2012

A safety elements model for the building construction industry

Cliff Dunlap Dunlap
Louisiana State University and Agricultural and Mechanical College

A SAFETY ELEMENTS MODEL FOR THE BUILDING CONSTRUCTION INDUSTRY

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Engineering Science

by
Cliff Dunlap
B.A., Ambassador University, 1966
December 2012

ACKNOWLEDGMENTS

I would like to extend my special thanks to my Committee Chair, Dr. Isabelina Nahmens and the other members of the committee in alphabetical order, Dr. Eurico D'Sa (Graduate School Dean Representative), Dr. Craig Harvey, Dr. Sherif Ishak, Dr. Joe Kotrlik and Dr. Jared Llorens for their time effort and patience on my Dissertation.

I would also like to extend my special thanks to the members of the special Louisiana State University Safety Council (LSUSC), Dr. Laura Ikuma and Mr. Charles Pecquet for their valuable input on the Safety Elements Questionnaire (SEQ).

And lastly I would like to extend my special thanks to four Louisiana Non-Residential Building (NRB) construction companies for taking time out of their very busy schedules to take part in a Pilot Study of the SEQ, Mr. Charles Westerchil of Westerchil Construction Company, Mr. Art Gunnell of Living Quarter Technology, Inc., Mr. Paul Higdon of Cajun Maritime, LLC and Mr. Tony Ancona of Superior Service Company, Inc.

TABLE OF CONTENTS

ACKNOWLEDGMENTS ii

ABSTRACT v

CHAPTER 1. INTRODUCTION 1
1.1 Motivation 1
1.2 Safety in Construction 3
1.3 Research Question 4
1.4 Hypotheses 5
1.5 Research Purpose and Objective 5
1.6 Methodology Overview 6
1.7 Research Contribution 7

CHAPTER 2. LITERATURE REVIEW 8
2.1 Literature Search Methodology – Phase I 8
2.2 Literature Sorting Methodology – Phase II 8
2.3 Literature Overview 10
2.3.1 Management Role 10
2.3.2 Safety Evaluation 12
2.3.3 Specific Safety Elements 13
2.3.4 Safety Management Programs 15
2.3.5 Independent Standards 17
2.3.6 Design for Safety 17
2.4 Literature Gap 19

CHAPTER 3. METHODOLOGY 21
3.1 Phase I: Development of the Safety Elements Questionnaire (SEQ) 23
3.1.1 SEQ Data Collection Plan and Pilot Study 23
3.1.2 Final SEQ Design 34
3.2 Phase II: Implementation and SEQ Validation 35
3.2.1 Implementation of the SEQ 35
3.2.2 SEQ Data Validation 36
3.3 Phase III: Hypothesis Test and Development of a Safety Elements Model 37
3.3.1 Hypothesis Test 37
3.3.2 Research Question and Objective 37
3.3.3 Safety Elements Model 38

CHAPTER 4. RESULTS 41
4.1 SEQ Validation 41
4.2 SEQ Combined Response and Non-Response Comparison Demographics 41
4.3 SEQ Response Comparison Demographics 46
4.4 Hypothesis Test 48

4.5 Research Question and Objective …….. 50
4.6 Safety Elements Model and Validation ……. 51

CHAPTER 5. CONCLUSION, DISCUSSION AND FUTURE RESEARCH ..……..…. 56
5.1 Limitations of the Study …… 58
5.2 Major Findings …….. 59
5.3 Recommendations and Future Areas Research ……. 66

REFERENCES ……...….. .. 69

APPENDIX A: LITERATURE REVIEW SUMMARY ……...……..... 72

APPENDIX B: DEMOGRAPHICS AND SAFETY SCORES ..……..…….…... 75

APPENDIX C: SAFETY ELEMENTS *Z* TEST AND *P* VALUES ..……...… 78

APPENDIX D: 2008 OSHA TCR NAICS 2362 SAFETY SCORES …….……..…. 81

APPENDIX E: FINAL SEQ ……...….... 83

VITA …….. 136

ABSTRACT

The construction industry is a dangerous occupation and has the highest fatality rate of any industry in the United States. Although there have been significant improvements in the past few years, there is still a significant amount of work that needs to be done to further reduce the fatality and injury rates among construction workers. It is therefore imperative to identify the common safety practices that are found within construction companies that have above average safety records.

The current study explores specifically the non-residential building (NRB) construction companies and takes a look at the available literature over the past 10 years on all safety aspects of the industry. This study identifies significant gaps in the literature. It shows that very little studies have been done in identifying the common safety practices among multiple NRB construction companies and there are no studies that identify the common safety practices among NRB construction companies with above average safety scores.

This study's contribution to research knowledge is the identification of those common safety practices within the safety programs of NRB construction companies with above average safety scores. A survey was done using 55 of the 69 NRB construction companies as identified by OSHA's 2008 TCR safety rating system. There were 33 completed responses to the Safety Elements Questionnaire (SEQ).

There were 9 Safety Elements found to be statistically significantly different among Louisiana NRB construction companies with above and below average safety scores as determined by OSHA's 2008 TCR Safety rating system.

A Safety Elements Model was developed and validated from the results of this study. The Safety Elements Model consists of two Levels. Level I has 9 Safety Elements as mentioned

above and they were ranked in order of usage by the 13 NRB construction companies with above average safety scores. Level II has 20 Safety Elements that were ranked in order of usage by 92.3 % of the 13 NRB construction companies with above average safety scores. It is hoped that the Safety Elements Model, presented in this study, can be used to improve the safety of all construction companies.

CHAPTER 1. INTRODUCTION

1.1 Motivation

The construction industry is an inherently dangerous occupation. Although the industry's safety and health management record has improved significantly since the Occupational Safety and Health Act (OSHA) was passed by Congress in 1970 (Hallowell et al. 2009), it still has the highest fatality rate among all industries. From 2001 through 2010 there were over 10,000 fatalities. In addition to the fatalities in 2010, there were also over 195,000 non-fatal injuries (Bureau of Labor Statistics, 2010). These injuries and fatalities are very costly to the United States economy in terms of lost time, workers compensation costs and lost productivity. This is in addition to the unimaginable toll in human suffering and pain over the loss or injury of a loved one that is placed on family and friends.

According to Teizer et al. (2010) there were over six hundred deaths between 2004 and 2006 relating to construction equipment and contact collisions alone. Gillen et al. (2002) showed a significant correlation between injury severity (functional limitation) and the safety climate within construction companies. They went on to show the need for workers to be alerted to dangerous work practices and conditions.

Hallowell et al. (2010) showed that construction companies have several unique challenges in addressing safety issues. Three of the challenges mentioned are:

(1) The temporary nature of the projects

(2) The usually unique construction of each project

(3) The complexity of the projects

Hallowell et al. (2010) mentioned that there is no mechanism in place for formally evaluating the safety risk and selection of safety programs for implementation. In addition to the

challenges mentioned by Hallowell et al. (2010), there are usually a number of independent trades working in parallel with each other. This can sometimes lead to confusion on safety responsibilities which further complicate the ability to have an effective safety management program.

Sometimes there is also a difference in perception between management and the workforce in the assessment of the safety climate within their company. Gittleman et al. (2010) states that management, at times, perceives a more positive safety climate as compared to workers. This can partially be explained because most construction companies informally select the Safety Elements within their own safety program (Hallowell et al. 2009). This becomes even more critical when taken in light of the Garrett et al. (2009) study that found several other studies that show human error is the main reason for up to 80% of all accidents. According to Hallowell et al. (2009), research studies have shown that the most effective safety programs have upper management support as being critical to an effective safety program. Therefore it is imperative to identify those common Safety Elements that may have a positive impact on the reduction of work place injuries and fatalities.

For purposes of this study, as mentioned earlier, any individually identifiable, documented and measurable item of a company's safety program will be referred to as a "Safety Element". The sum of all the Safety Elements will be considered a safety program. Hallowell et al. (2009) refers to Safety Elements as the individual parts of a safety program.

This study looks at the non-residential building (NRB) construction sector of the construction industry. As mentioned earlier, this construction sector falls under the United States Census Bureau's NAICS (North America Industry Classification System) 2362 code. The NAICS 2362 sector code is defined as "The industry group that comprises establishments

primarily responsible for the construction (including new work, additions, alterations, maintenance, and repairs) of nonresidential buildings. This industry group includes nonresidential general contractors, nonresidential operative builders, nonresidential design-build firms, and nonresidential project construction management firms" (United States Census Bureau. 2007).

1.2 Safety in Construction

The General Duty Clause of OSHA, Section 5(a)[1] requires that every employer furnish to each of its employees a place of employment which is free from recognized hazards that are causing or are likely to cause death or physical harm. Therefore it is the duty of each employer to identify and mitigate any hazards that might cause death or physical harm.

There is also a strong financial incentive for companies to put in place an effective safety program that reduces workplace injuries and fatalities. Some construction company customers now use the safety record of a construction company in awarding contracts (McDonald et al. 2009). The higher the present fatality and injury rates are, the higher the annual Workers Compensation insurance policy rate will be in the future.

Friend et al. (2010) identifies safety professionals as the persons responsible for helping management identify, evaluate and control hazards in the work place. The majority of construction companies have their own 'in-house" safety experts that are responsible for putting together safety programs to minimize loss exposure in the workplace.

Friend et al. (2010) states that there are three basic methods for improving an existing safety environment:

(1) Engineering controls

(2) Administrative controls

(3) Personal protective equipment controls.

They went on to say that engineering controls are the preferred method because of their ability to isolate or eliminate safety hazards. Furthermore, they say accidents are not a random event but have specific causes. Accidents represent failures in the system or failures in management.

1.3 Research Question

For purposes of this study, as mentioned previously, Safety Elements will be defined as those individually identifiable, documented and measurable safety items that make up a safety program. After conducting an extensive literature review, a three tiered gap in the literature was found:

(1) The literature shows that very little research studies have been done on identifying common Safety Elements in NRB construction companies.

(2) The literature also shows that no research studies have been done on identifying the common Safety Elements that are found in NRB construction companies with above average safety scores as identified by OSHA's 2008 TCR safety rating system.

(3) The literature further shows that no studies have been done on ranking common Safety Elements within the NRB construction companies with above average safety scores as identified by OSHA's 2008 TCR safety rating system.

Therefore this study's research question is: Are there common Safety Elements among Louisiana NRB construction companies with above average safety scores as determined by OSHA's TCR reporting system from the year 2008 and are some of them statistically significantly different from the Louisiana NRB construction companies with below average safety scores as determined by OSHA's 2008 TCR reporting system from the year 2008?

1.4 Hypotheses

In order to address the research question a hypothesis was framed:

(1) Ho (Null Hypothesis): There are no statistically significant differences in the use of one or more Safety Elements between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system from the year 2008.

(2) Ha (Alternative Hypothesis): There are statistically significant differences in the use of one or more Safety Elements between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system from the year 2008.

1.5 Research Purpose and Objective

On the assumption that safety performance is not a random event, and that an NRB construction company's above average safety record does not happen by accident, it should be possible to identify the common Safety Elements that appear within two or more NRB construction companies with above average safety scores. The general purpose of this study is to identify those common Safety Elements among the NRB construction companies with above average safety scores as identified by OSHA's TCR safety rating system from the year 2008.

This study intends to develop a Safety Elements Model that can help all construction companies develop and implement an effective safety program. As mentioned in the Abstract above, the Safety Elements Model has two Levels. Level I consist of Safety Elements that were determined to have a statistically significant difference in usage between the NRB construction companies with above average safety scores and the NRB construction companies with below average safety scores as determined by OSHA's 2008 TCR rating system. Level II consists of

Safety Elements that were ranked by the amount of usage in 92.3 % of the NRB construction companies with above average safety scores as determined by OSHA's 2008 TCR Safety rating system.

In summary this study's objective is two-fold:

(1) Identify the common Safety Elements in the Louisiana NRB construction companies with above average safety scores as determined by OSHA's TCR safety rating system from the year 2008.

(2) Develop a Safety Elements Model of the common Safety Elements and the ranking of them by a percentage of usage as reported by the NRB construction companies with above average safety scores as determined by OSHA's TCR safety rating system from the year 2008.

1.6 Methodology Overview

This study's methodology combines the results of a preliminary Safety Elements list developed from the literature review with the results in a random sample of Designated Safety Experts within NRB construction companies that have above average safety scores, as identified by OSHA's TCR safety rating system from the year 2008. The Safety Elements Questionnaire (SEQ) was developed from the final Safety Elements list and approved by the Louisiana State University Safety Council (LSUSC).

The SEQ internal consistency was validated using the cronbach alpha test. The data from the SEQ was then analyzed using a *z* test on the individual questions relating to each Safety Element.

The results from the *z* test and descriptive statistics were used to develop the two level (Level I and Level II) Safety Elements Model as mentioned above.

1.7 Research Contribution

The primary research contribution of this study is the development of a Safety Elements Model that can be used by any construction company to help improve their safety performance by reducing the fatalities and injuries in the workplace. According to the literature review conclusions, this is the first study to survey the safety experts within NRB construction companies while specifically looking for differences in the usage of Safety Elements within NRB construction companies that have above average safety scores and NRB construction companies that have below average safety scores. Hopefully this study will be one of many more studies looking to identify and study those differences in the hope of reducing fatalities and injuries in the construction industry.

CHAPTER 2. LITERATURE REVIEW

There are two phases used in the literature review. Phase I is the initial literature search phase using online search engines with applicable filters. Phase II is a manual review of the literature that resulted from phase I using applicable manual filters. A process flow chart was developed to show Phase I and Phase II of the search and sorting methodology as seen in Figure 1 below.

2.1 Literature Search Methodology – Phase I

Two LSU access search engines were used with a primary filter for the Literature search. The search engines were SceVerse - Science Direct and Engineering Village. The primary filter was: *construction, *safety. The sites were further limited by four secondary filters:

(1) Title

(2) Engineering Journals

(3) English

(4) American Society of Civil Engineers on the Engineering Village site

The search engines and filters collectively yielded 172 potential research articles.

2.2 Literature Sorting Methodology – Phase II

As mentioned in the section above, the total number of research articles from the search was 172. This was further reduced to 26 research articles by eliminating research articles:

(1) That were published prior to Spring 2001

(2) That were not United States research articles

(3) That were not peer reviewed in a published Journal

(4) That were not applicable to the North America Industry Classification System (NAICS) 2362 code.

