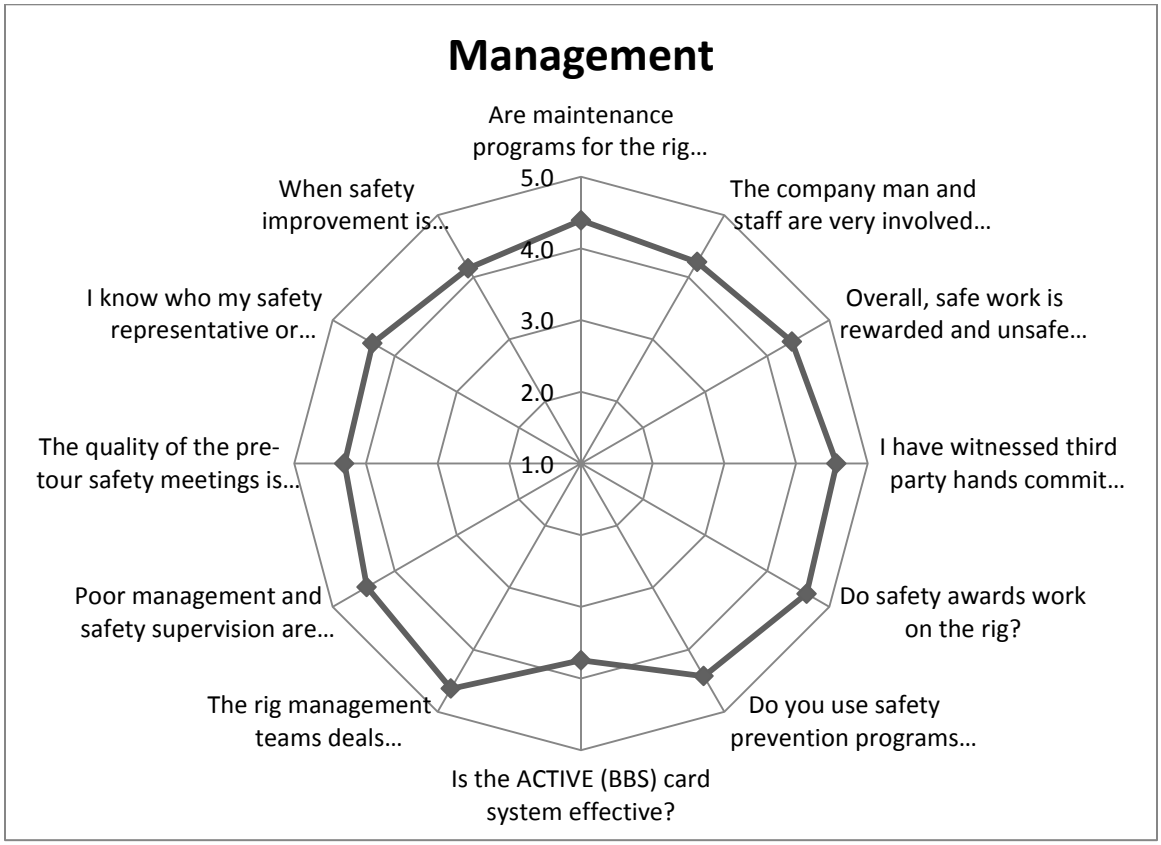
Figure 7. Dropped Casing. The dropped casing is seen in the picture lying across the red zone.

3. A lift bringing a 4ft x 4ft x 4ft baskets full of drill pipe end protectors located in the setback area was dropped when the basket caught on an overhang structure of the Riser Pipe Shuttle (RPS) track. Each drill pipe protector weighed 3.6KG and generated a total of 807 Joules.
4. Pipe was lifted clear of well center and retracted towards the Riser Pipe Shuttle (RPS), in the operation of passing the joint from the VDM to the RPS the VDM Head Vertical function was left activated in error with the result that the head could not "float" as required to allow the pipe to be laid out and in turn caused the pipe to be forced from the VDM clamp and out through the gripper arms with the pipe falling to the drill floor. The drop generated over 74 Joules of energy.
5. A piece of metal from one of the tripping elevator head lifting inserts weighing 1.82Kg fell off the main Vee Door Machine (VDM) from a height of 17m bounced on the rig floor and continued to fall through the opening for the VPC and landed in the setback area 22m below. The drop generated 696 Joules of energy.
6. During tripping in (hole) operations, the drill crew was making up stands of drill pipe; the driller noticed an unusual movement in the tool joint breaker and then observed debris falling to the drill floor. One bushing 9cm long weighing 400gms creating approximately 170 joules had fallen from the tool joint breaker at a height of 140' landing inside the red zone.

The UK Health and Safety Executive (HSE) reviewed existing literature on the causes of major hazard incidents and control measures and behaviors that may prevent incidents occurring (Bell and Healy, 2006). One of the factors considered by the research was safety culture. All of the papers appear to find common behaviors in safety culture: leadership, two-way communication, employee involvement, learning culture, and attitude towards blame. The authors state, “Effective leadership is for the management’s commitment to safety to be highly visible; senior managers should demonstrate visibly and repeatedly show their commitment to safety throughout all areas of the organization. This will create a shared vision of the importance of safety” (para. 3.2.1.1.2).

Considering the number high potential incidents that occurred between December 2009 and January 2010, critical safety leadership was required to turn the tide and change the safety culture on board the rig. Factors to consider for a viable safety culture are two-way communication, employee involvement, learning, and the attitude towards blame. Table 17 demonstrates the high evaluation on senior management's involvement in safety.

Table 17.
Management Table; Survey Two



Note: The Management section comes from Survey 2 where the rig hand is more introspective of safety commitment by management.

Leadership and Personnel

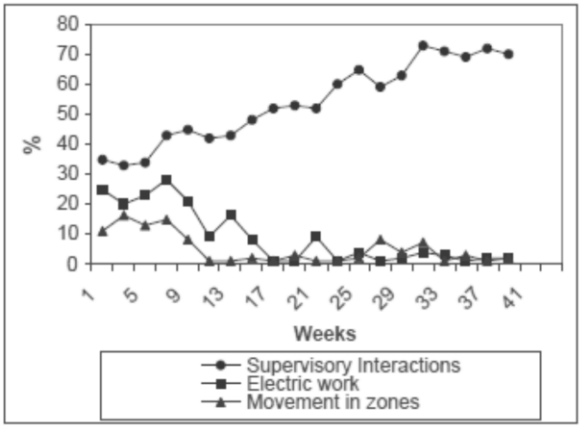
Safety leadership, as it has been demonstrated, is vital to an organization's safety culture. "Safety behavior presents a paradox to practitioners and researchers alike because, contrary to the assumption that self-preservation overrides other motives

(Maslow, 1970), careless behavior prevails during many routine jobs, making safe behavior an ongoing managerial challenge" (Zohar & Luria, 2003, p. 3). Zohar & Luria examined safety-oriented supervisory interaction and safety behaviors and found management interventions were "based on the idea that supervisory monitoring and contingent rewarding (or punishing) will modify the cost/benefits ratio associated with safety behavior, which is initially biased against safe behavior in routine work situations" (Zohar & Luria, 2003, p. 16). When a supervisor or manager intervenes, in short, good things happen.

Zohar and Luria's safety management surveyed leadership in various plants, safety-oriented supervisory interactions; safety behaviors and a group safety climate were organized for an oil refinery, baked goods processing plant and milk processing plant. The survey on the rig was not as extensive regarding interactions and behaviors but was more robust when it comes to the safety climate. Table 18 shows the supervisory interaction increasing over the period of 41 weeks. Management decided electrical work and movement within safe zones was paramount to worker safety. Theoretically, the plant safety posture increased. This was confirmed by the safety climate survey.

Table 18.
Safety Leadership and Intervention

Company A: Oil refinery sub-section



Notes: (a) Workers' data refer to % unsafe behavior.
(b) Intervention started on week 9 and ended on week 21.

Note: Safety leadership and intervention is critical for plant safety.

Table 18 (continued). Source: Zohar, D., & Luria, G. (2003). The Use of Supervisory Practices as Leverage to Improve Safety Behavior: A Cross-Level Intervention Model . Informally published manuscript, Technion Institute of Technology, Haifa, Israel and Institute for Work and Health, Toronto, Canada. Figure 1.A.

As mentioned in Zohar & Luria's study, personnel are critical to a rig's safety performance. After all, it's the plant or rig hand closest to the work that will get hurt or create a dangerous situation for others. Michael Christian, Jill C. Bradley, J. Craig Wallace, and Michael J. Burke wrote "Workplace Safety: A Meta-Analysis of the Roles of Person and Situation Factors" which examined safety knowledge and safety motivation regarding safety performance behaviors (2009). Within Christian's, et.al work there is a discussion on safety climate and this is the applicability to this thesis research. Christian stated "group-level safety climate as shared perceptions of work environment characteristics as they pertain to safety matters that affect a group of individuals" (p. 1106). Group workers are best served by management commitment, best human resources management practices, safety systems, supervisory support, internal group processes, risk and work pressure. In the analysis, Christian, et. al found with regards to safety compliance versus safety participation, safety climate tended to be more highly related to safety participation than safety compliance (2009). What does this mean for the rig?

Participation in safety programs is more important than safety compliance. For the rig survey, questions regarding safety programs and compliance were asked (Christian, et. al.) also found that safety climate, safety conscientiousness, safety knowledge, safety motivation lead to safety performance. All of these factors in a negative sense lead to poor accidents and injuries. So how does the rig compare to Christian's supposition? Before answering this, examining the human interface with safety is required.

"Factoring the Human into Safety: Translating Research into Practice, Crew Resource Management, Volume 3 (of 3)" published by the HSE in the UK was an important study into benchmarking, accident analysis and crew resource management (Mearns, et.al, 2003). Analysis from offshore installations in the UK sector of the North Sea provided the source for the study in the late 1990s. The aim of the crew resource

management section of the HSE study was to "evaluate a form of human factors training called Crew Resource Management (CRM) which is intended to improve safety, productivity, and to reduce down time on offshore installations" (Mearns, et. al, p. 11). The report issued two findings: CRM appears to be a valuable method of providing human factors training to offshore installation crews. CRM can 'close the loop' between accident analyses/ human factors research and offshore safety training.

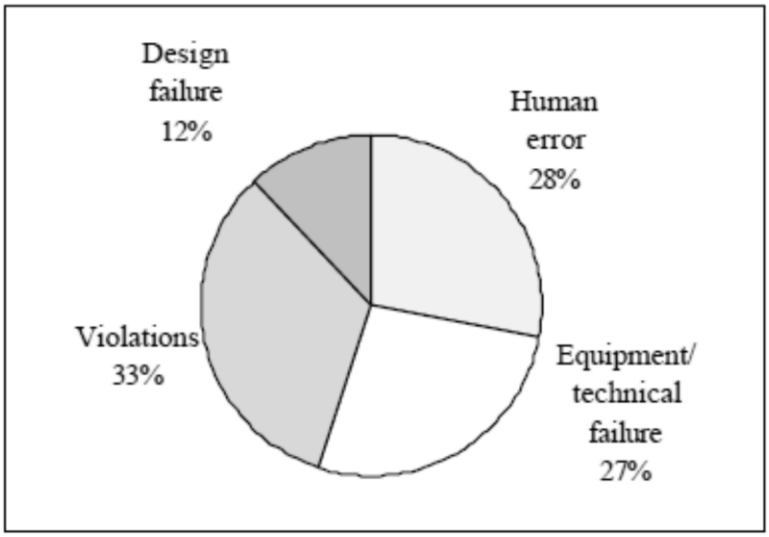
As noted in the Table 19, safety violations are the largest causal factor for offshore incidents followed by human error and equipment failure. Whether the rigs offshore are production platforms or drilling rigs, there is a control room (called a dog house on rigs). Like airline pilots in cockpits, these control room operators require training in CRM. The control room operators were trained before the study in decision making, communication, stress, and assertiveness. The training was based on airline pilot training which, in many way, were similar to offshore operations. After the training, the crews were given questionnaires on the training and its impact in their roles. The range of the responses was like the rig survey used in this thesis: 1-5. The average of the responses for CRM background was 4, situation awareness 4, decision making 4, communication 4, team coordination 4, fatigue and shift work 4, stress was 4 and overall, surprisingly, the average was 4. The course also evaluated the crews' effectiveness in safety, productivity, and reduction in down time. There are synergies between CRM and the rig. There are also synergies between safety climate, safety conscientiousness, safety knowledge, safety motivation, safety performance and CRM.

Understanding causal factors, or reasons behind incidents, is a part of any safety program ashore and afloat. This means thorough investigations of incidents and especially near misses are critical to any factory or rig understanding and preventing incidents. Like resources management, understanding how the work group operates is like understanding incidents and their causes. Table 19 is a summation of incidents studied in the North Sea on rigs and platforms. While safety violations are the largest of the group, human error is the next largest causal factor for incidents from Mearns, et. al study. How much does human error play into equipment or technical failures? Human factors and how the human interfaces with other members of the work team and

equipment are critical to a rig's safety culture. While Table 19 provides a good insight into North Sea causal factors, this research did not investigate causal factors.

Table 19.
Causal Factors

Figure 1. Percentage involvement of causal factors in offshore incidents.



Note: Safety violations are the largest causal factor for offshore incidents followed by human error and equipment failure

Source: Mearns, Kathryn, Sean Whitaker , Rhona Flin, Rachael Gordon, and Paul O'Connor. United Kingdom. Health and Safety Executive. Factoring the Human Into Safety: Translating Research Into Practice. Aberdeen: Crown, 2003. Print. Page 4.

Survey One, Question 28 asks several questions with safety leadership and the importance of training: "I have completed a safety leadership program on the rig or at another company." There were two possible answers to the survey question: 1=I received safety leadership training at another company. 5=I have received safety leadership training on the rig. The average response was 3.6 (SD=1.9[11]) which indicate either the respondent did not have any training or received the training from another company. The problem with this result is the company does not form the training and expected outcome

[11] Largest deviation in Survey One.

for the training. As in the training for the CRM study, the course was designed for an expected outcome. Different rig companies have different emphasis on safety programs.

In Survey One, Questions 22-26, the rig crew was asked to rank what you think are the causes of injuries to the following positions: training, supervision, safety culture, age and experience. Most of the crew believed lack of experience was the most important factor; 3.9 (SD=1.3). Training was the next factor leading to incidents; 3.3 (SD=1.4). Safety culture was third (3.0; SD=1.6) followed by supervision (2.6; SD=1.2) then age (2.3; SD=1.5).

In Survey Two, Question 5, the following was asked: "Is your training for your current job sufficient?" The crew averaged 4.5 (SD=.7) which suggest the crew is sufficiently trained for the job. Regarding emergencies (Question 20), the following was asked: "The rig management teams deal professionally with emergencies." The crew average was 4.6 (SD=.6). Safety drills and exercises are conducted on a regular basis and they add value to the rig's safety culture according to the survey (Question 27). An average of 4.6 (SD=.8) agreed with this assessment. The crew was asked if poor management and safety supervision are directly related to poor safety performance (Question 21). 4.4 agreed to this assessment (SD=.9). Question 22 asked if competency and safety are related. 4.6 of those surveyed agreed (SD=.8). Crew training and emergency drills and management scores are consistent and support the CRM and Christian's et. al study (2009).

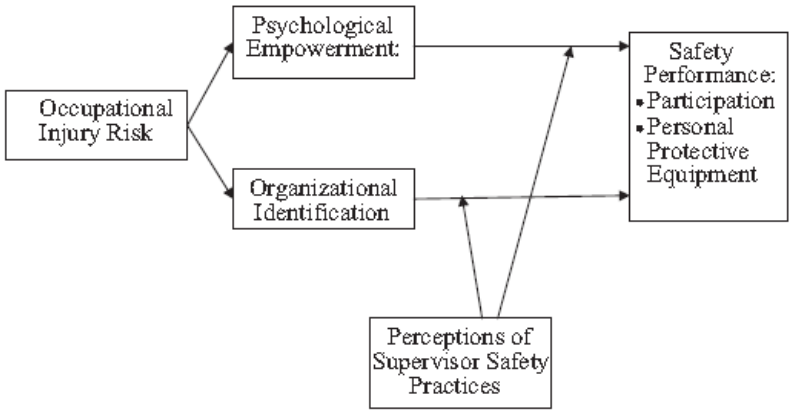
Regarding rig crew participation in safety programs on the rig, does the crew find participation more important than safety compliance? Christian, et. al research found that safety climate, safety conscientiousness, safety knowledge, safety motivation lead to safety performance (2009). A review of Tables 2 and 3 demonstrate the rig crew valued participation over compliance.

Attitudes, People and Performance

What does psychological empowerment and organizational identification with respect to occupational outcomes and leading indicators have to do with safety performance (Ford & Tetrick, 2011)? The authors raised seven hypotheses in studying hospital environments noted in Table 20. The participants in this study were employees of a small community hospital in the US. Of the 900 surveys distributed and 198 were

returned which equaled a 22% response rate. (The response rate for the rig survey was 82.4 %.) The highest number of participants in Ford & Tetrick's survey was registered nurses and the lowest were counselors/psychologists/social worker and a licensed practical nurse.