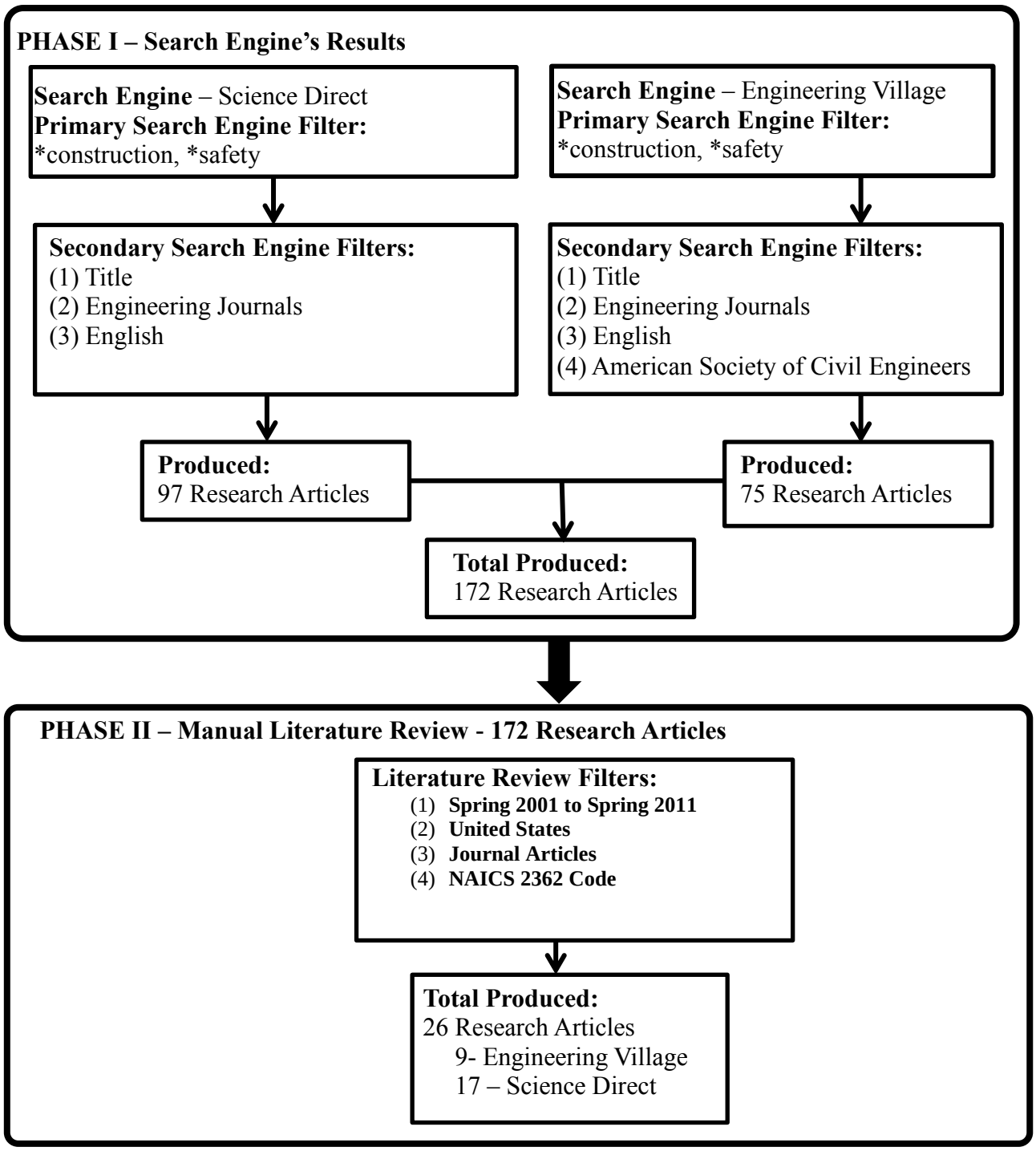

Figure 1: Process Flow Chart of Searching and Sorting Methodology

The 26 research articles appeared in 7 different recognized Journals as shown in Table 1 on next page.

Table 1: Number of Research Papers per Journal

Journal	Number of Research Papers	Percent Total of Research Papers
Accident Analysis and Prevention	1	3.8%
Automation in Construction	1	3.8%
Journal of Safety Research	5	19.2%
Journal of Construction Engineering and Management	13	50.0%
Journal of Professional Issues in Engineering Education and Practice	1	3.8%
Practical Periodical on Structural Design and Construction	3	11.5%
Safety Science	2	7.7%
	26	**100%**

2.3 Literature Overview

A careful review of each of the 26 research articles was studied to determine the subject matter and primary focus of the research articles. A matrix chart was developed which includes the author's name, the title of the article, the journal the article appeared in and the research focus of the article (APPENDIX A).

The following is a more detailed Literature review summary of the research articles listed under general subtitles of subject matter.

2.3.1 Management Role

Several studies specifically looked at management's role in safety. Most of the other studies stressed management's role to one degree or another but specific management's role was not the primary focus.

Toole et al. (2006) mentions that when it comes to safety responsibilities between design engineers, general contractors and subcontractors there is no uniform agreement on site safety responsibilities. They went on to recommend that site safety responsibility be assigned by each group's ability to control the factors that lead to construction accidents.

Huang et al. (2006) took it one step further and implied that owners should take a part in the safety management of a project's execution. They say that past studies have investigated roles of contractors, subcontractors and designer's impact on safety but the owner's impact on safety had not been previously researched.

In one interesting study, Gittleman et al. (2010) noted that on one company's construction site, where eight workers died, management perceived a more positive safety climate as compared to workers. They went on to note that perception about site safety is critical when it comes to feedback on safety at all levels of an organization. Several studies inferred that acknowledgement of safety hazards is important in reducing injuries and fatalities. In other words if management's evaluation and perception of safety hazards is less than what actually exists, then there is increased potential for injuries and fatalities.

There is some indication that union's commitment to safety may improve the perception of a safer working environment. Gillen et al. (2002) determined that union workers were more likely than nonunion workers to: (a) perceive their supervisors as caring about their safety; (b) be made aware of dangerous work practices; (c) have received safety instructions when hired; (d) have regular job safety meetings; and (e) perceive that taking risks was not a part of their job. This is an interesting conclusion, possibly inferring that management does not play as much of a role in safety as they should. These authors concluded that their study underscores the critical need for construction managers to alert workers to dangerous work practices and conditions more frequently which probably infers that unions are picking up some of the responsibility that management should be doing.

In light of these studies it becomes even more critical for management at all levels to take on personal responsibility for a more positive safe working environment. The challenge is to

identify those Safety Elements that directly influence a commitment to safety at both the management level and the employee level.

2.3.2 Safety Evaluation

Several studies evaluated the safety climate of construction companies and identified hazardous conditions at construction sites.

DeArmond et al. (2011) focused on the correlations between safety compliance and safety participation and injuries. They found that safety compliance had a stronger impact on the reduction of injuries than safety participation. In other words, insuring compliance may be a stronger driver of safety than just safety meetings alone without any follow-up initiatives.

There are three evaluation studies on scaffold safety. The first one, by Halperin et al. (2004), showed that a very high rate of defects was found in scaffolds in nine areas of the eastern United States. This study led to a 150 point checklist that was used in the evaluation of the scaffolds. Defects were found in 36.9% of the scaffolds inspected and ranged from a danger of collapse to missing guardrails. A second one by Yassin et al. (2004) studied the effectiveness of the revised scaffold safety standard in Title 29 of the Code of Federal Regulations Part 1926, Subpart L. Their study showed that the revised scaffold safety standard would prevent approximately 4.6 fatalities per year with a reduction of 404 non-fatal injures per year. A third one by Khudeira (2008) discusses the effect of Chicago's revised ordinance after a 2002 scaffolding accident that killed four people on the ground after coming loose from the John Hancock building. His conclusion was that the ordinance improved safety and invited readers to discuss other issues and ordinances relating to the scaffolding design in other major cities.

Another group of researchers narrowed their research down to concrete form work within the construction industry. They found that few studies look at risk at the activity level or look at

the low-severity, high frequency risk that is often associated with a high percentage of the total risk. They looked at three areas. The first one was the identification of the activities. The second one was assigning a risk classification to the activities and the third one was quantifying the average frequency and severity of each risk classification with each activity. Their results indicated that the highest risk activities were applying form oil and lifting and lowering form components (Hallowell et at. 2009).

To sum it up there appears to be a significant lack of commitment on the evaluation of safety practices within some companies. This could potentially lead to a bias on safety evaluations studies.

2.3.3 Specific Safety Elements

The majority of the studies contained Safety Elements to one degree or another. Many of the Safety Elements mentioned are more general in nature and tend to not be easily measured, such as: safety policy, safety organization, inspecting hazardous conditions, plant and equipment maintenance, safety promotion, high risk times, organization collective values, individual competence and management behavior. These are all important general Safety Elements but they need to be formatted in such a way as to be measurable in order to use the implementation of Safety Elements as a possible predictor of a safe working environment.

A majority of contractors provide safety and health training, but most do not quantitatively evaluate their training programs for a reduction in hazardous behaviors, increased job satisfaction or productivity (Goldenhar et al. 2001). Little is known about the nature and quality of safety and training in non-union construction sites. This generalization approach to safety and health training does not lead to measurable and recognizable Safety Elements.

Rajendran et al. (2009) used a rating system of 50 specific Safety Elements to determine a tasks safety risk and it's importance. The Safety Elements were validated by 12 experienced safety and health professionals representing different sectors using the Delphi method. The Delphi panel was made up of professionals in academics, health and safety, construction, regulatory agency, insurance and workers union. The 50 Safety Elements that were identified with the Delphi Method were similar to Safety Elements found in prior studies. One of the interesting results of the study was that the Delphi panel excluded safety incentives as an important Safety Element although prior studies indicated that safety incentives had a positive influence on safety. The top three Safety Elements found in this study were:

(1) Clear project safety authority responsibilities and accountability

(2) Employee empowerment to stop work authority

(3) Contractor selection based on safety

The least important three Safety Elements found in this study were:

(1) Task based hazard database

(2) Hearing conservation program

(3) Stretch and flex programs

A number of the Safety Elements used in the Rajendran et al. (2009) study did not meet the original criteria of the current study for being measurable, within the control of the contractor or were not backed up by other studies. However, the current study used 52 of the general inferences of this study for the Safety Elements that were eventually used in the Safety Elements Questionnaire (SEQ).

Another specific Safety Element that was looked at in a study by Tiezer et al. (2010) evaluated the effectiveness of a radio frequency sensing devise to alert workers-on-foot and

equipment operators when the two are in a too close proximity situation that could lead to a serious injury or a fatality.

There are a number of general Safety Elements mentioned in the literature but some are difficult to quantify as to their real effectiveness as a possible predictor of a safe working environment. Some companies are implementing Safety Elements that have a specific effect on decreasing fatalities and injuries while others are implementing Safety Elements that have little effect on decreasing fatalities and injuries. Part of this is probably explained due to little follow-up and monitoring of the programs.

2.3.4 Safety Management Programs

A few of the studies look at software driven programs for the purpose of managing and analyzing safety data while others look at manual tracking systems.

Some of the most effective safety management programs have Safety Elements that have upper management support with a commitment to strategic subcontractor selection. The least effective Safety Elements seem to be record keeping, accident analyses and emergency response planning (Hallowell et al. 2009). The current process of selecting specific Safety Elements for a safety management program is informal. Hallowell et al. (2010) in a later study analyzes the risk levels of different activities. This allows safety management planners to develop appropriate measures to implement safety factors that have the potential for reducing the risk. They go on to say that it also has a practical side:

(1) For validating a risk-based safety and health analytical model that can be used to evaluate expected risk with specific worker activities

(2) For strategically selecting highly effective safety program Safety Elements for implementation when resources are limited

(3) For quantifying the resulting risk once the identified Safety Elements have been implemented.

There is not a uniformly accepted policy or approach to safety management of on-site responsibilities. The American Society of Civil Engineers issues a policy for on-site safety and explicitly assigns some safety responsibilities to owners and design professionals whereas the trade organizations assign primary responsibility to the general contractor. On the other hand OSHA (Occupational Safety and Health Act) assigns primary responsibility to the employers of the employees exposed to hazards (Toole 2002). This has created considerable confusion on the worksite as to the accountability responsibility for insuring worker safety.

Koehn et al. (2003) analyzes the QES (quality, environmental and safety) safety management system that had been accepted by various contractors from time to time. They mention that implementing an effective safety management program is a top down process where top management, line management and other employees work together to develop the program and then motivate all employees to accept the process.

Another study on safety management takes the HFACS (human factors analysis classification system) that was originally developed for analyzing the human causes of accidents for rail, air and offshore environments and introduces the HEAT (human error awareness training) concept for potential application to the construction industry (Garrett et al. 2009).

In summary there does not appear to be a universally accepted approach to safety management in the construction industry, especially in the area of primary responsibility for safety. As the literature shows, there are available systems and approaches that can be used for managing safety but some caution and careful study of the applications should be exercised prior to application.

2.3.5 Independent Standards

A couple of studies use Independent Standards for measuring a company's safety performance. McDonald et al. (2009) analyzed the safety record on a university construction contract based on ROCIP (Rolling Owner Controlled Insurance Program) "lost time" injury rates. They went on to say that safety was considered in the awarding of contracts.

Rajendran et al. (2009) looked at the impact of green building design, as rated by LEED (Leadership in Energy and Environmental Design), on construction worker safety and health as measured by OSHA's recordable lost time injury and illness data. These results were then measured against non-green projects.

The studies show that very little research has been done on using independent standards to measure a construction company's safety performance and no research has been done on identifying Safety Elements among construction companies with above average safety scores as identified by OSHA's TCR (total case rate) safety rating system.

2.3.6 Design for Safety

The studies on the principle of designing-for-safety show that there are two design opportunities to help prevent accidents prior to construction. The first is at the design phase and the second is on the location site planning prior to beginning construction.

Research studies have identified the design phase of projects as being a significant contributing factor to construction site accidents. However, widespread use of designing-for-safety is not common in the United States because of engineering and architecture firms' perception of industry and project barriers. Designing-for-safety is much more common in Europe than here in the United States. Project costs, scheduling and limitations on design

creativity were mentioned the most often as reasons for not implementing designing-for-safety at the design phase of a project here in the United States (Gambatese et al. 2005).

Weinstein et al. (2005) analyzed a designing-for-safety initiative in the design and construction of a large manufacturing facility. The authors proposed 26 potential design changes and followed the design and construction process to see if the changes were integrated into the construction. They also considered whether the design changes would have occurred without the designing-for-safety initiative. Their conclusion was that the design changes probably would not have occurred without the initiative.

There appears to be a clear link between designing-for-safety upstream from the construction site that can affect worker safety (Behm, 2005). He also mentioned that the United States is lagging the rest of the world in implementing this practice. He analyzed 224 fatalities and 42% of the fatalities at the construction site were linked to the design phase of the project. He recommended that the United States construction industry adopt the practice of designing-for safety at the design phase of a project. However, as we saw above in the previous study, there are some strongly held beliefs that are preventing this process from being widely implemented in the United States.

Toole (2005) identified additional barriers that would prevent designers from designing-for-safety at the design phase of a project. Those additional barriers are a lack of safety expertise, a lack of understanding of the construction processes, the use of typical contract terms and professional fees. He studied the United Kingdom's regulations requiring engineers to design-for-safety but concluded that similar legislation in the United Sates would not be "appropriate". The Toole (2005) study is at some variance with the rest of the studies on the

importance of designing-for-safety at the design phase by concluding that it is not "appropriate" in the United States.