Table 20.
Hypotheses



Note: Ford & Tetrick's outline of study hypotheses

Source: Ford, Michael T., and Lois E. Tetrick. "Relations Among Occupational Hazards, Attitudes, and Safety Performance." *Journal of Occupational Health Psychology*. 16.1 (2011): 48-66. Print. Page 49.

The authors found common sense results: employees in the same institution but different workgroups showed varying scales of empowerment. Interestingly, hazardous positions typically meant differences in employee attitudes; positions with hazardous work felt less empowered. One of the findings from the study showed employees in hazardous occupations tend to feel less psychologically empowered and identify less with their organization than do their counterparts in less-hazardous situations within the same worksite. One can conclude the incident rates for these employees are higher than those employees in less hazardous occupations.

No matter where one works, attitude is an important value for work and safety at work. From 1995-2000 the UK HSE and the University of Oxford conducted a studies on offshore work characteristics, mental and physical health for offshore personnel, and safety attitudes and perceptions and other factors influencing work offshore such as

environment and health (Parkes, 2002). Some of the key findings with respect to job characteristics showed management personnel indicated the highest level of workloads and management roles. Of note, job satisfaction was the lowest between the ages of 39 and 44. The average age on the rig was 34.8 which are close to the ages noted in Parkes research. There were no questions regarding job satisfaction on the rig survey. In the second summary study on injuries for offshore personnel, three databases were analyzed, one from the HSE Offshore Safety Division, and two from large multi-national oil and gas companies (Parkes, 2002).

Similar attitudes were examined in the survey on the rig. In the surveys, the following questions are attributable to attitude:

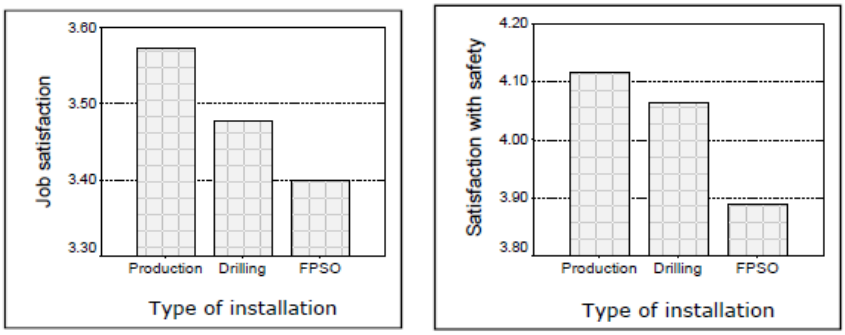
- Survey One, Question 11: Sometimes I feel I am paid to work and NOT think about working safely. Average 4.4 (SD=.9) One *means this is true and five means I am paid to think act and work safely.*
- Survey Two, Question 7: My work is boring and repetitive. Average 4.3 (SD=1.0). Whereas*, one means my work is boring and repetitive and five meaning my work is enjoyable and rewarding.*
- Survey Two, Question 8: I only work for money. Average 3.9 (SD=1.2) One *is true and five means I do not work for money but enjoy the work.*
- Survey Two, Question 10: There is plenty of job satisfaction in my job. Average 4.3 (SD=.9) One *means no job satisfaction and five means very satisfied.*

From 1995 to 2002 a comparison of Floating Production, Storage and Offloading (FPSO) and drilling rigs was completed by Parkes, Farmer and Carnell (2002). The focus of the study was on "work and well-being" among offshore personnel in the North Sea oil and gas directory (p. iii). FPSOs are essentially large crude oil carriers (ships) that have been either converted to offshore oil production facilities or built to work as FPSOs. A FPSO is an offshore refinery at sea connected to an underwater supply mast. The finished products are either piped ashore or lightered to smaller tankers.

The report concludes with an assumption the undersigned has made regarding offshore safety. The study, while wide ranging, was used in the thesis for psychological well-being of the offshore FPSO crews compared to a rig and a platform (much like Ford

and Tetrick). A rig drills for oil and gas while a platform works on existing wells. Rigs are brought to platforms for work overs and interventions. Psychological well-being is defined as work satisfaction and mental health (Parkes, Farmer, and Carnell, 2004). Three aspects of overall satisfaction with the work situation were assessed in the study: job satisfaction, job security and satisfaction with safety and emergency response measures. In the rig survey, only job security was not measured. Satisfaction with safety measures on the rig, platform and FPSO crews remained consistent: 4.1, 4.1 and 3.9 respectively. On the rig survey, the average was 4.5 (SD=.61) for the question "How would you rate the rig management team's safety performance?"[12] Compared to job satisfaction in Table 21, the rig's job satisfaction was greater.

Table 21.
Job Satisfaction on Platforms



Note: Platforms had the highest job satisfaction (3.57 out of 5), followed by the rig (3.48) and FPSO (3.40). The rig in the thesis study had and average job satisfaction rate of 4.3 which is significantly higher than Parkes' study.

Source: Parkes, Katharine R., Elly Farmer, and Susan Carnell. United Kingdom. Health and Safety Executive. Psychosocial Aspects of Work and Health in the North Sea Oil and Gas Industry. Oxford: University of Oxford, 2004. Print. Table 6.2

Parkes, et. al assessed mental health by a 12-item General Health Questionnaire (GHQ), which asked respondents on the installations to what extent they have experienced each of 12 symptoms of psychological distress over the previous six-week period (2004). 16.4% of the respondents were considered "high GHQ" or those whose

[12] Survey One, Question 30.

scores indicate possible clinical or near-clinical levels of distress according to Parkes (p. 42). The rig survey was not used to assess mental health of the crew but we can draw some conclusions: a happy worker is a satisfied worker. When comparing the differences between the participants in the rig crew in the thesis survey, the rig crew's "contentment with work" average exceeded those in Parke's study (2004). Can one assume then if a crew is content, the crew is also safe?

How much does work rest affect the rig worker? Most offshore rigs operate 24/7 with no slowdown in operations. How does short changing affect the crew's ability to function? The National Institute for Occupational Safety and Health (NIOSH) presented a paper on shift work (Rosa & Colligan, 1997). Shift work[13] does affect workers. Anyone who has worked a day shift followed by the evening shift and grave yard shift knows what shift work can do physiologically. Rig workers are no different except the consequences may be dire if a mistake is made from lack of sleep. Survey Two, Question 28, the following question was asked: If you short change, does this affect your ability to work safely? 1=it affects my ability to work safe. 5=there are no issues with short changing. The average was 3.2 (AD=1.6) which was one of the lowest marks in the survey. For those affected by short changing, it is an important issue and should be addressed by rig management.

While there may have been studies on work and well-being on rigs in the USGOM in the past, none were found similar to Parkes, et. al. Authors Neal and Griffin studied safety climate, motivation and behavior for workers on individual and group levels (2006). The authors examined the concepts of safety climate and safety behavior "into the broader theoretical context of work performance and examine the way safety motivation is linked to safety climate and safety behavior" (Neal & Griffin, 2006, p. 946). The article mentions several studies discussed within this thesis regarding causation of incidents from climate to motivation and from motivation to behavior. From here, Neal & Griffin made two hypotheses: 1: Group safety climate will exert a lagged effect on individual safety motivation; and 2: Individual safety motivation will exert a lagged effect on individual safety compliance and safety participation. In other words, a poor

[13] Working designated segments of time. For example, 0800 to 1600, 1600-0000, and 0000-0800 consists of three eight hour shifts.

safety climate will affect safety motivation of the work (p. 947). A lack of safety motivation will affect the employee's conformance to safety rules and participation. Neal & Griffin also suggested that "safety behavior in work groups will be associated with a subsequent reduction in accidents at the group level of analysis" (p. 948). Note the research lasted over five years.

Leading indicators are predictors of poor safety performance (Nordine, 2007). If a company can predict or plan for incidents via leading indicators, the theory suggests occupational injuries or incidents and preventable. Leading indicators seek out and adjust a safety program by eliminating unrecognized hazards, unsafe conditions, reckless behavior or other safety program deficiencies. The author concluded there were "few concrete examples or methods of proactively measuring and monitoring health and safety program performance" (p. 35). Leading safety indicators in the project were tabulated from such dimensions as management commitment, communication, compliance and corrective actions. All of these factors were asked and answered by the rig crew in the affirmative.

Are the leading indicators on the rig preventing incidents? It is well established the rig had an active and vigorous card observation system. Incidents were investigated and actions closed out without repeats. There is a clear vision from the crew on visible leadership. "Various researchers and experts agree that culture is the primary driver and predictor of improving safety performance" (Blair, and O'Toole, p. 30, 2010). In the research, we see two principles merging: culture and leading indicators. Understanding where incidents may come from next can only be enhanced by a culture of safety. From the rig managers down to the rig hands, there was an understanding, maybe not realized by the crew, to try and prevent incidents before they occur.

Blair and O'Toole provide the means to select the right metrics to evaluate and adjust for proper safety performance. Leading indicators are catalyst for change, the metrics are motivational for the crew and the metrics drive safety performance (Blair and O'Toole, 2010). There are four suggestions the authors provide for an organization to measure their safety performance.

1. Customizing the site (Blair and O'Toole, 2010). No work site or rig is the same and require fit for purpose metrics for the rig. The rig's measurement

evolved over time, became focused on the operations at hand and improved to capture the right risks and outcomes from work.

2. Prioritizing risks bases on assessments. Consistent use of risk assessments beginning with the ones that can hurt or kill, working down to lesser hazards. The rig's safe system of work categorized work permitting (WP) into two sections. High risk operations were WP 1 and lesser risk operations were WP 2. The rig's OIM had to sign off on all WP 1. Each WP was assessed by the work team for its effectiveness at the end of the job. Changes or improvements to the work permit or SJA were implemented for the next time.
3. Limit the number of safety metrics. The safety officers tallied all the work site visits, audits, WP audits, walk-arounds, and observation cards into one readable spread sheet. All of these were reviewed by the rig management team, shore base management team and discussed at monthly safety meetings.
4. Employee engagement. As the safety culture developed and matured the rig hands became more engaged and developed a sense of ownership. From toolbox talks to safety meetings to observation cards, the crew was engaged. Corporate also engaged the crew through annual surveys. The rig management team was tasked with evaluating the surveys, developing action plans and meets the expectations of the crew to raise applicable scores. Fortunately, the scores were some of the highest in the fleet and required little in way of improvement plans.

Trust: the rig is like an industrial plant that operates offshore and no one goes home at night. The crew works 28 days on and 28 days off. Helicopters fly to from the shore side heliport most days during the week for contractor and rig crew changes. Eventually, like any group, there exists an unwritten membership as discussed in "Effective Training: A Case Study from the Oil & Gas Industry" by Elaine T. Cullen (2011). The rig crew is part of a large culture and work groups have their own work culture. Without trust in the work group, safety performance is in question.

In Tharaldsen's et. al article in *Safety Science*, a study posited functional or "creative" mistrust which is important for a "sound safety culture" and "blind trust" (1063). Too much distrust would be detrimental for a safety culture according to

Tharaldsen et. al. Does high trust in the rig crew and sound safety behavior enhance good safety performance? A Norwegian participant in Tharaldsen's article stated he trusts persons most who they know best. A UK participant stated they care most for the people in the crew and trust does take time. The [surveyed] rig crew consisted of 24 nationalities working without incident for many months in a relatively small confined space. While there were no survey questions regarding the varying cultures on the rig, there were, like Tharaldsen's surveys, questions regarding self-reporting for behavior and safety performance, trust in colleagues and management, and commitment to safety. These answers have been listed above and prove the value of Tharaldsen's comment that high trust in a rig hand's fellow workers "buffers against incident involvement and the same applies for high safety compliance" (2009, p. 1062).

CHAPTER VI

CONCLUSIONS

Hypothesis: Conclusions

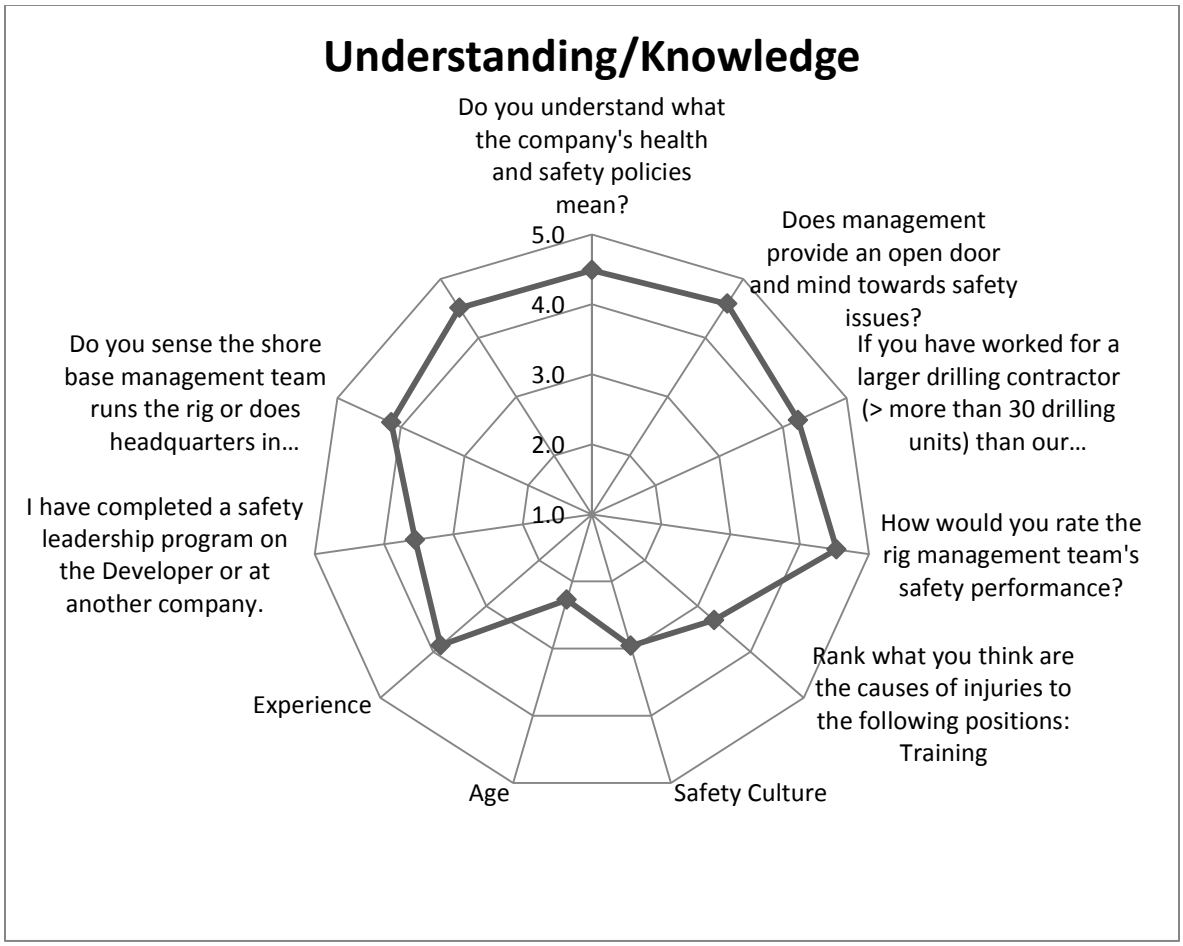
A high (safe) performing drilling rig in the US Gulf of Mexico is the result of a robust safety culture. Or, what does safety culture look like on a high-performing rig?

It is clear, key decisions by rig hands will affect their safety and those on board the rig. Provided there is a culture to promote safety objectives from the top down (OIM to roustabout) on the rig. Leadership, that is visible and interactive leadership, is a critical element of the work group's safety culture. This was borne out on the survey. Other elements of safety culture, according to Skogdalen, defined this as the rig hand's perception, attitudes and believe in risk and consequences (2011). In other words, research revealed the rig hand's core values on safety and risk is developed by rig leadership. Each member of the crew is an individual and brings their own "baggage" (good and bad) to the rig. It is obvious the rig hand, through visible leadership can cultivate the rig hand's attitudes and beliefs.

Does the rig hand understand the difference between safety compliance and safety participation? Yes, they must fill out a lot of paper work (SJA, PTW and TBT cards) to get the job done on a rig. There is a difference between compliance and the need to understand the risks. Moving a rig crew from compliance to knowledge is another element of an active safety culture. The rig crew appears to understand this concept as noted in the following table.

Table 22 provides results from a question rating what will prevent injuries: experience, age, safety culture. Experience had the highest mean of the group (experience, age, safety culture, supervision, and training). There were five possible answers with ranking one meaning the least likely cause and five meaning the most likely cause for injuries. Supervision is listed on the Actions Table; Survey One (Table 13); its mean was 2.6 (SD=1.2). Experience, according to the survey, is a leading factor to prevent injuries (3.9 man; SD=1.3). Age, 2.3 man (SD=1.5) would be a leading factor to an injury according to the crew of the rig.

Table 22.
Understanding/Knowledge Table; Survey One



Note: The table derives from Survey 1 regarding the rig crew man's understanding, knowledge and opinions on rig policies and management.

The best means to determine if the rig's safety culture is to compare the findings of the survey to the elements of a safety culture. Again, we go back to NEBOSH (2010).