There are a couple of studies that demonstrate that designing-for-safety can be done in the United States. Khaled et al. (2005) proposes a model that takes into account safety planning when planning a construction site layout while minimizing the travel costs of the resources to the site. Usman et al. (2002) integrates safety planning at all levels on public school construction projects for the protection of workers, school staff and students. Kleiner et al. (2008) deals with a rush project where safety and costs could be compromised. The authors developed a system called RUSH (Rapid Universal Safety and Health) and applied it to a 106 hour construction project. The study showed that the results from this initial application of designing-for-safety included a safe build in approximately 5 days without recordable incidents.

As we see above there is a very strong case for doing up-front designing-for-safety in order to lower costs and improve the safety of the working environment. As we saw also, the studies tended to indicate that the United States is behind the rest of the world in designing-for-safety as a regular practice. However the studies also did not show a strong case for the reasons behind the slow implementation in the United States.

2.4 Literature Gap

The aforementioned studies show very little study on the use of common Safety Elements among multiple construction companies. The majority of the previous studies quantify safety improvements after the implementation of particular safety factors or Safety Elements within the same company. Also, as was noticed previously, there were only two studies that used a referenced standard for studying the use of Safety Elements that would be similar to OSHA'S TCR safety rating system.

The primary major Gap among the various studies is the lack of studies that identify common Safety Elements among construction companies with above average safety scores. If safety is not a random event or a series of random events, then a possible inference can be made that there are common Safety Elements among construction companies with above average safety scores that can be used to develop a Safety Elements Model.

None of the referenced studies researched whether common Safety Elements exist among construction companies with above average safety scores. Also none of the referenced studies identified a model based on common Safety Elements found in companies with above average safety scores.

CHAPTER 3. METHODOLOGY

This study uses OSHA's TCR (total case rate) rating system for identifying non-residential building (NRB) construction companies with above average safety scores and NRB construction companies with below average safety scores. Each year the Occupational Safety and Health Administration (OSHA) collects work-related injury and illness data from companies within specific industry and employment size specifications. The companies are required by law to respond to OSHA with the requested data. The collection of this data is called the OSHA Data Imitative or ODI. The resulting data is used by OSHA to calculate a company's specific injury and illness incidence rates. The searchable database contains a table with the name, address, industry, and associated TCR rating for the company. The TCR data for a company is translated into a specific safety score with 1.0 being average, less that 1.0 being above average and more than 1.0 being below average. The final score is adjusted for the number of hours worked based on 200,000 hours per year.

This current study is focused on the non-residential building (NRB) construction companies North America Industry Classification System (NAICS) code 2362. However in the construction industry, OSHA collects the data by job-site each year instead of collecting it by specific company on a year to year basis. OSHA only collects the data on a population of construction companies approximately every five to eight years. The database used in this current study is from the year 2008 and involved NRB construction companies with 40 or more employees. In 2008 there were 783 total Louisiana based NRB construction companies. Out of the total 783 only 69 companies had 40 or more employees. The remaining 714 companies had under 40 employees with 323 companies having under 4 employees. The last time OSHA collected the data by specific construction companies before 2008 was in 2002. The 2008

population data base had safety scores on 69 Louisiana based NRB construction companies (*n*=69). There were 34 (49.3%) NRB companies with above average safety scores and 35 (50.7%) with below average safety scores. Please see APPENDIX D.

In order to accomplish the objective of this study, a three phase methodology plan was used. Please see Figure 2 below.

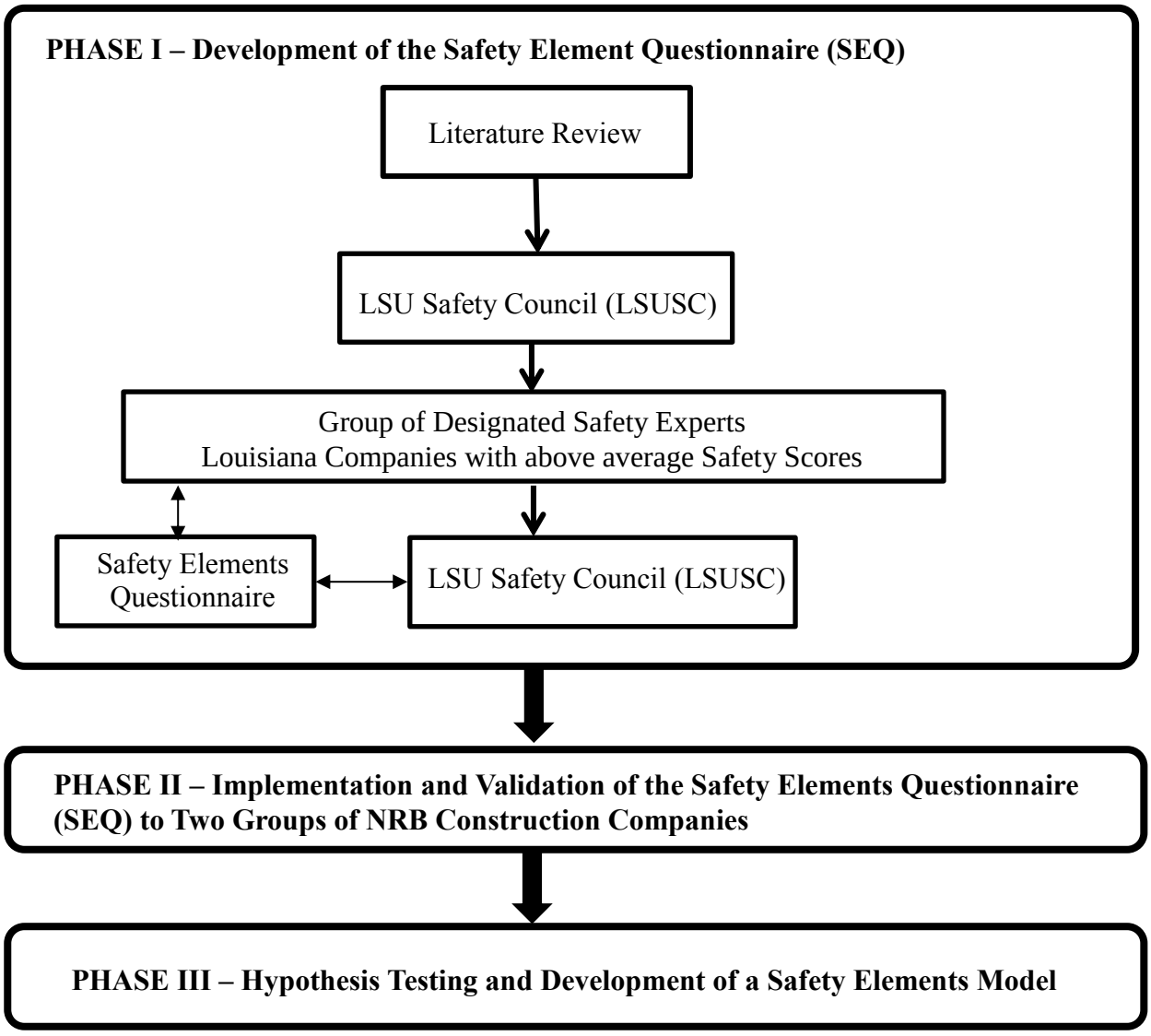

Figure 2: Three Phase Methodology Overview

3.1 Phase I: Development of the SEQ

The purpose of this phase is to develop the Safety Elements Questionnaire (SEQ) by characterizing the Safety Elements that are found in the referenced literature and combining them with the additional Safety Elements submitted form the group of 4 Designated Safety Experts from a pilot study within the NRB construction companies as mentioned in the Abstract above and section 3.11 below.

3.1.1 SEQ Data Collection Plan and Pilot Study

The initial list of Safety Elements was compiled from the referenced literature which produced 52 Safety Element recommendations. This initial list was reviewed by the Louisiana State University Safety Council (LSUSC) and asked to add any Safety Elements that, in their professional opinion and experience, contribute to the overall safety environment of NRB construction companies. The LSUSC did not add any additional Safety Elements.

The second round of additions was the pilot study using the 4 Designated Safety Experts from a random sample of 8 Louisiana NRB construction companies, with above average safety scores as identified by OSHA's TCR safety rating system from the year 2008. There were 4 companies that choose not to participate in the pilot study. The total of 8 companies from the original random sample was not part of the final SEQ. The random sample of 4 NRB construction companies with above average safety scores were given the updated preliminary list of Safety Elements and were asked to add any Safety Elements that, in their professional opinion and experience, contribute to the overall safety environment at their construction company. They were not permitted to remove any Safety Elements from the preliminary list and could only add Safety Elements that have been fully implemented and documented at their construction company. The Pilot Study produced an additional 6 Safety Elements.

The original list of 52 Safety Elements from the literature was then combined with the 6 Safety Elements from the group of 4 Designated Safety Experts from the construction companies with above average safety scores. This final list of 58 Safety Elements was then submitted to and approved by the LSUSC. Please see Table 2 and Table 3 below.

Table 2: Literature Reference Identification of Safety Elements

Safety Elements	Literature General Safety Elements	
designated safety budget as part of the normal operating budget	… safety expenses were accounted for in their operating budget … Goldenhar et al. (2001)	
pay employees for the hours they spend attending voluntary off-hour safety training sessions	… employees were paid when safety training … after normal work hours … Goldenhar et al. (2001)	
communication between management and company employees on safety issues	… regular communication between management and workers … Gillen et al. (2002)	
management support in the use of safety principles and practices	… management need to … show their genuine concern for safety. Gittleman et al. (2010)	Senior and mid-level management need to serve as role models … in critical safety activities … Gittleman et al. (2010)
	… supervisors as caring … Gillen et al. (2002)	Recalibration of executive leadership and revision of processes … Garrett et al. (2009)
	… status of safety officers within the organization … Gillen et al. (2002)	… management's concern with their well being … Gillen et al. (2002)
	… perceived level of importance place on safety and health … Goldenhar et al. (2001)	Staff motivation and support … Koehn et al. (2003)
	Upper management support. Hallowell et al. (2009)	Management commitment to safety and health … Rajendran et al. (2009)
	… selecting safe contractors … Huang et al. (2006)	Subcontractor selection and management. Hallowell et al. (2009)

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
take into account a subcontractor safety record when awarding contracts (continued)	Select only those subcontractors who have a good record … Koehn et al. (2003)	… bids only from companies which had low experience modification ratings … McDonald et al. (2009)
	Safety and health in contracts … Rajendran et al. (2009)	
owners of the projects attend company safety meetings	… owner's involvement … Huang et al. (2006)	Owner/representative commitment to safety … Rajendran et al. (2009)
formal safety program	Set up a construction safety department … Huang et al. (2006)	… formal safety program … Goldenhar et al. (2001)
	… comprehensive safety program … McDonald et al. (2009)	
formal safety goals that are updated periodically	Set goals for construction safety … Huang et al. (2006)	… clearly defined organizational safety goals and policies … Gittleman et al. (2010)
continuous safety improvement program	… continuous quality improvement methods … Garrett et al. (2009)	
formal safety committee that meets on a regular schedule	Establish labor/management safety committees … Gittleman et al. (2010)	Safety and health committees. Hallowell et al. (2009)
	Owner safety representative … Rajendran et al. (2009)	Always include safety …at owner-contractor meetings … Huang et al. (2006)
	Constructor safety representative … Rajendran et al. (2009)	Employee safety committee and leadership team … Rajendran et al. (2009)
	Set goals for construction safety … Huang et al. (2006)	
Invite subcontractors to the safety committee meetings	Subcontractor safety representative … Rajendran et al. (2009)	

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
Formal personal protective equipment training program	… proper use of personal protective equipment … DeArmond et al. (2011)	Use appropriate personal protective equipment … DeArmond et al. (2011)
	… appropriate PPE. Kleiner et al. (2008)	PPE expectations communicated … McDonald et al. (2009)
	Personal safety equipment must be worn … Usmen et al. (2002)	Know what safety equipment is required task … Tool (2002)
Supply new employees with company required personal protective equipment free of charge	… provided personal protective equipment … Goldenhar et al. (2001)	… proper equipment always available. Gillen et al. (2002)
	Supply … personal protective equipment … Koehn et al. (2003)	
formal site-specific housekeeping plans	… house keeping … DeArmond et al. (2011)	… general housekeeping … Gillen et al. (2002)
	… clear plan for regular housekeeping. McDonald et al. (2009)	… housekeeping plan … Rajendran et al. (2009)
	Worksite housekeeping … Usmen et al. (2002)	
site-specific safety procedures	...safety procedures. DeArmond et al. (2011)	… site specific safety programs, … Garrett et al. (2009)
	… safety plan that is project and site specific … Kleiner et al. (2008)	Require short-term permits … for hazardous activities. Huang et al. (2006)
	Establish a formal reporting system … for issues that need to be conveyed to all site personnel … Gittleman et al. (2010)	… project-specific safety plan … Huang et al. (2006)
	… existence of on-site safety monitors/observers … Kleiner et al. (2008)	… identify proper storage locations for all hazardous material … El-Rayes et al. (2005)

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
site-specific safety procedures (continued)	…badges to prevent unauthorized individuals on site … McDonald et al. (2009)	… taping hazardous areas … Kleiner et al. (2008)
	on/off site traffic plan … Rajendran et al. (2009)	Specifications of less hazardous materials … Rajendran et al. (2009)
	Engineering controls for health hazards … Rajendran et al. (2009)	Constructor site specific safety plan … Rajendran et al. (2009)
	Know proper site conditions … Tool (2002)	Safety managers on site … McDonald et al. (2009)
	… able to enforce safety … Tool (2002)	Safety hazard identification in construction drawings … Rajendran et al. (2009)
		Contractor evaluation based on safety performance … Rajendran et al. (2009)
onsite safety inspections	Frequent worksite inspections. Hallowell et al. (2009)	Conduct safety audits … Huang et al. (2006)
	… on-site safety monitors should be OSHA certified. Kleiner et al. (2008)	Safety managers make regular site walk throughs … McDonald et al. (2009)
	Safety inspections … Rajendran et al. (2009)	
third party safety inspections	… third party oversight … to insure … metrics are verified. Garrett et al. (2009)	
task-specific procedures	Use critical path method … Koehn et al. (2003)	Know standard methods and sequencing for task … Tool (2002)
	Proper documentation and document control. Koehn et al. (2003)	Implement work procedures … Koehn et al. (2003)
	… documentation … Usmen et al. (2002)	

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
survey employees to find out what their safety needs are	Written and comprehensive SH plan. Hallowell et al. (2009)	… employees what they think (of training) and what can be done better … Goldenhar et al. (2001)
	… workers should be empowered to raise risk concerns … Kleiner et al. (2008)	Stretch and flex program. Rajendran et al. (2009)
	Hazard communication … Usmen et al. (2002)	… communication issues of workers who did not speak English … McDonald et al. (2009)
	… written and safety and health policies … Goldenhar et al. (2001)	
check references before hiring a new employee	… checked references to ensure new employees had the necessary abilities and skills … Goldenhar et al. (2001)	
assigned safety person for each job site	… designated safety supervisor … Goldenhar et al. (2001)	… assign safety coordination responsibilities … on site … Huang et al. (2006)
	… formal safety and health record keeping … Goldenhar et al. (2001)	Safety manager on site. Hallowell et al. (2009)
	… include safety as senior and mid-level management's responsibility … Gittleman et al. (2010)	Supervisors evaluated on safety performance … Rajendran et al. (2009)
formal emergency response plan for injured employees	Emergency response planning. Hallowell et al. (2009)	Procedure established for first-aid on site … McDonald et al. (2009)
	Emergency management … Usmen et al. (2002)	First aid and medical requirements … Usmen et al. (2002)

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
formally addresses worker safety risk concerns	… aware of dangerous work practices … Gillen et al. (2002)	Employees empowered with stop authority … Rajendran et al. (2009)
	… conduct anonymous short safety needs assessments surveys … to allow employees .. To voice their opinions … on the current status of safety programs … Gittleman et al. (2010)	… written task specific procedures … Garrett et al. (2009)
	… state of the art communication methods … Garrett et al. (2009)	
Procedure for rejecting defective materials	Reject defective materials on site. Koehn et al. (2003)	
formal policy for reassigning injured workers to light duty tasks	Policies established for modified (light) duty work for those that are injured. McDonald et al. (2009)	
use skilled and trained persons for performing high risks tasks	… effective warnings regarding specific equipment risk … Kleiner et al. (2008)	Competent personnel for all high hazard tasks … Rajendran et al. (2009)
	Assessment of all equipment operators skills and training … Rajendran et al. (2009)	
on-site safety plans for subcontractors	Subcontractor site specific safety plan … Rajendran et al. (2009)	
safety performance evaluations for key personnel	… behavior based safety reporting … Garrett et al. (2009)	
ergonomic task analysis on critical tasks	Ergonomic task analysis … Rajendran et al. (2009)	Ergonomics … Usmen et al. (2002)

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
regularly scheduled on-site worker safety meetings	… voluntary safety meetings … DeArmond et al. (2011)	… quality toolbox talks … Gittleman et al. (2010)
	.. Worker safety meetings … Goldenhar et al. (2001)	… regular job safety meetings … Gillen et al. (2002)
	… regular safety meetings. Hallowell et al. (2009)	… regular safety meetings with supervisory personnel … Huang et al. (2006)
	Regular tool box talks… McDonald et al. (2009)	… regular safety meetings … McDonald et al. (2009)
	Toolbox meetings … Rajendran et al. (2009)	
new employee orientation safety training program	… employee orientation programs … Goldenhar et al. (2001)	… received safety instruction when hired … Gillen et al. (2002)
	Safety and health orientation and training … Hallowell et al. (2009)	… safety measures for unskilled volunteers … Kleiner et al. (2008)
	Opportunities for training … McDonald et al. (2009)	Provide job training … Koehn et al. (2003)
	Proper training … Usmen et al. (2002)	Have expertise in task … Tool (2002)
Regularly scheduled safety training programs for existing employees	Maintaining up-to-date knowledge … DeArmond et al. (2011)	… initiating safety-related workplace change … DeArmond et al. (2011)
	… training … DeArmond et al. (2011)	… proper use of equipment ... DeArmond et al. (2011)
	Apply the appropriate practices … DeArmond et al. (2011)	Attend non-mandatory safety orientated training … DeArmond et al. (2011)
	… worker training … Gillen et al. (2002)	Training is viewed as an important support function … Kleiner et al. (2008)
	Safety orientation for all workers … Rajendran et al. (2009)	Safety training for all supervisors … Rajendran et al. (2009)

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
Employee feedback on safety training program effectiveness	… effective training program … Garrett et al. (2009)	… effective worker orientation program … Huang et al. (2006)
External safety training programs	… internal and external educational programs … Garrett et al. (2009)	
Pair-up training of inexperienced employees with experienced employees for learning new tasks	... helping to teach … DeArmond et al. (2011)	… pair-up experienced workers/mentors with inexperienced workers. Goldenhar et al. (2001)
use simulation models for equipment training	… equipment simulation training, … Garrett et al. (2009)	
safety training for subcontractors	… General contractors and sub-contractors … provide training to foremen on pro-active management skills … Gittleman et al. (2010)	… on-the-job training … did not include subcontractors. Goldenhar et al. (2001)
		Constructor mentors subs to improve safety performance … Rajendran et al. (2009)
Project specific safety training for new projects	Project-specific training … Hallowell et al. (2009)	Require safety training of all project employees … Huang et al. (2006)
	Orientation program for all workers before … work on site. McDonald et al. (2009)	Workers oriented to site … McDonald et al. (2009)
OSHA 10 hour training course for all job site employees	… at a minimum, an OSHA 30-hour training course to all foremen … Gittleman et al. (2010)	OSHA 10 h training for all workers … Rajendran et al. (2009)

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
employees to report unsafe working conditions and safety violations	… encouraging others to get involved … DeArmond et al. (2011)	Try … to make it safer … DeArmond et al. (2011)
	Take the appropriate steps … for exercising your rights under OSHA … DeArmond et al. (2011)	… report injuries, accidents, or illnesses. DeArmond et al. (2011)
employees assisting other employees on safety issues	Assist others to make sure they perform their work safely … DeArmond et al. (2011)	… protecting fellow crew members … DeArmond et al. (2011)
taking safety risks is not part of their job	Speak up … to get involved in safety issues … DeArmond et al. (2011)	… perceived that taking safety risks was not part of their job. Gillen et al. (2002)
safety incentive reward program	… timely feedback for improvement and recognition … Gittleman et al. (2010)	… safety and health incentive program … Goldenhar et al. (2001)
discipline procedure for employees that commit unsafe acts	… reporting crew members who violate safety … DeArmond et al. (2011)	Explain … you will report safety violations. DeArmond et al. (2011)
	Take action to stop safety violations … DeArmond et al. (2011)	… immediate, constructive, and specific feedback to workers when they demonstrate poor performance … Gittleman et al. (2010)
	Authority to remove workers who demonstrated unsafe work practices. McDonald et al. (2009)	… able to influence behavior through evaluations … Tool (2002)
investigation procedure for worker related accidents	… capturing, or loss, of lessons learned … Garrett et al. (2009)	Identifying employee and field supervisory personnel behavioral traits and motivators … Garrett et al. (2009)

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
investigation procedure for near-miss accidents	… engage in open communications about safety errors and near misses with workers … Gittleman et al. (2010)	… near miss reporting systems, … Garrett et al. (2009)
	Accident and near miss investigation … Rajendran et al. (2009)	
maintain safety performance statistics for improving safety on the job site	Maintain statistics on … safety performance … Huang et al. (2006)	Record keeping and accident analyses. Hallowell et al. (2009)
	Proper record keeping for monitoring … Usmen et al. (2002)	
detailed safety reports to employees on a regular basis	… failure of employees at the field level to fully comprehend … procedures or job hazard analysis … Garrett et al. (2009)	… detailed safety reports to all employees … Gittleman et al. (2010)
	Job hazard analyses and hazard communication. Hallowell et al. (2009)	
Procedure for making corrections to unsafe conditions at the job site	… daily job safety analysis … Huang et al. (2006)	Hazard analysis … McDonald et al. (2009)
	Job hazard analysis … Rajendran et al. (2009)	… regular workplace hazard analyses … Gittleman et al. (2010)
	Job safety analysis. Usmen et al. (2002)	… capturing, or loss, of lessons learned … Garrett et al. (2009)
	Identifying employee and field supervisory personnel behavioral traits and motivators … Garrett et al. (2009)	… job hazard analysis … Huang et al. (2006)

Table 2: Literature Reference Identification of Safety Elements (continued)

Safety Elements	Literature General Safety Elements	
Procedure for making corrections to unsafe conditions at the job site (continued)	… unsafe condition … natural part … construction site … Behm (2005)	… unsafe acts …. Behm (2005)
	Safety Violations identified and corrected … Rajendran et al. (2009)	… non-human … events Behm (2005)
Substance abuse awareness program	Substance abuse programs. Hallowell et al. (2009)	… substance abuse program … Huang et al. (2006)
	Substance abuse … Usmen et al. (2002)	
Substance abuse testing program	Drug and alcohol testing program … Rajendran et al. (2009)	Random drug and alcohol tests … McDonald et al. (2009)
	… drug and alcohol testing … Goldenhar et al. (2001)	… substance abuse testing programs ... Garrett et al. (2009)

Table 3: Pilot Study - Identification of Six Additional Safety Elements

safety risk management program
job site heat stress prevention program
employees verify if they have been injured on the job
job hazard analysis prior to the start of a new type of operation or procedure
root cause safety analysis training program for key employees that deal with safety issues
temporary labor safety training program

3.1.2 Final SEQ Design

The SEQ has two sections. The first section contains the previously identified 58 Safety Elements with 52 of them coming from the literature review and 6 of them coming from the Pilot Study as previously mentioned. In the first section of the SEQ, the respondents were asked to

identify the Safety Elements that they were presently using as of 2012. In the second section they were asked to identify, from the same list of 58 Safety Elements, that they were using back in 2008. Please see APPENDIX E for a copy of the SEQ.

A follow-up question was sent to the respondents upon completion of the SEQ and they were asked to list the number of employees they had inside the state of Louisiana and the number of employees they had outside the state of Louisiana.

3.2 PHASE II: Implementation and SEQ Validation

As noted in the Introduction section 1.5, the objective of this study is two-fold:

(1) Identify the common Safety Elements in the Louisiana NRB construction companies with above average safety scores as determined by OSHA's TCR safety rating system from the year 2008.

(2) Develop a Safety Elements Model of the common Safety Elements and the ranking of them by a percentage of usage as reported by the NRB construction companies with above average safety scores as determined by OSHA's TCR safety rating system from the year 2008.

The final SEQ design was structured to meet the first part of the objective upon receipt of the responses from the respondents to the SEQ. The second part of the objective was fulfilled upon the analysis of the data and design of the Safety Elements Model as shown below in section 3.3.3

3.2.1 Implementation of the SEQ

In the implementation of Phase II of this study, the Designated Safety Experts at the NRB construction companies were asked to fill out the SEQ. The data collection of the SEQ was coordinated by the Author with the use of an on-line data collection system.

As mentioned earlier there was a population of 69 (n=69) Louisiana NRB construction companies, with 40 or more employees, in Louisiana for OHSA's TCR safety rating system from the year 2008. Out of the original 69, there were 55 (n=55) potential respondents with verifiable e-mail addresses that were asked to take part in the SEQ. An on-line survey system was used for the data collection (SurveyMonkey.com, LLC, Palo Alto, CA). This survey system is widely used in the public and private sectors. The survey instrument is created on-line and is distributed by e-mail to each potential respondent. The system automatically tracks and stores each respondent's answers. The final data can be down-loaded into several formats depending on which statistical system is being used to analyze the data. Each potential respondent was personally visited by the Author to explain the purpose of the SEQ and the author was also available by personal cell phone to answer any questions during the respondents' response to the online SEQ. There were three types of personal follow-ups to encourage a response:

(1) Up to three additional personal follow-up visits were used to encourage additional responses.

(2) Up to five e-mail follow-ups were used to encourage additional responses.

(3) Up to five phone calls were used to encourage additional responses.

The original submissions and follow-ups produced a total of 33 responses to the SEQ.

3.2.2 SEQ Data Validation

SAS (SAS Institute Inc., Cary, North Carolina) 9.3 was used as the primary statistical analysis software for the SEQ data. The SEQ was validated by a cronbach alpha internal consistency test.

3.3 PHASE III: Hypothesis Test and Development of a Safety Elements Model

3.3.1 Hypothesis Test

If the *z* test, at the 90% confidence level, shows that there are no statistically significant differences in the use of one or more Safety Elements between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system for the year 2008, then the Null Hypothesis will be accepted.

As originally noted in section 1.4 of this study, the hypotheses are as follows:

(1) Ho (Null Hypothesis): There are no statistically significant differences in the use of one or more Safety Elements between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system from the year 2008.

(2) Ha (Alternative Hypothesis): There are statistically significant differences in the use of one or more Safety Elements between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system from the year 2008.

3.3.2 Research Question and Objective

The original research question in section 1.3 of this study was: Are there common Safety Elements among Louisiana NRB construction companies with above average safety scores as determined by OSHA's TCR reporting system from the year 2008 and are they significantly statistically different from the Louisiana NRB construction companies with below average safety scores as determined by OSHA's reporting system from the year 2008? The answer to the research question will be answered by the results and analysis of the SEQ responses.

In section 1.5 of this study a two-fold objective for the study was laid out. The objective was:

(1) Identify the common Safety Elements in the Louisiana NRB construction companies with above average safety scores as determined by OSHA's TCR safety rating system from the year 2008.

(2) Develop a Safety Elements Model of the common Safety Elements and the ranking of them by a percentage of usage as reported by the NRB construction companies with above average safety scores as determined by OSHA's TCR safety rating system from the year 2008.

3.3.3 Safety Elements Model

As mentioned earlier in section 1.5, the second part of the objective of this study was to develop a Safety Elements Model based on the results of the data from the SEQ. The Safety Elements model consists of two levels – Level I and Level II (Figure 3).

SAS 9.3 was the primary statistical analysis program used for the Safety Elements Model testing for Level I. Descriptive statistics was the primary statistical analysis method used for the Safety Elements Model validation for Level II.