1. Leadership and commitment to health and safety throughout and at all levels of the organization. The best example is from the survey regarding rig management. As noted below, with the exception of the "pat on the back" question, the averages above 4.0.
2. Acceptance that high standards of health and safety are achievable as part of a long-term strategy formulated by the organization. Additionally, systems for monitoring equipment, processes and procedures and the prompt rectification of

any defects. To answer this question, the following questions were asked on the survey:

3. A detailed assessment of health and safety risks in the organization and the development of appropriate control and monitoring systems. For this answer, one has to find applicable questions from the survey. Survey Two, Question 9 asks if the company man and staff are very involved in the safety culture on board this rig. The average is 4.2 (SD=1.0). Question 18: Do you use safety prevention programs such as SJAs, PTWs and TBTs? Are they effective in preventing safety incidents? The average answer for these questions was 4.4 (SD=.9). It is regular to see follow up actions for findings resulting in unsafe acts, conditions and incident investigations. Question 26 average was 4.4 again (SD=.8).
4. Relevant employee training programs and communication and consultation procedures. In Question 5 of Survey Two, 4.5 (SD=.7) of the respondents agreed with the following statement: Is your training for your current job sufficient? Question 22: Competency and safe work are related averaged 4.6 (SD=.8).
5. The prompt investigation of all incidents and accidents and reports made detailing any necessary remedial actions. 4.6 (SD=.7) of the respondents agreed with the following statement (Survey One, Question 10): Safety information is always brought to my attention (Alerts, IADC notices, One Pagers). Survey Two, Question 3: Have you ever sustained or witnessed another rig hand sustaining an injury caused by contact with objects or equipment? 4.0 (SD=1.6) of the respondents did not agree. In Survey Two, Question 26, 4.4 (SD=.8) of the respondents agreed with the following statement: It is regular to see follow up actions for findings resulting in unsafe acts, conditions and incident investigations.

Based on the elements that make up a safety culture there is no doubt the rig surveyed has established a culture that is consistent with its safety performance. The quality of the survey questions which aligns with the referenced documents adds to the response validity. Table 23 shows the safety culture on the rig is consistent with safety performance. There is a clear indication by the mean averages of responses the crew

believes the rig management team supports the crew. One of the highest responses is that of alignment of policies with actions. The average (mean) response was 4.5.

Table 23.
Standards of Health and Safety Support

QUESTION FROM SURVEY ONE	AVERAGE RESPONSE/SD
3. The rig management demonstrates daily the company's Safety and Health Policies. (Five means there is evidence of the rig management team living the company's Safety and Health Policies.)	4.4/.7
4. The shore management team demonstrates the company's Safety and Health Policies. (Five means there is evidence of the rig management team living the company's Safety and Health Policies.)	4.1/.9
6. How is the company's action match its actions regarding health and safety policies? (One means the company's actions don't match the words.)	4.4/.7
15. Do you believe the goals and policies align with actual practices on board? (Five means I agree.)	4.5/.7
31. Are the goals for the company and strategy regarding safety clear and concise? (Five means the strategy and goals are one in the same.)	4.5/.8

Note: Standards of Health and Safety Support. The high averages indicate the rig management and long-term strategy for health and safety standards are considerable.

The rig journeyed from a poorly performing rig to a high performing rig in two years. Many leaders will want to effect change immediately but building a safety culture takes time. It also took the right mix of crew to make this happen. Of note, during the survey, the two OIMs were not the same when the rig arrived in the USGOM. The two STP and Maintenance Engineers have been on board since the construction phase which provided

stability along with other mid-level managers on the rig. As Cullen stated, the rig created its own safety culture which means a highly performing rig with little NPT (2011). This is not a mystery: a high performing rig in safety and operations are mutually beneficial. This author believes you cannot have one without the other. In other words, an "unsafe" rig will have NPT.

To summarize, the rig's safety culture was defined as:

1. Visible leadership
2. Engaged crew
3. A culture of understanding risk vs. compliance
4. Crisis and change are managed well
5. Application of learning's from incidents to prevent further incidents
6. The crew trusts and respects each other
7. Substandard work or unsafe acts are not tolerated

Further Questions

As with any survey, there are areas in the questionnaire that could have been better worded. There are areas where the rig and management team should look further and investigate more in depth.

Standard Deviation: The standard deviation throughout the surveys demonstrated an acceptable range for the mean. The highest standard deviation for Survey One was Question 28 regarding whether the rig hand has completed safety leadership on the rig or another company. The answer had the highest deviation of 1.9 but this is understandable due to the low number of responses to the question. The mean for this question was 3.6.

The lowest deviation for Survey One was Question 21: "Does anyone on the rig have stop work authority?" The mean was 4.9 (highest) and the standard deviation was .45. This should be good news for the drilling contractor and operators.

The highest standard deviation for Survey Two was Question 8 regarding working just for money. Again, this question was one of those that could have been worded better. The standard deviation was 1.2 and a mean of 3.9. The lowest deviation for Survey Two was Question 29: "Am I responsible for my own safety or is the rig management team?" The standard deviation was .5 and the mean was 4.8 (highest). Again, this should be good news for the drilling contractor and operators. Consequently,

despite some better wording the survey did as it intended and the results are credible and reliable.

Hurts. Do we know why workers in a very active and strong safety culture still get hurt? The person who finds the answer to this question is like the person finding the perfect mouse trap. Since the human element is involved, there will be no perfect answer and solution. The psychological aspect of the safety culture was not investigated on purpose. The perceptions and value the worker places on his personal safety is sufficient to warrant another research project into worker safety. It is self-evident from the studies contained in this thesis and safety performance exhibited by this rig and many others, safety culture is critical and vital for a safe operation.

Mentoring. The average time aboard for the rig hand was 1.8 years (SD=7.8). The average time in the industry for the rig hand was 8.5 years (SD=12.5). The longest serving rig hand on board had 34 years and two months on board as the least. Given: a senior position on board does not have a high school diploma; several rig hands in supervisory positions completed the requirements for high school graduation; and several rig hands had post graduate degrees but were not in senior positions: formal education is not a factor for seniority. Further research may reveal the effectiveness and power of mentoring of crews on the rig currently and from past experiences at other drilling companies. This means some "uneducated" rig hands are very smart. Someone early in this rig hand's career mentored this rig hand. This also speaks to the nature of the oil field worker: they might not have many letters behind their names but they are obviously intelligent and can hold they own with college graduates who have engineering degrees. Neither is an easy feat.

OJT. On the job training (OJT) is one of the reasons for the success of the rig crew surveyed. It cannot be helped if a mentor takes an interest in the mentee and the latter's career takes off. Proper mentoring and OJT are a possible reason the rig did so well performing safely and in the surveys. A research project on the effectiveness of OJT may prove useful to the rig contractors in the USGOM or other regions in the world.

Crewing. The rig is a complicated piece of machinery operated by men. There are also 180 personalities on the rig which complicate matters as sophisticated machinery does. Proper crewing will ensure the right rig hand is selected for the right job. There is

no guarantee this will produce a highly motivated and safe crew but it should be studied on a rig with a strong safety culture. The rig crew in September 2009 was not the same crew in May 2012. There were only a few of the original crew left and most joined the rig after September 2009. A major change in the rig crew occurred during the Moratorium. Careful study of high performing crews' post-Macondo with respect to crewing methodology by the rig contractor may prove useful to the drilling contractor industry.

Final Thoughts

Noble Drilling developed Five Pillars for safety leadership. "You have to listen to the crews. You have to listen to the people while you're developing your system, and the visible leadership has to actively support both the culture and the systems that you develop" (Liou, 2012, p. 1). Noble realized that there was an opportunity using proven visible leadership to make a positive impact that on culture. The Five Pillars are:

1. Show genuine care and concern for employees.
2. Measure and respond to exposure.
3. Conduct safety perception surveys.
4. Make safety personal.
5. Celebrate successes.

Of the five, the objective evidence via the survey, the rig team demonstrated four of the five pillars. The only one not conducted was the safety perception surveys. As noted previously, the rig company conducted safety perception surveys but the last one was in 2009. Perhaps the rig company will conduct safety perception surveys in the future. Previous tables form the survey data reports (Supervisor, Action, Management and Understanding/Knowledge tables) demonstrate the rig crew and management team on and off shore demonstrate genuine care and concern for employees, measure and respond to exposure (risk), make safety personal, and celebrate successes. The chart below demonstrates the rig team's commitment to safety. In fact, a high mark on the table shows the rig management team is committed to safety (average 4.7 out of 5). This is a high score even if you throw out the high and low scores (which the author did not do).

Companies like Rowan would be served to use this model for their safety culture programs. It is said, you don't know what you don't know. Understanding your workforce is the key to changing or improving a safety culture. The reader should be mindful that management cannot simply create a safety culture on their rig or within their organization. They must get to know the workforce and accept the consequences of surveys. Likewise, there are tools, as discussed within this thesis to assist companies to achieve a great safety culture as the rig had done.