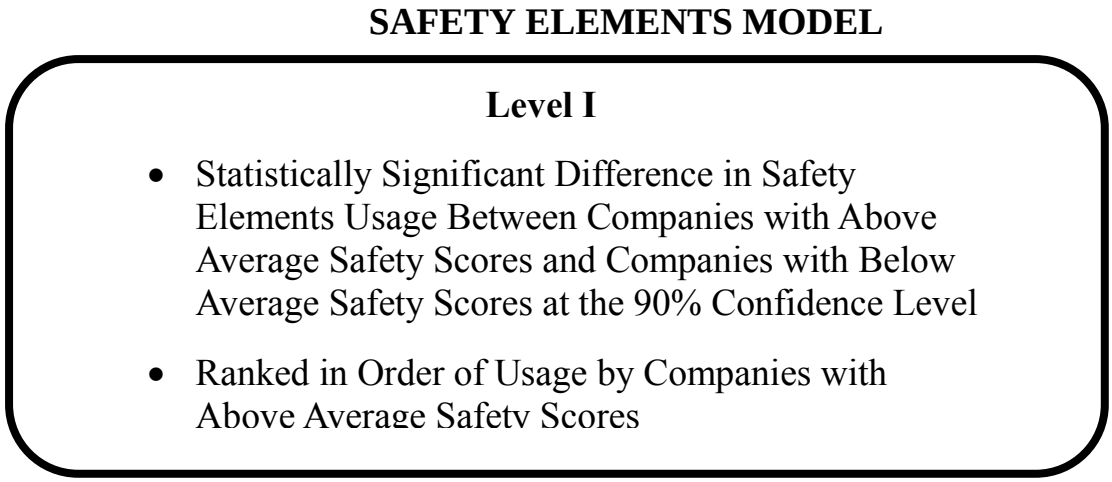

Figure 3: Safety Elements Model - Method

Safety Elements Model (continued)

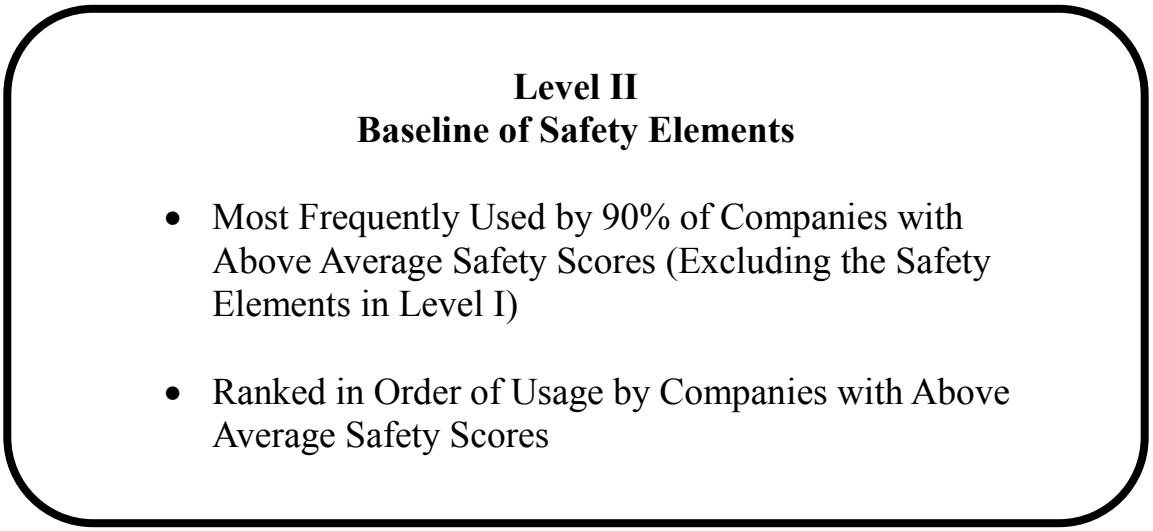

Figure 3: Safety Elements Model – Method (continued)

Level I of the Safety Elements Model contain the Safety Elements that had a significant difference between the NRB construction companies with above average safety scores (*n*=13) as identified by OSHA's TCR safety rating system for the year 2008 and the group of NRB construction companies (*n*=20) with below average safety scores as identified by OSHA's TCR safety rating system for the year 2008. Level I of the Safety Elements Model was tested by using a *z* test for each Safety Element question between the 13 NRB construction companies with above average safety scores as identified by OSHA's TCR safety rating system for the year 2008 and the 20 NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system for the year 2008 (Table 6). The *z* test *p* value was done at the 90% confidence level. Level I's Safety Elements were then ranked by the percentage of usage among the 13 companies with above average safety scores.

Level II of the Safety Elements Model contain the Safety Elements that are the most frequently used by 92.3% of the NRB construction companies with above average safety scores

as identified by OSHA's TCR safety rating system for the year 2008 after removing the Safety Elements identified in Level I of the Safety Elements Model. Level II of the Safety Elements Model was developed by using Descriptive Statistics to rank the Safety Elements that were most frequently used by 92.3% of the NRB construction companies with above average safety scores.

CHAPTER 4. RESULTS

4.1 SEQ Validation

SAS was used to run a cronbach alpha internal consistency test on the Safety Elements Questionnaire (SEQ) responses for Section One (use of Safety Elements during 2012) and Section Two (use of Safety Elements during 2008). The cronbach alpha (also called *alpha* or *measure alpha*) is a statistical measure of internal reliability that is often cited in studies that use index variables. The alpha can range from 0 to 1, where 1 indicates perfect correlation among the measurement variables, and a 0 indicates the lack of any correlation among the measurement variables. Values between 0.80 and 1.00 are desired, and they indicate high reliability among the measurement variables (Berman 2007).

Section One of the SEQ had a cronbach alpha score of 0.93 and Section Two had a cronbach alpha score of 0.96.

4.2 SEQ Combined Response and Non-Response Comparison Demographics

The basis of this study and the resulting hypotheses is based on a 2008 OSHA (Occupational Safety and Health Act) study that collected population injury and fatality data from all non-residential building NRB construction companies in Louisiana with 40 or more employees. The data was weighted by company size and then used to develop a TCR (total case rate) safety score as explained in Chapter 3 (Methodology) of this study.

Louisiana's portion of the NRB construction company North America Industry Classification System (NAICS) code 2362 survey was 69 NRB construction companies (n=69). There were 8 (n=8) of the 69 that were used for the Pilot Study. The remaining 61 (n=61) became the contact frame for the SEQ. An additional 6 (n=6) had failed contact results which left 55 (n=55) with verifiable contact information for the SEQ. The final response was 33 (n=33)

respondents out of the original SEQ frame of 61 NRB construction companies. This gives a net response rate of 54.1%.

The original SEQ frame of 61 NRB construction companies was sorted by the individual NRB construction company TCR score from less than 1.0 representing above average safety scores to equal to or greater than 1.0 representing below average safety scores. A matrix chart was developed that includes the NRB construction company numerical ID, zip code, safety scores, number of employees inside Louisiana, number of employees outside Louisiana and the year the NRB construction company began (APPENDIX B). It should be noted that the data for the NRB construction companies' beginning date was taken from the Louisiana Secretary of State's official website (2012).

A *t* test was run on the responders and non-responders using the safety score as the variable. The *t* test results (Pr > *t* = *.152)* showed that there was no significant statistical difference between the responders and the non-responders using the safety score as the variable. The following is a comparison of the safety score listing of the original SEQ frame of 61 NRB construction companies (responders and non-responders) with above average safety scores percentages and the below average safety scores percentages (APPENDIX B):

(1) 26 NRB construction companies had above average safety scores - 42.6%

(2) 35 NRB construction companies had below average safety scores - 57.4%

The lowest TCR safety score was 0 and the highest TCR safety score was 31.52 (APPENDIX D).

The average age of the NRB construction companies was quite similar between the ones that responded to the SEQ and the ones that did not respond. The greatest and least difference in

age of the NRB construction companies between the ones that responded to the SEQ and the ones that did not respond are as follows (Table 4):

(1) Greatest age difference between NRB construction companies with above average safety scores was 4. 4 years – 25.1 years for the respondents and 20.8 years for the non-respondents.

(2) Least age difference between NRB construction companies with below average safety scores was 0.4 years – 28.6 years for the respondents and 28.2 years for the non-respondents.

The average safety score of the NRB construction companies was somewhat similar between the ones that responded to the SEQ and the ones that did not respond. The greatest and least difference in safety scores of the NRB construction companies between the ones that responded to the SEQ and the ones that did not respond are as follows (Table 4 below):

(1) Greatest safety score difference was between NRB construction companies with below average safety scores was 1.4 – 7.09 for the respondents and 5.68 for the non-respondents.

(2) Least safety score difference was between NRB construction companies with above average safety scores was 0.23 – 0.30 for the respondents and 0.07 for the non-respondents.

The average size of all respondent NRB construction companies was 104.3 employees inside Louisiana and 55.5 employees outside Louisiana. Two NRB construction companies were excluded from the employee statistics due to their unusual size. NRB construction company ID 41 and ID 44 had a combined total of 5,229 employees inside Louisiana and 28,634 employees

outside Louisiana while the average of all the other companies had 104.3 employees inside Louisiana and 55.5 employees outside Louisiana (Please see Table 4 below and APPENDIX B).

Table 4: Company Age, Safety Score and Employee Size Demographics

Demographics	Response	Non Response	Total Average
Average age (years) of all (*n*=61) companies	27.24	24.74	25.99
Average age (years) of all above average (*n*=26) companies	25.14	20.75	22.95
Average age (years) of all below average (*n*=35) companies	28.60	28.20	28.40
Average safety score for all (*n*=61) companies*	2.39	3.08	2.73
Average safety score for all above average (*n*=26)* companies	0.30	0.07	0.18
Average safety score for all below average (*n*=35)* companies	7.09	5.68	6.39
Average number of employees of all respondent (*n*=33)* companies inside Louisiana (excluding company ID 41 and 44)	104.3	N/A	
Average number of employees of all above average respondent (*n*=13) companies inside Louisiana (excluding company ID 41)	141.6	N/A	
Average number of employees of all below average respondent (*n*=20) companies inside Louisiana (excluding company ID 44)	89.6	N/A	
Average number of employees of all respondent (*n*=33) companies outside Louisiana (excluding company ID 41 and 44)	55.5	N/A	
Average number of employees of all above average respondent (*n*=13) companies outside Louisiana (excluding company ID 41)	91.0	N/A	
Average number of employees of all below average respondent (*n*=20) companies outside Louisiana (excluding company ID 44)	29.8	N/A	

* Range of Safety Scores: 0 to 31.52 (APPENDIX D)

Please see Table 5 below for the location demographics on the above average and below average responses and non-responses of the NRB construction companies. There are 8 (*n*=8) cluster area locations where NRB construction companies are located within 40 miles of a

metropolitan center which account for 58 (*n*=58) of the 61 construction companies. The remaining 3 (*n*=3) companies are located in the northwest part of Louisiana. Please see the following for the lowest and highest TCR scores by area:

(1) Area 2 had the lowest OSHA TCR (total case rate) safety score overall which included the responses and non-responses among the top 4 cluster metropolitan centers of area 1, area 2, area 3 and area 4 at 64%

(2) Area 3 had the highest OSHA TCR (total case rate) safety score overall which included the responses and the non-responses among the top 4 cluster metropolitan centers of area 1, area 2, area 3 and area 4 at 67%.

Table 5: Above Average/Below Average - Location Demographics (*n*=61)

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6 t	Area 7	Area 8	Area 9 Misc. Cities	Total
Above Average Response	5 (56%)	5 (56%)	1 (33%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	1 (50%)	13 (39%)
Below Average Response	4 (64%)	4 (64%)	2 (67%)	2 (100%)	3 (100%)	3 (100%)	1 (100%)	0 (0%)	1 (50%)	20 (61%)
Above Average No Response	3 (27%)	2 (100%)	1 (33%)	3 (75%)	2 (100%)	1 (100%)	1 (33%)	0 (0%)	0 (0%)	13 (46%)
Below Average No Response	8 (73%)	0 (0%)	2 (67%)	1 (25%)	0 (0%)	0 (0%)	2 (67%)	1 (100%)	1 (100%)	15 (54%)
Total Above Average	40%	64%	33%	50%	40%	25%	25%	50%	33%	43%
Total Below Average	60%	36%	67%	50%	60%	75%	75%	50%	67%	57%

4.3 SEQ Response Comparison Demographics (*n*=33)

A *t* test was run on the early responders and late responders using the safety score as the variable. The *t* test results (Pr > *t* = *.175)* showed that there was no significant statistical difference between the responders and the non-responders using the safety score as the variable. The following is a comparison of the safety score listing of the 33 (*n*=33) responding NRB construction companies with above average safety scores percentages and the below average safety scores percentages (Table 5 above):

(1) 13 NRB construction companies had above average safety scores – 39.4% (13/33)

(2) 20 NRB construction companies had below average safety scores – 60.6% (20/33)

(3) Area 1 and area 2 had the highest percentage number of companies with above average TCR safety scores among the responding companies in the top 4 cluster metropolitan centers with 56% each.

(4) Area 5 had the highest percentage number of companies with below average TCR (total case rate) safety score responses among the responding companies in the top 4 metropolitan centers at 100%.

The average size of all respondent NRB construction companies with above average safety scores was 141.6 employees inside Louisiana and 91.0 outside Louisiana with a total employee base of 232.6 (Appendix B). The average size of all respondent NRB construction companies with below average safety scores was 89.6 employees inside Louisiana and 29.8 outside Louisiana with a total employee base of 119.4. The 13 responding NRB construction companies with above average safety scores were 94.8% larger than the 20 responding NRB construction companies with below average safety scores.

As mentioned earlier in section 4.2, the NRB construction companies were placed in 9 different areas that were within 50 miles of a metropolitan center. The 9th area (miscellaneous cities), as was mentioned earlier, is a small collection of cities where only 1 NRB construction company was located in each city.

The other 8 areas are considered metropolitan centers. The same areas of metropolitan centers were used for the analysis in this section that deals with SEQ respondents only. The average mean, minimum and maximum data should be viewed with some caution in Table 6 due to the small number of data points in each of the 8 metropolitan area categories. However it is interesting to note the following (Table 6):

(1) Area 2 has the lowest average mean TCR (total case rate) safety score at 0.28 with an average of 257 employees per NRB construction company.

(2) Area 3 has the highest average mean TCR (total case rate) safety score at 13.29 with an average of 117 employees per NRB construction company.

There is a modest positive correlation coefficient of 0.41 between the size of a NRB construction company with an above average safety score and their actual safety score. In other words, this indicates a modest correlation between an increasing company size and an increasing TCR (total case rate) score. Taylor (1990) says that correlation coefficients of 0.35 and below represent low or weak correlations, correlation coefficients of 0.37 to 0.67 represent modest or moderate correlations while correlation coefficients of 0.68 to 1.00 represent strong or high correlations.

Table 6: SEQ 33 Respondents Demographics by Area

ABOVE AVERAGE (*n*=13)						
Co ID Code	Area	Total Emp.	Safety Score	Avg Mean	Min	Max
18	1	181	0			
41	1	7K	0.33			
35	1	100	0.54			
42	1	600	0.75			
47	1	147	0.85	0.49	0	0.85
	Emp. Aver:	257				
12	2	283	0			
13	2	105	0			
27	2	150	0			
34	2	300	0.69			
46	2	130	0.71	0.28	0	0.71
	Emp. Aver:	193.6				
16	3	35	0			
25	8	65	0			
6	9	200	0			
	Emp. Aver:	N/A				

BELOW AVERAGE (*n*=20)						
Co ID Code	Area	Total Emp.	Safety Score	Avg Mean	Min	Max
30	1	105	1.26			
44	1	27K	1.81			
51	1	67	3.06			
67	1	50	14.81	5.24	1.26	14.81
	Emp. Aver:	74				
50	2	85	3.94			
59	2	50	6.23			
38	2	23	9.98			
28	2	40	11.47	7.91	3.94	11.47
	Emp. Aver:	49.5				
53	3	187	1.05			
69	3	47	25.52	13.29	1.05	25.52
	Emp. Aver:	117				
62	4	44	5.62			
39	4	100	6.20	5.91	5.62	5.62
	Emp. Aver:	72				
43	5	400	1.49			
57	5	136	6.20			
29	5	40	6.21	4.63	1.49	6.21
	Emp. Aver:	192				
54	6	54	1.45			
56	6	40	1.59			
55	6	30	2.97	2.00	1.45	2.97
	Emp. Aver:	41.33				

4.4 Hypothesis Test

For testing the hypothesis, the responding 33 NRB construction companies (*n*=33) were split into two groups:

(1) Responding NRB construction companies with above average safety scores (*n*=13) as identified by OSHA's 2008 TCR safety rating system.

(2) Responding NRB construction companies with below average safety scores (n=20) as identified by OSHA's 2008 TCR safety rating system.