It is clear from the surveys taken from the rig, there is evidence if a healthy safety culture on board. There was also a cooperative and collaborative relationship between the shore base in Houston and the rig team. It took time to develop the safety culture on board and proved that safety and performance go hand-in-hand. The evidence collected compared with the references cited show a hard working rig with visible leadership and engaged crew all pulling in the same, safe direction.

REFERENCES

Adie, Wendy, John Cairns, Jennie MacDiarmid, John Ross, Stephen Watt, Claire Taylor, and Liesl Osman. “Safety Culture and Accident Risk Control: Perceptions of Professional Divers and Offshore Workers*.” Safety Science*, 43, (2005): 131-145. Print.

Atherton, John and Frederic Gill. *Incidents That Define Process Safety.* 1 ed. Hoboken: John Wiley and Sons, 2008. Print.

Attwood, Daryl. “A Reliability Approach to the Quantification of Occupational Accidents in the Offshore Oil and Gas Industry.” Diss. Memorial University of Newfoundland, 2006. Ottawa: Library and Archives of Canada, 2006. Print.

Bell, Julie, and Nicola Healy. United Kingdom. Health and Safety Laboratory. *Causes of Major Hazard Incidents and How to Improve Risk Control and Health and Safety Management: A Review of the Existing Literature*. Buxton: Crown, 2006. Print.

Blair, Earl, and Michael O'Toole. "Leading Measures, Enhancing Safety Climate and Driving Safety Performance." *Professional Safety*. (2010): 30-34. Print.

United States. Bureau of Labor Statistics. *Nonfatal Occupational Injuries and Illnesses Requiring Days Away From Work*. Washington, DC: GPO, 2008. Print.

"Fact Sheet Oil and Gas Industry." *Bureau of Labor Statistics*. GPO, n.d. Web. 28 April 2011. http://www.bls.gov/iif/oshwc/osh/os/osar0013.htm.

Christian, Michael S., J. Craig Wallace, Jill C. Bradley, and Michael J. Burke. "Workplace Safety: A Meta-Analysis of the Roles of Person and Situation Factors." *Journal of Applied Psychology*. 94.5 (2009): 1103-1127. Print.

Cullen, Elaine. T. “Effective Training, A Case Study From the Oil and Gas Industry.” *Professional Safety*. 56.3 (March, 2011): 40-44. Print

"DuPont STOP Program." *DuPont Safety Resources*. Dupont, n.d. Web. 14 April, 2012. http://www2.dupont.com/DuPont_Safety_Resources/en_ZA/solutions/STOP.html

"Exxon Mobil." *Exxon Corporate Citizenship*. Exxon Mobil, n.d. Web. 16 April 2011. http://www.exxonmobil.com/Corporate/Newsroom/Publications/XOMGlobalCap/page_7.html.

"Exxon Mobil." *2009 SHE Interactive Chart*. Exxon Mobil, n.d. Web. 16 April 2011. http://www.exxonmobil.com/Corporate/safety_health.aspx .

Ford, Michael T., and Lois E. Tetrick. "Relations Among Occupational Hazards, Attitudes, and Safety Performance." *Journal of Occupational Health Psychology*. 16.1 (2011): 48-66. Print.

Hughes, Phil, and Ed Ferrett. *Introduction to International Health and Safety at Work* 1. Burlington: Elsvier, 2010. Print.

United Kingdom. Health and Safety Executive. Offshore Injury, Ill Health and Incident Statistics. Merseyside: Health and Safety Executive, 2010. Print.

Hekmat, Maximillian. "Examining the Safety Road Map." *Professional Safety*. 56.3 (2011): 30-32. Print.

Hopkins, Andrew. "Management walk-arounds: Lessons from the Gulf of Mexico oil well blowout." *Safety Science*. 49. (2011): 1421-1425. Print.

"IADC Incident Statistics Program." Trans. Array 2012 *Incident Statistics*. IADC, 2013. Print.

"IADC Incident Statistics Program Question and Answer Book." IADC HSE. IADC, 4 Jan 2010. Web. 14 April 2010. (Includes the definition of an LTI.)

Liou, Joanne. "Noble Program Details 5 Pillars Leaders Should Exhibit to Impact Safety Culture." *Drilling Contractor*. Dec 2012: n. page. Print. http://www.drillingcontractor.org/noble-program-details-5-pillars-leaders-should-exhibit-to-impact-safety-culture-19798.

Maersk Drilling A/S. Company-wide safety climate survey. *Internal Company Report*. 2010.

Mearns, Kathryn, Sean Whitaker , Rhona Flin, Rachael Gordon, and Paul O'Connor. United Kingdom. Health and Safety Executive. *Factoring the Human Into Safety: Translating Research Into Practice*. Aberdeen: Crown, 2003. Print.

National Center for Health Statistics. *Health in the United States, 2010: With Special Feature on Death and Dying* (DHHS Pub No 2011-1232). Hyattsville, MD: US GPO. 2010. Print.

United States. National Commission on the BP Deepwater Horizon Oil Spill. *Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling*. Washington: GPO, 2011. Print.

Neal, Andrew, and Mark A. Griffin. "A Study of the Lagged Relationships Among Safety Climate, Safety Motivation, Safety Behavior, and Accidents at the Individual and Group Levels." *Journal of Applied Psychology*. 91.4 (2006): 946-953. Print.

"About NEBOSH." NEBOSH, n.d. Web. 1 September 2011. http://www.nebosh.org.uk/About_Nebosh/.

Nordine, Lawrence D. *Leading Safety Indicators: Proactively Monitoring Safety Performance.* MS thesis. University College University of Denver, 2007. Print.

"Process Safety Standard." *OSHA Publications*. GPO, n.d. Web. 22 March 2010. http://www.osha.gov/Publications/osha3132.html.

Parkes, Katharine R. United Kingdom. Health and Safety Executive. *Psychosocial Aspects of Work and Health in the North Sea Oil and Gas Industry; Summaries of Reports Published 1996-2001*. Oxford: University of Oxford, 2002. Print.

Parkes, Katharine R., Elly Farmer, and Susan Carnell. United Kingdom. Health and Safety Executive. *Psychosocial Aspects of Work and Health in the North Sea Oil and Gas Industry*. Oxford: University of Oxford, 2004. Print.

Rosa, Roger R., and Michael J. Colligan. United States. National Institute for Occupational Safety and Health. *Plain Language About Shiftwork*. Cincinnati: GPO, 1997. Print.

Skogdalen, Jon Espen, Ingrid B. Utne, and Jan Erik Vinnem. "Developing Safety Indicators for Preventing Offshore Oil and Gas Deepwater Drilling Blowouts." *Safety Science*. 49. (2011): 1187-1199. Print.

Snodgrass, Richard, Anita Scott, and Rachael Lee. United Kingdom. Health and Safety Laboratory. *Attitudes and Behaviours Towards Slips, Trips and Falls - A Literature Review*. Buxton: Crown, 2005. Print.

Southern Company. *It's All About People: Rejuvenating a Stalled Safety Program*. 2011. Predictive Solutions. Atlanta. Print.

Spackman, Alan. *Drill Safe* [Online forum comment]. February 2010. Web. http://iadc.org July 2, 2010.

Tharaldsen, J.E., K.J. Mearns, and K. Knudsen. "Perspectives on Safety: The Impact of Group Membership, Work Factors and Trust on Safety Performance in UK and Norwegian Drilling Company Employees." *Safety Science*. 48. (2010): 1062-1072. Print.

Sorrow, April. "Perception, Work-Life Balance Key Factors in Workplace Safety, says UGA Study." *The College of Public Health*. University of Georgia, 17 Feb 2012. Web. 13 March 2012. http://citationmachine.net/index2.php?reqstyleid=1&reqsrcid=MLAWebDocument&srcCode=11&more=no&mode=form.

Zohar, D., & Luria, G. (2003). *The Use of Supervisory Practices as Leverage to Improve Safety Behavior: A Cross-Level Intervention Model* . Informally published manuscript, Technion Institute of Technology, Haifa, Israel and Institute for Work and Health, Toronto, Canada.

APPENDICIES

APPENDIX A:

Surveys One and Two Blank Samples

Survey One (blank sample)

Survey One: Introduction, Purpose and Instructions:

Thank you for agreeing to complete this survey. This has the support of the Rig Manager and shore base staff. We are trying to determine why safety decisions are made, or not made. The safety performance for the drilling industry in general has excelled over the past thirty years. In the past 10 years, safety incidents have leveled and not improved but remained static. This survey is intended to generate a base of data for the rig hands on the rig. The survey is the property of the researcher and will remain confidential. Data from the surveys and observations will be made available to the crew and rig management team. The expectation is for a safer work environment and safer thought processes to prevent you and your fellow rig hands from getting hurt.

INSTRUCTIONS: The answers you provide are you own and you need not feel the need to justify your responses. If you answer a question one way, this is your judgment not anyone else's. You will see a range of 1 to 5 for most responses. One is low and five is associated with a high or favorable response. There is a dimension for each question. Select the number that fits best for the question. There are some yes/no and boxes to tick; these are self-explanatory. The estimated time for completing this survey is no more than 15 minutes. The first number that comes to your mind is typically the best answer.

Upon completion, insert the survey in the envelope provided and return to the Rig Admin. These surveys will be collated and data will be extracted for evaluation. There has been little in research of this nature. We hope the results will lead the rig

management team to provide you a safer work environment. The research will hopefully assist other rigs in the fleet with tools to match the rig's safety culture.

Thank you.

AGE: _____

DOB: _____

POSITION: _____

EDUCATION: NO HIGH SCHOOL DIPLOMA_____

HS DIPLOMA_____

SOME COLLEGE/TECHNICAL SCHOOL____

COLLEGE DEGREE_____

POST GRADUATE DEGREE_____

YEARS IN THE DRILLING INDUSTRY (land and off shore if applicable):_____

MONTHS and YEARS ON THE DEVELOPER: _____

ARE YOU A MEMBER OF A SAFETY COMMITTEE: Y N

HAVE YOU COMPLETED SIRIUS, SYNERGI and SAP TRAINING?

Y or N for each: ____, _____, ____

QUESTIONS:

1. Is the rig's senior management committed to safety? _____

   One means low commitment.

   Five means very committed

2. Is the company more interested in safety over profit? _____

   One means interested only in profit.

Five means the company places a high emphasis on safety and at times over profit.

3. The rig management team demonstrates daily the company's Safety and Health Policies. _____

   One means you rarely see the rig management team living the company's Safety and Health Policies.

   Five means you see evidence of the rig management team living the company's Safety and Health Policies.

4. The shore base management team demonstrates the company's Safety and Health Policies. _____

   One means you rarely see the shore base management team living the company's Safety and Health Policies.

   Five means that you see evidence of the shore base management team living the company's Safety and Health Policies.

5. Does the rig management team spend resources on safety (equipment, training and programs)? _____

   One means the rig management team spends too little money on safety.

   Five means the rig management team spends the right amount of resources on safety.

6. How is the company's action match its actions regarding health and safety policies? _____

   One, the company's actions don't match the words.

   Five means the company's actions and policies match a majority of the time.

7. Do you understand what the company's Health and Safety Policy mean? _____

   One means that I have not read the company's Health and Safety Policy.

   Five means I completely understand the policies.

8. Does management provide an open door and mind towards safety issues? _____

   One means there is little or no two-way communication on safety.

   Five means the rig management team is very open to safety related communications.

9. The rig management team publicly praises the crew and individuals for working safely. _____

   One means the rig management team rarely, if ever, praises the crew for working safety.

   Five means the rig management team consistently praises the crew.

10. Safety information is always brought to my attention (Alerts, IADC notices, One Pagers). _____

    One means I never hear about safety information.

    Five means safety information is regularly provided.

11. Sometimes I feel I am not paid to work and NOT think about working safely.

    _____

    One means this is true.

    Five means I am paid to think act and work safely.

12. Does the rig management team support a safe work atmosphere? _____

    One means the rig management team does not support a safe work atmosphere.

Five means the rig management team supports and actively participates in a safe work atmosphere.

13. Do the rig and shore base management teams place an emphasis in productive time over stopping a job for safety concerns? _____

    One means the rig and shore base management team is far more concerned with productive time than safety.

    Five means safety is more of a concern.

14. If you crew change and serve with both OIMs for more than a week, is there is noticeable difference between the two OIMs regarding safety? _____

    N/A _____ I crew change with the OIM.

    One means there is a remarkable difference between the two OIMs.

    Five means the transition between OIMs is seamless.

15. Do you believe the goals and policies align with actual practices on board? _____

    One means there is no alignment between policies and practices.

    Five means I agree.

16. Are rig management safety priorities and shore base management priorities consistent? _____

    One means I see no consistency.

    Five means there is consistency between safety priorities on the rig and shore base.

17. Does the company pressure you to complete jobs quickly for the sake of safety? _____

    One means this is a common occurrence.

Five means this rarely, if ever happens.

18. Does the company accept results over safety? _____

    One means safety is not as important as making hole.

    Five means there is a balance between operations and safety with respect towards safety.

19. If you have worked for a larger drilling contractor (more than 30 drilling units) than our company, how do you compare the emphasis on safety performance?

    _____

    One means your previous company placed a higher emphasis on safety performance.

    Five means our company places a higher emphasis on safety performance.

20. How would you rate the rig management team's safety performance? _____

    One means low safety performance.

    Five means a high safety performance.

21. Does anyone on the rig have stop job authority? Yes _____ No _____

22. Rank what you think is the causes of injuries (that we don't want to occur of course) to the following positions.

    One means the LEAST likely cause and five is the MOST likely cause.

    _____ Training

    _____ Supervision

    _____ Safety Culture

    _____ Age

    _____ Experience

23. Does the company provide you with a safe work place? _____

    One means there many unsafe areas workplaces.

    Five means a safe workplace.

24. I have completed a safety leadership program on the DEVELOPER or at another company.

    One means I have had safety leadership training at another company.

    Five means I have had safety leadership training on the DEVELOPER.

25. Do you sense the shore base management team runs the rig or does headquarters in Copenhagen? _____

    One means Copenhagen runs the rig with little regard to the shore base.

    Five means it is clear Houston shore base runs the rig.

26. Do third party contractors have the same commitment to safety as the rig? ____

    One means third party contractors place a higher emphasis on safety than the rig.

    Five means our rig's safety posture is equal to or greater than third party contractors.

27. Are the goals for the company and strategy regarding safety clear and concise? _____

    One means I have no idea what the company's strategy regarding safety is.

    Five means the strategy and goals are one in the same.

28. Is the safety committee active on the rig?

    One means I never have heard of any results from the rig's safety committee.

    Five means the safety committee are involved in the rig's safety posture.

29. In a few words, define the term “safety culture”:

_____

30. Is the Safety Officer involved in major planning on the rig?

One means the Safety Officer is rarely engaged in safety planning.

Five means the Safety Officer is integral to safety planning.

Survey Two (blank sample)

Survey Two: Safety Perceptions of the Individual Rig Hand

This is the second part of the Safety Survey. This survey is tailored to how you perceive safety right now on the rig. This survey is intended to generate a base of data for the rig hands on the DEVELOPER. The survey is the property of the researcher and will remain confidential. Data from the surveys and observations will be made available to the crew and rig management team. The expectation is for a safer work environment and safer thought processes to prevent you and your fellow rig hands from getting hurt.

INSTRUCTIONS: The answers you provide are you own and you need not feel the need to justify your responses. If you answer a question one way, this is your judgment not anyone else's. You will see a range of 1 to 5 for most responses. One is low and five is associated with a high or favorable response. There is a dimension for each question. Select the number that fits best for the question. There are some yes/no and boxes to tick; these are self-explanatory. The estimated time for completing this survey is no more than 15 minutes. The first number that comes to your mind is typically the best answer.

Upon completion, insert the survey in the envelope provided and return to the Rig Admin. These surveys will be collated and data will be extracted for evaluation. There has been little in research of this nature. We hope the results will lead the rig management team to provide you a safer work environment. The research will hopefully assist other rigs in the Maersk fleet with tools to match the Developer's safety culture. You will see the results of the surveys.

Thank you.

1. Are maintenance programs for the rig sufficient for the equipment you use day to day? _____

   One means the maintenance programs do not keep the equipment safe.

   Five means the equipment is maintained and safe to use.

2. Are leaders held accountable for their actions by the shore base? _____

   One meaning rig leaders are not held accountable for their actions.

   Five means leaders are held accountable.

3. Have you ever sustained or witnessed another rig hand sustaining an injury caused by contact with objects or equipment. _____

   One means I have witnesses or been injured by objects or equipment.

   Five means I have never been injured by objects or equipment on the rig.

4. Do your supervisors take responsibility for their safety actions even if they violate company policy? _____

   One means supervisors NEVER take responsibility for their actions.

   Five means they ALWAYS take responsibility.

5. Is your training for your current job sufficient? _____

   One means your training is insufficient and creates unsafe situations for me and my rig hands.

   Five means your training has provided you perform your work safely.

6. Have you ever executed an unsafe act and it turned out ok? _____

   One means this has happened more than a few times.