A z test was run on each Safety Element from the SEQ using the SAS software to identify statistically significant differences between the 13 NRB construction companies usage of Safety Elements with above average safety scores and the 20NRB construction companies with below average safety scores. A matrix chart was developed that includes the SEQ question number, the Safety Elements, the z test and p values for each Safety Element (APPENDIX C). The number of Safety Elements that had a statistically significant difference in usage between the two groups are as follows:

(1) at the 95% confidence level – three Safety Elements had a statistically significant difference in usage with above average 13 NRB construction companies having the higher usage.

(2) at the 90% confidence level – six Safety Elements had a statistically significant difference in usage with above average 13 NRB construction companies having the higher usage.

(3) at the 90% confidence level – one Safety Element had a statistically significant difference in usage with below average20 NRB construction companies having the higher usage.

The 9 statistically significant Safety Elements that NRB construction companies with above average OSHA safety scores used more frequently than NRB construction companies with below average OSHA safety scores are as follows:

(1) Formal safety goals that are updated periodically (p value = 0.073)

(2) Regular safety training programs for existing employees (p value = 0.085)

(3) Designated safety budget as part of the normal operating budget (*p* value = .026)

(4) Formal personal protective equipment training program (*p* value = .050)

(5) Formal safety committee that meets on a regular schedule (*p* value = .038)

(6) Discipline procedure for employees that commit unsafe acts (*p* value = .085)

(7) safety training for subcontractors (*p* value = .0773)

(8) Pay employees for the hours the spend attending voluntary off-hour safety training sessions (*p* value = .047)

(9) Detailed safety reports to employees on a regular basis (*p* value = .0787)

The Ho (Null Hypothesis) is rejected because there are statistically significant differences in the use of 9 Safety Elements between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system for the year 2008.

4.5 Research Question and Objective

The research question in section 1.3 of this study was: Are there common Safety Elements among Louisiana NRB construction companies with above average safety scores as determined by OSHA's TCR reporting system from the year 2008 and some of them are significantly statistically different from the Louisiana NRB construction companies with below average safety scores as determined by OSHA's reporting system from the year 2008? The answer to the research question is yes, that there are common Safety Elements among Louisiana NRB construction companies with above average safety scores and 9 Safety Elements are statistically significantly different from Louisiana NRB construction companies with below average safety scores.

In section 1.5 of this study a two-fold objective for the study was laid out. The objective was:

(1) Identify the common Safety Elements in the Louisiana NRB construction companies with above average safety scores as determined by OSHA's TCR safety rating system from the year 2008.

(2) Develop a Safety Elements Model of the common Safety Elements and the ranking of them by a percentage of usage as reported by the NRB construction companies with above average safety scores as determined by OSHA's TCR safety rating system from the year 2008.

4.6 Safety Elements Model Validation

As mentioned in Chapter 3 (Methodology), the Safety Elements Model consists of two Levels:

(1) Level I of the Safety Elements Model contains the Safety Elements that had a statistically significant difference in usage between the 13 NRB construction companies with above average safety scores as identified by OSHA's TCR safety rating system for the year 2008 and the 20 NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system for the year 2008. The Safety Elements were individually tested by using a *z* test for each Safety Element question in the difference of usage between the 13 NRB construction companies with above average safety scores as identified by OSHA's TCR safety rating system for the year 2008 and the 20 NRB construction companies with below average safety scores as identified by OSHA's TCR safety rating system for the year 2008. The *z* test was done at the 90% confidence level. The 90% Confidence Level was chosen due to the human factor being present in the answers to the SEQ. However the full range of *p* values are listed in

Appendix C. The *z* test, at 90% confidence level, resulted in 9 Safety Elements for Level I of the Safety Elements Model.

It should be noted that one Safety Element, out of the original ten that were identified as having a significant difference of usage, was the only one that the NRB construction companies with below average safety scores had a higher usage. This particular Safety Element was question number 27 on the SEQ - "an assigned safety person for each job site". It could possibly be inferred that using this particular Safety Element may be reactive instead proactive. It could also possibly be inferred that using this particular Safety Element may be a substitute for more proactive NRB construction company-wide Safety Elements. This Safety Element was not used in the Safety Elements Model because it was a Safety Element where there was a statistically significant negative difference in usage.

The 9 Safety Elements were eventually ranked in order by the percentage of usage by the 13 companies with above average safety scores. Please see the analysis in Chapter 5 under 5.2 of the Major Finding section.

(2) Level II of the Safety Elements Model contain the Safety Elements that are the most frequently used by 92.3% of the 13 NRB construction companies with above average safety scores as identified by OSHA's TCR safety rating system for the year 2008 after removing the Safety Elements identified in Level I of the Safety Elements Model. The primary justification for Level II of the Safety Element Model is that a strong argument could be made that using only the nine statistically significant Safety Elements without using a "baseline" of other Safety Elements may not produce a safer working environment. Level II of the Safety Elements Model was developed by using

Descriptive Statistics to rank the Safety Elements that were most frequently used by 92.3% of the 13 NRB construction companies with above average safety scores.

Please see Table 6 below for the listing details of the Safety Elements for each level. Please see Figure 4 below for the Final Safety Elements Model.

Table 6: Safety Elements Model – Level I and Level II

Safety Model - Level I		
Sec 1 (2012) SEQ Number	Safety Elements	*p* value*
38	regularly scheduled safety training programs for existing employees	0.085
51	discipline procedure for employees that commit unsafe acts	0.085
8	formal safety goals that are updated periodically	0.073
12	formal personal protective equipment training program	0.050
2	pay employees for the hours they spend attending voluntary off-hour safety training sessions	0.047
1	designated safety budget as part of the normal operating budget	0.026
10	formal safety committee that meets on a regular schedule	0.038
43	safety training for subcontractors	0.073
55	detailed safety reports to employees on a regular basis	0.075

Table 6: Safety Elements Model – Level I and Level II (continued)

Safety Model - Level II		
Sec 1 (2012) SEQ Number	Safety Elements	Above Average Companies' Usage (92.3%)
3	communication between management and company employees on safety issues	13
7	formal safety program	13
13	supply new employees with company required personal protective equipment free of charge	13
16	on-site safety inspections	13
58	substance abuse testing program	13
4	management support in the use of safety principles and practices	12
9	continuous safety improvement program	12
15	site-specific safety procedures	12
17	safety risk management program	12
18	job site heat stress prevention program	12
28	formal emergency response plan for injured employees	12
36	regularly scheduled on-site worker safety meetings	12
37	new employee orientation safety training program	12
44	project specific safety training for new projects	12
46	employees to be involved in safety issues	12
47	employees to report unsafe conditions and safety violations	12
49	taking safety risks is not part of their job	12
52	investigation procedure for worker related accidents	12
56	procedure for making corrections for unsafe conditions at the job site	12
57	substance abuse awareness program	12

SAFETY ELEMENTS MODEL

Level I
9 Safety Elements

- regularly scheduled safety training programs for existing employees
- discipline procedure for employees that commit unsafe acts
- formal safety goals that are updated periodically
- formal personal protective equipment training program
- pay employees for the hours they spend attending voluntary off-hour safety training sessions
- designated safety budget as part of the normal operating budget
- formal safety committee that meets on a regular schedule
- safety training for subcontractors
- detailed safety reports to employees on a regular basis

Level II
Baseline of 20 Safety Elements

- communication between management and company employees on safety issues
- formal safety program
- supply new employees with company required personal protective equipment free
- on-site safety inspections
- substance abuse testing program
- management support in the use of safety principles and practices
- continuous safety improvement program
- site-specific safety procedures
- safety risk management program
- job site heat stress prevention program
- formal emergency response plan for injured employees
- regularly scheduled on-site worker safety meetings
- new employee orientation safety training program
- project specific safety training for new projects
- employees to be involved in safety issues
- employees to report unsafe conditions and safety violations
- taking safety risks is not part of their job
- investigation procedure for worker related accidents
- procedure for making corrections for unsafe conditions at the job site
- substance abuse awareness program

Figure 4: Safety Elements Model – Results

CHAPTER 5. CONCLUSION, DISCUSSION AND FUTURE RESEARCH

The construction industry is a dangerous occupation and has the highest fatality rate of any industry in the United States (Bureau of Labor Statistics, 2010). The fatalities and injuries are very costly to the United States economy in terms of lost time and productivity. This of course is in addition to the unimaginable pain and suffering brought to the families and loved ones of employees killed or injured on the work-site. There has been some movement on decreasing the amount of fatalities and injuries over the years, however there is still a significant amount of work to be done.

As previous studies have shown (Rajendran et al. 2009; Behm 2005; Gittleman et al. 2010), there is a clear link between general safety practices and incidents of fatalities and injuries. The challenge to all researchers in the safety field is to specifically quantify and link particular safety practices to the reduction of fatalities and injuries. It is a very difficult challenge because the safety performance within non-residential building (NRB) construction companies is typically not public knowledge. Some previous studies (Hallowell et al. 2009; Weinstein et al. 2005; McDonald et al. 2009: Yassin et al. 2004) look at safety practice change and then analyze the safety record after the change with the safety record before the change. The limitations of course to this approach is the willingness of NRB construction companies' to participate and the willingness of construction companies to disclose fatality and injury data. Insurance companies also track fatality and injury data among the construction companies they insure in order to set the premium prices according to a company's safety record. However this data is proprietary and confidential.

On the other hand, OSHA (Occupational Safety and Health Act) tracks fatalities and injuries for all industries and makes it available for public knowledge. As was mentioned

previously in this study, OSHA tracks the data yearly on all industries by company except the construction industry which is done every five to eight years. In this study, the data on NRB construction companies' safety scores are from the year 2008.

As we have seen in this study, the OSHA data identifies the NRB construction companies by name as well as their safety score. This allows a study of Safety Elements usage between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores.

This study is unique in a couple of areas:

(1) A content analysis of previous studies show that this is the first study to go inside NRB construction companies and gather data from their Designated Safety Expert. A strong inference can be made that the safety people within construction companies know best what works and what doesn't work when it comes to the use of particular Safety Elements in their safety programs. An analogy could be made that the generals on the front line might know more about what's going on in a war than the generals in the Pentagon. Previous studies tend to use "outside experts" for defining what Safety Elements should be implemented in a safety program in order to reduce fatalities and injuries.

(2) This study uses the OSHA mandated data collection system to identify NRB construction companies with above average safety scores and NRB construction companies with below average safety scores. This allows a distinction to be made between what safety elements that NRB construction companies with above average safety scores use and what NRB construction companies with below average safety

scores use. An inference can then be made that a company's safety score can conceivably be tied to the Safety Elements they are using.

(3) A Safety Element Model was built on the concept that there are differences in the usage of Safety Elements among NRB construction companies with above average safety scores and NRB construction companies with below average safety scores.

It is this author's hope that this study can be another step in helping define what safety practices may be instrumental in lowering the number of fatalities and injuries in NRB construction companies. The implication for the construction industry is that safety is not random and does not happen by accident and that there are specific steps that can be taken to create a safer working environment.

5.1 Limitations of the Study

There are a couple of limitations to the study that should be noted as follows:

(1) As previously pointed out, the population of Louisiana based NRB construction companies was 69 companies with 40 or more employees. The current study had a response rate of 47.8% on the 69 Louisiana based companies and may not be representative of NRB construction companies in other states or representative of any construction companies with less than 40 employees.

(2) The OSHA TCR safety ratings scores are from the year 2008. This author makes an assumption that company culture tends to change slowly over time and that NRB construction companies with below average safety ratings will tend to remain with below average safety ratings over time and that NRB construction companies with above average safety ratings will tend to remain with above average safety ratings over time. The link between the reporting of safety ratings and the current practices of an NRB

construction company will tend to be stronger with the time being shorter between the two events.

5.2 Major Finding

There were 9 Safety Elements out of the original 58 Safety Elements that showed a statistically significant difference in present (2012) usage at the 90% confidence level (*p* values ranging from 0.026 to 0.085) with NRB construction companies that had above average safety scores and NRB construction companies with below average safety scores. This represents a 15.5% gap (9/58) in Safety Element usage between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores. The 9 Safety Elements are as follows:

(1) regularly scheduled safety training programs for existing employees.

Safety training has shifted somewhat in the past few years. Originally, training was geared more toward following safety regulations. In recent years there has been a trend toward combining safety compliance with safety participation where behavior modification helps develop an environment that promotes safety (DeArmond et al. 20011). Gillen et al. (2002) made the point that it is not always clear what contributes to the occurrence of injuries or their severity. It was recognized as long as 20 years ago that successful injury control programs included strong management and worker training. Kleiner et al. (2008) cautioned that even though training is viewed as an important support function, it is still mostly an off-line function. They stressed the need for on-the-job support and training. It is not only important to train the workers, but is equally important to train the field supervisors and then evaluate them on the basis of their safety performance (Rajendran et al. 2009)

(2) discipline procedure for employees that commit unsafe acts.

Friend et al. (2010) mentions that Bird and Loftus (1976) say, that the primary symptoms of all incidents are unsafe acts and conditions when the basic causes of incidents exists within an organization which allows the occurrence of substandard practices and conditions which can lead directly to a loss. A good example of an unsafe act would be for an employee to not wear the proper PPE when performing a task. DeArmond et al. (2011) showed that reporting safety violations is a shared responsibility and that when an employee sees a safety violation it is the responsibility of the employee to report the safety violation. They also mentioned that immediate constructive and specific feedback should be given to the employee that committed the safety violation. McDonald et al. (2009) mentioned that one of the risk control measures is the authority to remove workers who demonstrate unsafe work practices. Tool, (2002) says that while it is impossible to eliminate all accidents, the frequency of occurrence can be reduced by influencing the behavior of the workers through positive influence, verbal chastisement, written warnings or dismissal.

(3) formal safety goals that are updated periodically.

It is very important to establish goals and benchmarks to improve safety performance. Like many other initiatives, it needs to start at the top. Management must provide clearly defined organizational safety goals and policies (Gittleman et al. 2010). Setting safety goals is an important part of construction safety according to Huang et al. (2006).

(4) formal personal protective equipment training program.

One of the items that is used to measure safety compliance is the use of personal protective equipment (PPE) as required by the site safety plan (DeArmond et al. 2011). This measure of course requires a site safety plan. In the absence of a site safety plan, this measure would not be effective and may be difficult to control and enforce the proper use of PPE. McDonald et al. (2009) makes it a point that PPE expectations must be communicated to the workers prior to them potentially being involved in an accident in order to reduce the amount or level of injuries. Each new employee should be supplied with a copy of the safety rules including PPEs that must be worn as prescribed for each job (Usmen et al. 2002). Construction accidents occasionally happen due to workers not effectively using the safety equipment that is provided. These occurrences can be reduced if the construction company has a program to continually monitor the use of PPE on the job site (Tool. 2002).

(5) pay employees for the hours the spend attending voluntary off-hour safety training sessions.

The literature was somewhat limited on this particular Safety Element. Goldenhar et al. (2001) did a survey on various safety methods used by construction companies. One of the methods was paying employees for the hours they spent in voluntary off-hour safety training. The majority of training occurred during work hours, however some construction companies paid employees when they voluntarily attended after-hours safety training sessions.