   Five means I always think of the effects of the unsafe act and do the right thing.

7. My work is boring and repetitive. _____

One means my work is very boring and repetitive.

Five means I enjoy my work and it is challenging.

8. I work for money only. _____

   One means this is true.

   Five means I do not work just for money but enjoy the work.

9. The company man and his staff are very involved in the safety culture on board this rig. _____

   One means the company man and his staff are rarely involved in safety initiatives on this rig.

   Five means the company men are very active participants.

10. There is plenty of job satisfaction in my job. _____

    One means no job satisfaction and I am looking elsewhere now.

    Five means I am very satisfied in my job.

11. Overall, safe work is rewarded and unsafe work results in discipline. _____

    One means unsafe work is not noticed and overlooked.

    Five means safe work is recognized and failure to work safely is dealt with by rig management effectively.

12. A “pat on the back” is a regular occurrence for safe work practices. _____

    One means no one ever receives a pack on the back or any recognition for safe work practices.

    Five means this happens regularly.

13. I have witnessed third party hands commit unsafe acts and fear retaliation if I say anything. _____

One means unsafe acts by third party occur on this rig and I never report it for fear of retaliation.

Five means intervention is expected and does happen when I see a third party hand doing something unsafe.

14. There are daily and regular safety inspections by members of the rig crew. _____

One means safety inspections rarely happen.

Five means the rig management team conducts regular safety inspections.

15. I have worked in other areas of the world and the US is a safer place to work.

_____

N/A _____ I have never worked overseas.

One means it is safer to work overseas.

Five means working in the US is safer.

16. I regularly see the OIM on walkabouts? _____

One means I have never seen the OIM on a walkabout.

Five means this is a regular occurrence.

17. Do safety rewards work on this rig? _____

One means safety rewards have no effect on safety on board this rig.

Five means safety rewards are effective in reducing incidents.

18. Do you use safety prevention programs such as SJAs, PTWs and TBTs? Are they effective in preventing safety incidents? _____

One means these programs are not effective.

Five means SJAs, PTWs and TBTs are effective to prevent incidents.

19. Does the ACTIVE card systems effective? _____

One means the ACTIVE card program has no effect on the safety on this rig.

Five means ACTIVE cards help to prevent safety incidents.

20. The rig management team deals professionally with emergencies. _____

    One means the rig management team does not deal well with emergencies professionally.

    Five means the rig management team is very effective in all kinds of emergencies.

21. Poor management and safety supervision are directly related poor safety performance. _____

    One I disagree.

    Five means I strongly agree.

22. Competency and safe work are directly related. _____

    One means I strongly disagree.

    Five means I strongly agree.

23. Leadership is a better method for safety conformance rather than violations or punishment except for deliberate violations of safety rules. _____

    One means I disagree.

    Five means I agree.

24. I believe my work group is safe. _____

    One means my work group is not as safe as other work groups.

    Five means my group is very safe and I can prove by few or no incidents.

25. The quality of the pre-tour safety meetings is useful and meaningful. _____

    One means the per-tour meetings are a waste of time and there is no value added.

    Five means these meetings are effective and useful.

26. It is regular to see follow up actions for findings resulting in unsafe acts, conditions and incident investigations? _____

    One means I have never seen follow up actions.

    Five means this is a regular occurrence.

27. Safety drills and exercises are conducted on a regular basis and they add value to the rig's safety culture. _____

    One means there are few safety drills and exercises and they are a waste of time.

    Five means safety drills and exercises are held regularly and add value to the rig crew.

28. If you short change, does this affect your ability to work safely? _____

    I don't short change. _____

    One means I wish I didn't have to short change as it directly affects my ability to work safe.

    Five means there are no issues with short changing.

29. Am I responsible for my own safety or is the rig management team responsible for my safety? _____

    One means the rig or others are responsible for my safety.

    Five means I am responsible for my own safety.

30. I see the Safety Officer on deck regularly and he is open to discussions relating to safety issues/concerns. _____

    One means I don't know who the Safety Officer is.

    Five means the Safety Officer is about the deck and at meetings regularly; his presence adds value.

31. I know who my safety representative or delegate is and he contributes to the rig's safety culture. _____

    One means I don't know who my safety representative is.

    Five means the safety representative is very active and provides good information to our team.

32. I believe if I say too much or complain too much about safety concerns, I may be fired. _____

    One means this is certainly true and I would be fired. \

    Five means I would never get fired over safety concerns.

33. People on the rig are very likely to report near misses. _____

    One means near misses are routinely NOT reported via the ACTIVE system.

    Five means near misses are reported via the ACTIVE system.

34. I trust my supervisor with my safety. _____

    One means my supervisor is more concerned with getting the job done.

    Five means my supervisor does everything possible to look out for my safety and my team.

35. My supervisor is likely to accept responsibility when a safety violation occurs within our work group. _____

    One means my supervisor blames his work group for safety violations.

    Five means he takes responsibility even when it is our fault.

36. I ignore safety rules regularly to get the job done. _____

    One means I ignore safety rules on a constant basis.

Five means I obey all safety rules and even stop the job rather than violate the rules.

37. I carry out activities that are unsafe with my coworkers. _____

    One means this is true on a regular basis.

    Five means this never happens with me or my coworkers.

38. I violate work procedures on a regular basis to get the job done. _____

    One means this is true on a regular basis.

    Five means this never happens.

39. I find it is better to get the job done than follow safety rules all the time. _____

    One means this is true on a regular basis.

    Five means this never happens.

40. My supervisor cares more about safety than most rig hands. _____

    One means this is not true and quite the opposite.

    Five means this is very true.

41. Safety procedures, processes, SJAs and work permits are the safest way to operate. _____

    One means this is not true of our work situation.

    Five means I agree.

42. When a safety improvement is recommended, it takes very little time to implement on the rig. _____

    One means this is not true and it takes a very long time if ever to implement safety improvements.

    Five means this is true.

43. I take shortcuts that may be unsafe to get the job done. _____

One means this is a regular occurrence.

Five means this is never done by me.

APPENDIX B

Age, Education, Time in Industry, Time on Rig

Summary Results

Age, education, time in industry, time on rig summary results

Title	Age	Education	Yrs of Service Industry	On rig
Medic	32	some college	12	8
Safety Officer	41	CD	34	18
Admin		CD	30	48
Catering		CD	36	12
Catering		CD	12	13
Steward	32	some college	8	8
Steward	44	some college	8	8
Cook	29	PGD	4	4
Catering	36	CD	12	12
Steward	32	CD	8	8
Baker	42	CD	12	10
Motorman	23	CD	9	9
Deck Pusher	40	some college	228	39
SDPO	43	CD	168	27
Driller	38	some college	180	23
Night Pusher	60	some college	408	13
Deck Pusher	48	HS Dip	240	22
Floor Hand	29	HS Dip	7	7
Roustabout	21	some college	36	5
AB	27	some college	3	3
Driller Trainee	22	PGD	18	2
Crane Operator	35	HS Dip	16	5
Roustabout	25	some college	60	6
Aux Driller	25	HS Dip	8	13
Aux Driller	36	some college	144	1
Safety Officer	60	some college	396	31
SDT	30	PGD	12	0.5
Asst. Crane operator	40	HS Dip	216	6
Roustabout	31	some college	108	46
Asst. Crane operator	28	some college	72	38
Driller Trainee	24	CD	30	3
Electronic Tech	36	PGD	84	36
Asst. Crane operator	34		48	2
Welder	52	HS Dip	384	39
Roustabout	22	CD	2	2
Floor Hand	35	some college	84	12
SDPO	40	CD	204	27
Lead Drillling Fluid Oper	47	HS Dip	204	36
Main AD	39	some college	108	36
SDPO	37	PGD	60	36
OIM	42	CD	204	6
Roustabout	26	HS Dip	66	8
Aux A.D.	31	some college	96	6
Camp Boss	51	some college	15	15
AB Deck	55	some college	3	3
AB	26	CD	12	6
SAP	56	CD	240	36

VITA

Jonathan Henson works in the oil and gas industry for a United Kingdom-based Exploration and Production Company. Jonathan lives in the UK with his wife of 35 years. Prior to working in the UK, Jonathan worked for a global drilling contractor based in Houston, TX. Jonathan's primary responsibilities while working for the drilling contractor was the HSSE manager for the drilling rig surveyed for the thesis. Before working for the drilling contractor in Houston, Texas, Jonathan worked for a shipping company which was part of the rig's parent company. Jonathan gained a great deal of experience with health, safety, security and environmental programs during his 30 year career with the U.S. Coast Guard. His time in the Coast Guard was spent in the US and two overseas tours of duty. Drilling rig inspections and audits were part of his career in the Coast Guard along with investigations.