(6) designated safety budget as part of the normal operating budget.

The literature was somewhat limited on this Safety element also. Golden et al. (2001) addressed this one in addition to the previous Safety Element. In the same survey

as previously mentioned, they asked the construction companies to indicate whether safety- related expenses were accounted for in their operating budget. Seventy six percent reported that financial resources were committed to support their safety needs.

(7) formal safety committee that meets on a regular schedule.

It is recognized that safety is a shared responsibility and that a good safety program will include management and workers on safety committees. It is important for management to select the safety committee members with appropriate experience and skills who will have a voice in the organizational safety decisions (Gittleman et al. 2010). A well thought-out safety plan serves as the foundation for an effective safety program. Upper management must show a commitment to having regular safety meetings which also includes adequate funding for carrying out the safety decisions (Hallowell et al. 2009). Huang et al. (2006) stresses the need for the owner of a project to be involved in the construction process including supporting the contractor's safety program. They stress the need to always include safety on the agenda at owner-contractor meetings.

(8) safety training for subcontractors.

Gittleman et al. (2009) encourages sub-contractors to be involved in safety with the general contractor. Both the general contractors and the sub-contractors are encouraged to provide training to their key employees. Rajendran et al. (2009) went so far as to suggest that construction companies should mentor their sub-contractors to improve safety. Goldenhar et al. (2001) did a survey that assessed to what extent general contractors provided training to their sub-contractors. Only 22% provided training to their sub-contractors.

(9) detailed safety reports to employees on a regular basis.

Gittleman et al. (2010) also suggested that contractors provide detailed safety reports to all employees and the reports should also include a description injuries and near-miss incidents. Hallowell et al. (2009) places a high priority on job hazard analysis. Job hazard analysis is a process that identifies potential hazards that may lead to an injury. They went on to say that the hazards must be effectively communicated to the employees.

All of the 9 Safety Elements are proactive in nature including, to an extent, the disciplining of employees that commit unsafe acts. The disciplining of an employee can be proactive with a procedure in place ahead of time or reactive in the absence of a procedure in place. This particular Safety Element specifically asked for a procedure to be in place prior to employees committing unsafe acts. Training is an important component of the 9 Safety Elements with one third of the Safety Elements being devoted to training.

The number one Safety Element, based on usage, out of the 9 is: regularly scheduled safety training for existing employees. This particular Safety Element puts a vision and purpose on improving safety in the workplace. Once again, this is a Safety Element that tends to demonstrate that safety is not a random event but a planned event among NRB construction companies with above average safety scores. Please see Figure 5 below for a ranking of the 9 Safety Elements by usage among the 13 companies with above average TCR safety scores. It should also be noted that the top 3 Safety Elements were used by 90% of the same 13 companies. These 9 Safety Elements form Level I of the Safety Elements Mode.

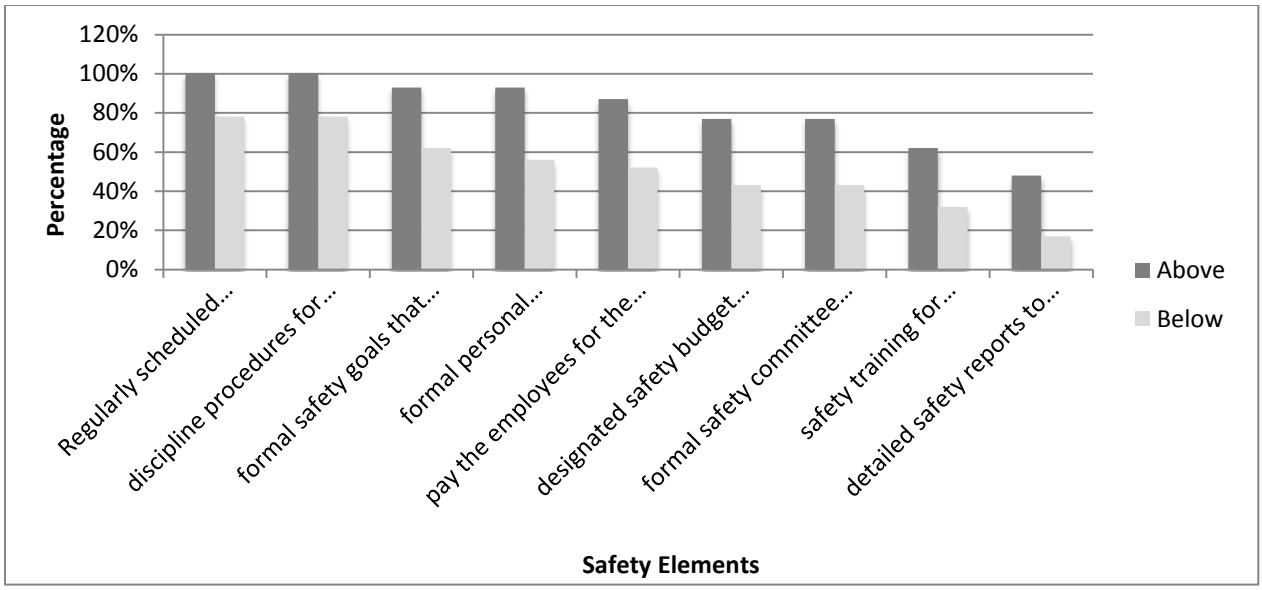

Figure 5: Level I Safety Elements Sorted by Usage Between Above Average Companies (*n*=13) And Below Average Companies (*n*=20)

Level II of the Safety Elements Model contain the Safety Elements that are the most frequently used by 92.3% of the 13 NRB construction companies with above average safety scores as identified by OSHA's TCR safety rating system for the year 2008 after removing the Safety Elements identified in Level I of the Safety Elements Model. As mentioned previously the primary justification for Level II of the Safety Element Model is that a strong argument could be made that using only the nine statistically significant Safety Elements without using a "baseline" of other Safety Elements may not produce a safer working environment.

Another interesting inference is the use of Safety Elements in the year 2008. There were 7 Safety Elements that had a significant statistical difference between NRB construction companies with above average safety scores and NRB construction companies with below average safety scores in 2008. This of course is based on the 2012 memory of the Designated Safety Expert of each of the 33 responding NRB construction companies for the Safety Elements that were being used in 2008. However, there is an interesting association between the Safety Elements being used in 2008 and the Safety Elements being used in 2012 by the same 33 NRB

construction companies. Out of the 7 Safety Elements that were determined to be statistically significantly different in usage between the NRB construction companies with above average safety scores and NRB construction companies with below average safety scores, 5 of the 7 Safety Elements were the same as the ones that were found to be statistically different in usage in 2012. The 5 common Safety Elements between 2008 and 2012 in usage are: formal safety goals that are updated periodically; designated safety budget as part of the normal operating budget; formal safety committee that meets on a regular schedule; discipline procedure for employees that commit unsafe acts and; detailed safety reports to employees on a regular basis.

The total average mean usage of Level I and Level II for the 13 responding NRB construction are as follows (Table 7):

(1) The total average mean usage of Level I Safety Elements is 7.26 out of 9.

(2) The total average mean usage of Level II Safety Elements is 19.76 out of 20.

Also please note the following:

(1) The lowest usage of Level I Safety Elements is in the under 100 employee size company with an average mean usage of Safety Elements at 6.33 out of 9

(2) The highest usage of Level I Safety Elements in the 201 to 600 employee size company with an average mean usage of Safety Elements at 7.83 out of 9.

(3) The lowest usage of Level II Safety Elements is in the under 100 employee size company with an average mean usage of Safety Elements at 16.67 out of 20.

(4) The highest usage of Level II Safety Elements in the under 201 to 600 employee size company with an average mean usage of Safety Elements at 20.67 out of 20.

Table 7: SEQ Respondents With Above Average Safety Scores Usage of Safety Element

Number of Employees Category	Employees Total	Total Level I Safety Elements Usage	Total Level II Safety Elements Usage
0-100 employees	67	6.33	16.67
101-200 employees	152	7.83	20.83
201-600 employees	394	7.00	20.67
Total Average	191.33	7.26	19.76

5.3 Recommendations and Future Areas Research

Safety in the workplace is an extremely important and on-going topic for discussion. There can be no greater loss than the loss of a loved one and this happens all too frequently in the construction workplace. The 195,000 employees that were injured in the construction industry in 2010 represents an unimaginable toll in human suffering on both the employees that were injured and the family and friends that were affected by the injury. This is the first study that looks for a link in the differences in the usage of Safety Elements within NRB construction companies that have an above average safety scores and NRB construction companies that have a below average safety score by asking the Designated Safety Experts that are on the front lines of safety within their own company.

There are a number of research areas that need to be explored further:

(1) As mentioned earlier in the limitations on this current study, the data that ranks the NRB construction companies safety scores is 4 years old. A tighter correlation between the safety scores of NRB construction companies and their usage of Safety Elements would be better served if the age of the data is closer to the age of the data being collected on the usage of Safety Elements between the NRB construction companies that

have above average safety scores and NRB construction companies that have below average safety scores. It is the authors hope that other researchers will be prepared to immediately begin research upon OSHA's release of the TCR safety rating scores of the individual NRB construction companies within the next two to three years. As mentioned previously, OSHA only collects data on the individual NRB construction companies every five to eight years.

(2) As mentioned previously, the OSHA safety data is 4 years old. An area of future research would be the duplication of this present study's list of Safety Elements to determine a commonality on the usage of Safety Elements with a later OSHA safety data set upon its release from OSHA.

(3) Linking the use of specific Safety Elements to a reduction in workplace fatalities and injuries is a difficult area of research due to limited information on cause and effect. However, any additional studies that can contribute to specific findings on specific Safety Elements could help prioritize the implementation of individual Safety Elements.

(4) Although designing-for-safety was not the basis for the hypotheses on this study, several studies showed that there is a strong inference that workplace fatalities and injuries could be reduced by using the concept of designing-for-safety at the design stage (Behm. 2005, Weinstein et al. 2005). Designing-for-safety is very common in Europe and is much less common in the United States for a variety of reasons (Gambatese et al. 2005). Please refer the previous section 2.36 of this study for more details. This is a wide open area of research that could ultimately have a significant impact on the reduction of fatalities and injuries in the workplace. A thought to ponder, as some of the studies indicated, it may take legislative action to bring about meaningful standards for

designing-for-safety. Some of the studies mentioned barriers that designers and architects offer as to why it would not work in the United States. This reluctance needs to be challenged by well thought out studies and recommendations.

In summary, it is the hope that this study will spur other studies on identifying Safety Elements that can reduce workplace injuries and fatalities.

REFERENCES

Behm, Michael (2005). Linking construction fatalities to the design for construction safety concept. *Safety Science, 43*(8), 589-611.

Berman, Evan M. (2007) Essentials statistics for public managers and policy analysts – 2nd ed. *CQ Press,* 54.

DeArmond, Sarah; Smith, April E.; Wilson, Christina L.; Chen, Peter Y. & Cigularov, Konstantin P. (2011). Individual safety performance in the construction industry: Development and validation of two short scales. *Accident Analysis & Prevention, 43*(3), 948-954.

Friend, Mark A.; & Kohn, James P. (2010). Fundamentals of Occupational Safety & Health. Published by: *The Rowman & Littlefield Publishing Group, Inc., 5*(5), 77, 122, 78

Gambatese, John A.; Behm, Michael; & Hinze, Jimmie W. (2005). Viability of designing for construction worker safety. *Journal of Construction Engineering and Management, 131(*9), 1029-1036.

Garrett, J. W.; & Teizer, Jochen (2009). Human factors analysis classification system relating to human error awareness taxonomy in construction safety. *Journal of Construction Engineering and Management, 135*(8), 754-763.

Guillen, Marion; Baltz, Davis; Gassel, Margy; & Vaccaro, Diane (2002). Perceived safety climate, job demands, and coworker support among union and nonunion injured construction workers. *Journal of Safety Research, 33*(1), 33-51.

Gittleman, Janie L.; Gardner, Paige C.; Haile, Elizabeth; Sampson, Julie M.; Cigularov, Konstantin P.; Ermann, Erica D.; Stafford, Pete; & Chen, Peter Y. (2010). [Case Study] City Center and Cosmopolitan Construction Projects, Las Vegas, Nevada: Lessons learned from the use of multiple sources and mixed methods in a safety needs assessment. *Journal of Safety Research, 41*(3), 263-281.

Goldenhar, Linda M.; Moran, Stacey Kohler; & Colligan, Michael (2001). Health and safety training in a sample of open-shop construction companies. *Journal of Safety Research, 32*(2), 237-252.

Hallowell, Matthew R.; & Gambatese, John A. (2009). Activity-based safety risk quantification for concrete formwork construction. *Journal of Construction Engineering and Management, 135*(10), 990-998.

Hallowell, Matthew R.; & Gambatese, John A. (2009). Construction safety risk mitigation. *Journal of Construction Engineering and Management, 135*(12), 1316-1323.

Hallowell, Matthew R.; & Gambatese, John A. (2010). Population and initial validation of a formal model for construction safety risk management. *Journal of Construction Engineering and Management, 136*(9), 981-990.

Halperin, Kopl M.; & McCann, Michael (2004). An evaluation of scaffold safety at construction sites. *Journal of Safety Research, 35*(2), 141-150.

Huang, Xinyu; & Hinze, Jimmie (2006). Owner's role in construction safety. *Journal of Construction Engineering and Management, 132*(2), 164-173.

Huang, Xingu; & Hine, Jimmie (2006). Owner's role in construction safety: Guidance model. Journal of Construction Engineering and Management, 132(2), 174-181.

Khaled, El-Rayes; & Ahmed, Khalafallah (2005). Trade-off between safety and cost in-planning construction site layouts. Journal of Construction Engineering and Management, 131(11), 1186-1195.

Khudeira, Soliman (2008). Scaffolding: Safety, design and construction issues. *Practice Periodical on Structural Design and Construction, 13*(3), 109-110.

Kleiner, Brain M.; Smith-Jackson, Tonya L.; Mills, Thomas; O'Brian, Michael; & Haro, Elizabeth (2008). Design, Development, and deployment of a rapid universal safety and health system for construction. *Journal of Construction Engineering and Management, 134*(4), 273-279.

Koehn, Enno; & Datta, Nirmal K. (2003). Quality, environmental, and health and safety management systems for construction engineering. *Journal of Construction Engineering and Management, 129*(5), 562-56.9

McDonald, Mary Annie; Lipscomb, Hester J.; Bondy, Jessica; & Glazner, Judith (2009). "Safety is everyone's job:" The key to safety on a large university construction site. *Journal of Safety Research, 40*(1), 53-61.

Rajendran, Sathyanarayanan; & Gambatese, John A. (2009). Development and initial validation of sustainable construction safety and health rating system. *Journal of Construction Engineering and Management, 135*(10), 1067-1075.

Rajendran, Sathyanarayanan; Gambatese, John A. & Behm, Michael G. (2009). Impact of green building design and construction on worker safety and health. *Journal of Construction Engineering and Management, 135*(10), 1058-1066.

Taylor, Richard (2009). Interpretation of the Correlation Coefficient: A Basic Review. *The Journal of Defense Modeling & Simulation, 1*(6), 35-39

Teizer, Jochen; Allread, Ben S.; Fullerton, Clare E.; & Hinze, Jimmie (2010). Autonomous pro-active real-time construction worker and equipment operator proximity safety alert system. *Automation in Construction, 19*(5), 630-640.

Toole, T. Michael (2002). Comparison of site safety policies of construction industry trade groups. *Practice Periodical on Structural Design and Construction, 7*(2), 90-95.

Toole, T. Michael (2002). Construction site safety roles. *Journal of Construction Engineering and Management, 128*(3), 203-210.

Usmen, Mumtaz A.; Selim, Brandan; & Kifah, Javyousi (2002). Safety program guidelines for public school facility construction and operations. *Practice Periodical on Structural Design and Construction, 7*(2), 74-80.

Weinstein, Marc; Gambatese, John; & Steven, Hecker (2005). Can design improve construction safety?; Assessing the impact of a collaborative safety-in-design process. *Journal of Construction Engineering and Management, 131*(10), 1125-1134.

Yassen, A.S.; & Martonik, J.F. (2004). The effectiveness of the revised scaffold safety standard in the construction industry. *Safety Science, 42*(10), 921-931

APPENDIX A: LITERATURE REVIEW SUMMARY

Author	Title	Jour	Research Article Focus
Behm 2005	Linking construction fatalities to the design of construction safety concept	SS	use of "design for construction safety" in initial design phase to reduce fatalities
DeArmond et al. 2011	Individual safety performance in the construction industry: Development and validation of two short scales	AAP	measure of safety performance and the relationships between different components of safety performance and safety outcomes
Gambatese et al. 2005	Viability of designing for construction worker safety	JEM	relationship between design for safety at design stage and workers
Garrett et al. 2009	Human factors analysis classification system relating to human error awareness taxonomy in construction safety	JEM	use of error framework (HFACS) and error awareness (HEAT) to improve safety
Gillen et al. 2002	Perceived safety climate, job demands, and coworker support among union and nonunion injured construction workers	JSR	union workers had a more safety climate than non-union workers
Gittleman et al. 2010	[case study] City Center and Cosmopolitan Construction Projects, Las Vegas, Nevada: Lessons learned from the use of multiple sources and mixed methods in a safety needs assessment	JSR	survey of workers, foremen, superintendents, management show perception differences
Goldenhar et al. 2001	Health and safety training in a sample of open-shop construction companies	JSR	survey of safety training showed most contractors did not evaluate the effect of training
Hallowell et al. 2009	Activity-based safety risk quantification for concrete formwork construction	JEM	quantification of safety risk at the activity level
Hallowell et al. 2009	Construction safety risk mitigation	JEM	determining effectiveness of safety program elements and recommendations
Hallowell et al. 2010	Population and initial validation of a formal model for construction safety risk management	JEM	using risk model to evaluate risks for specific activities and recommendations
Halperin et al. 2004	An evaluation of scaffold safety at construction sites	JSR	evaluation of scaffold safety practices by using 150 point checklist

APPENDIX A: LITERATURE REVIEW SUMMARY (continued)

Author	Title	Jour	Research Article Focus
Huang et al. 2006	Owner's role in construction safety	JEM	relationship between safety and owner's influence
Khaled et al. 2005	Trade-off between safety and cost in planning construction site layouts	JEM	site layout planning model to maximize construction safety
Khudeira 2008	Scaffolding: safety, design and construction issues	PSD	scaffolding ordinance before and after major accident
Kleiner et al. 2008	Design, development, and deployment of a rapid universal safety and health system for construction	JEM	case study of rapid universal safety and health system (RUSH)
Koehn et al. 2003	Quality, environmental, and health and safety management systems for construction engineering	JEM	discussion of the development of the quality, environmental and safety (QES) management system
McDonald et al. 2009	"Safety is everyone's job:" The key to safety on a large university construction site	JSR	how safety climate affects awarding of contracts
Rajendran et al. 2009	Development and initial validation of sustainable construction safety and health rating system	JEM	rating system of 50 safety elements to rate projects on importance given to safety
Rajendran et al. 2009	Impact of green building design and construction on worker safety and health	JEM	effects of green and non-green building construction on worker safety and health
Teizer et al. 2010	Autonomous pro-active real-time construction worker and equipment operator proximity safety alert system	AC	radio frequency sensors to early warn potential equipment collision with people or objects
Toole 2002	Construction site safety roles	JEM	no uniform agreement on site safety responsibilities
Toole 2002	Comparison of site safety policies of construction industry trade groups	PSD	trade organizations assign primary safety responsibility to the general contractor whereas OSHA assigns responsibility to employers of the employees
Toole 2005	Increasing engineers' role in construction safety: Opportunities and barriers	JEP	study of increasing designers' role in safety

APPENDIX A: LITERATURE REVIEW SUMMARY (continued)

Author	Title	Jour	Research Article Focus
Usmen et al. 2002	Safety program guidelines for public school facility construction and operations	PSD	construction, operations and maintenance of schools are to insure a safe and healthy environment for all school activities
Weinstein et al. 2005	Can design improve construction safety?: Assessing the impact of a collaborative safety-in-design process	JEM	safety-in-design process in the construction of an electronics plant
Yassin et al. 2004	The effectiveness of the revised scaffold safety standard in the construction industry	SS	compliance with the revised scaffold safety standard reduces workplace injuries

Abbreviations - Journal Name
aap=Accident Analysis & Prevention
ac=Automation in Construction,
jep=Journal of Professional Issues in Engineering, Education and Practice
jem=Journal of Construction Engineering and Management
jsr=Journal of Safety Research
psd=Practical Periodical on Structural Design and Construction
ss=Safety Science

APPENDIX B: DEMOGRAPHICS AND SAFETY SCORES

ABOVE AVERAGE - Responded (*n*=13)						
Company ID Code	**City**	**Zip Code**	**Safety Score**	**Employees inside Louisiana**	**Employees outside Louisiana**	**Year Business Began**
6	Monroe	71201	0	200	0	1961
12	New Orleans	70112	0	278	5	1987
13	Jefferson	70121	0	105	0	2006
16	New Iberia	70560	0	35	0	1979
18	Baton Rouge	70801	0	131	50	2003
25	Pineville	71360	0	65	0	1959
27	Harahan	70123	0	150	0	1998
41	Baton Rouge	70812	0.33	3,000	4,000	1979
35	Port Allen	70767	0.54	50	50	2004
34	Galliano	70354	0.69	250	50	1999
46	Harahan	70123	0.71	130	0	2000
42	Baton Rouge	70817	0.75	300	300	1973
47	Pierre Part	70339	0.85	147	0	1989
		avg.	0.30	372.4	742.5	1987.5
			- ID 41	141.6	91.0	2012.6
					avg.	25.1

ABOVE AVERAGE - No Response (*n*=13)						
Company ID Code	City	Zip Code	Safety Score	Employees inside Louisiana	Employees outside Louisiana	Year Business Began
1	Houma	70360	0			1980
2	Covington	70435	0			2006
3	Metairie	70001	0			1996
9	Baton Rouge	70817	0			1989
10	White Castle	70788	0			1988
11	Metairie	70002	0			1990
15	Shreveport	71101	0			2006
17	Sulphur	70663	0			1983
19	Houma	70363	0			1996
20	New Iberia	70560	0			2001
22	Chalmette	70043	0			1989
23	White Castle	70788	0			1987
48	Harvey	70058	0.93			1983
		avg.	0.07			1991.8
						2012.6
					avg.	20.8

APPENDIX B: DEMOGRAPHICS AND SAFETY SCORES (continued)

BELOW AVERAGE - Responded (*n*=20)						
Company ID Code	City	Zip Code	Safety Score	Employees inside Louisiana	Employees outside Louisiana	Year Business Began
53	Lafayette	70501	1.05	183	4	1995
30	Geismar	70734	1.26	70	35	1994
54	Minden	71005	1.45	53	1	1963
43	Houma	70363	1.49	325	75	1999
56	Bossier City	71111	1.59	40	0	1999
44	Baton Rouge	70809	1.81	2,229	24,634	1981
55	Bossier City	71112	2.97	30	0	1971
51	Baton Rouge	70809	3.06	67	0	1955
50	New Orleans	70118	3.94	85	0	1999
62	Mandeville	70448	5.62	40	4	1999
57	Houma	70363	6.20	136	0	1997
39	Covington	70433	6.20	100	0	2000
29	Houma	70360	6.21	40	0	1994
59	Harvey	70058	6.23	35	15	1974
38	Metairie	70005	9.98	23	0	1990
28	Belle Chasse	70037	11.47	40	0	1960
68	Leesville	71446	14.28	48	0	1988
67	Denham Springs	70726	14.81	50	0	2000
45	Westlake	70669	16.69	200	45	1957
69	Lafayette	70506	25.52	47	0	1965
		avg.	7.09	202.2	3544.7	1984.0
			- ID 44	89.6	29.8	2012.6
					avg.	28.6

BELOW AVERAGE - No Response (*n*=15)						
Company ID Code	City	Zip Code	Safety Score	Employees inside Louisiana	Employees outside Louisiana	Year Business Began
49	Metairie	70002	1.45			1994
33	Gonzales	70737	1.81			1979
36	Mandeville	70448	1.98			1979
40	Baton Rouge	70814	2.00			1973

APPENDIX B: DEMOGRAPHICS AND SAFETY SCORES (continued)

BELOW AVERAGE - No Response (*n*=15)						
Company ID Code	City	Zip Code	Safety Score	Employees inside Louisiana	Employees outside Louisiana	Year Business Began
52	Lake Charles	70615	2.08			2003
37	Lake Charles	70601	2.17			1982
61	Eunice	70535	2.61			1978
32	Prairieville	70769	2.81			1989
66	Port Allen	70767	4.84			1984
58	Baton Rouge	70809	4.94			1964
31	Baton Rouge	70811	5.19			1969
64	Oak Grove	71263	5.33			2004
63	Baton Rouge	70815	6.42			1989
60	Alexandria	71303	10.03			2001
65	Arnaudville	70512	31.52			1978
			5.68			1984.4
						2012.6
						28.2

APPENDIX C: SAFETY ELEMENTS *Z* TEST AND *P* VALUES

Sec 1 2012	Safety Elements	*z* Test	*p* value
1	designated safety budget as part of the normal operating budget	2.23	0.026*
2	pay employees for the hours they spend attending voluntary off-hour safety training sessions	1.99	0.047*
3	communication between management and company employees on safety issues	NaN	0.000
4	management support in the use of safety principles and practices	-1.26	0.208
5	take into account a subcontractor safety record when awarding contracts	0.85	0.395
6	owners of the projects attend company safety meetings	0.25	0.803
7	formal safety program	NaN	0.000
8	formal safety goals that are updated periodically	1.79	0.073*
9	continuous safety improvement program	-0.32	0.749
10	formal safety committee that meets on a regular schedule	2.08	0.038*
11	invite subcontractors to the safety committee meetings	-0.50	0.617
12	formal personal protective equipment training program	1.96	0.050*
13	supply new employees with company required personal protective equipment free of charge	NaN	0.000
14	formal site-specific housekeeping plans	0.13	0.897
15	site-specific safety procedures	0.63	0.529
16	on-site safety inspections	NaN	0.000
17	safety risk management program	1.02	0.308
18	job site heat stress prevention program	0.68	0.497
19	employees verify if they have been injured on the job site when they sign out each day	0.65	0.516
20	job hazard analysis prior to the start of a new type of operation or procedure	0.34	0.728
21	root cause safety analysis training program for key employees that deal with safety issues	0.79	0.430
22	temporary labor safety training program	1.26	0.208

APPENDIX C: SAFETY ELEMENTS *Z* TEST AND *P* VALUES (continued)

Sec 1 2012	Safety Elements	*z* Test	*p* value
23	third party safety inspections	0.09	0.930
24	task-specific procedures	0.48	0.631
25	survey employees to find out what their safety needs are	1.01	0.313
26	check references before hiring a new employee	0.23	0.820
27	an assigned safety person for each job site	-1.79	0.073* (see note 2)
28	formal emergency response plan for injured employees	0.63	0.530
29	formally address worker safety risk concerns	-0.03	0.976
30	procedure for rejecting defective material	0.36	0.719
31	formal policy for reassigning injured workers to light duty tasks	0.13	0.897
32	use skilled and trained persons for performing high risks tasks	-0.14	0.889
33	on-site safety plans for subcontractors	-0.46	0.646
34	safety performance evaluations for key personnel	0.83	0.407
35	ergonomic task analyses on critical tasks	1.57	0.116
36	regularly scheduled on-site worker safety meetings	-0.32	0.749
37	new employee orientation safety training program	0.68	0.500
38	regularly scheduled safety training programs for existing employees	1.72	0.085*
39	employee feedback on safety training program effectiveness	-0.03	0.976
40	external safety training programs	-0.96	0.337
41	pair-up training of inexperienced employees with experienced employees for learning new tasks	-0.62	0.535
42	use simulation models for equipment training	1.22	0.226
43	safety training for subcontractors	1.79	0.073*
44	project specific safety training for new projects	1.99	0.337
45	OSHA 10 hour training course for all job site employees	0.71	0.478
46	employees to be involved in safety issues	-0.32	0.749
47	employees to report unsafe conditions and safety violations	-1.26	0.208
48	third party safety inspections	-1.01	0.313

APPENDIX C: SAFETY ELEMENTS *Z* TEST AND *P* VALUES (continued)

Sec 1 2012	Safety Elements	*z* Test	*p* value
49	taking safety risks is not part of their job	-0.28	0.779
50	safety incentive reward program	1.09	0.276
51	discipline procedure for employees that commit unsafe acts	1.72	0.085*
52	investigation procedure for worker related accidents	-1.23	0.219
53	investigation procedure for near miss accidents	0.44	0.660
54	maintain safety performance statistics for improving safety on the job site	0.74	0.465
55	detailed safety reports to employees on a regular basis	1.79	0.075*
56	Procedure for making corrections for unsafe conditions	-0.32	0.749
57	substance abuse awareness program	1.53	0.126
58	substance abuse testing program	0.82	0.412

Notes:

1. * statistical significance at the 90% confidence level
2. This was the only statistically significant Safety Element that was used more frequently by companies with below average safety scores than companies with above average safety scores.

APPENDIX D: 2008 OSHA TCR NAICS 2362 SAFETY SCORES

ABOVE AVERAGE			
Company ID Code	City	Zip Code	Safety Score
1	Houma	70360	0
2	Covington	70435	0
3	Metairie	70001	0
4**	Alexandria	71301	0
5**	Baton Rouge	70809	0
6	Monroe	71201	0
7*	Prairieville	70769	0
8**	Baldwin	70514	0
9	Baton Rouge	70817	0
10	White Castle	70788	0
11	Metairie	70002	0
12	New Orleans	70112	0
13	Jefferson	70121	0
14*	Lake Charles	70605	0
15	Shreveport	71101	0
16	New Iberia	70560	0
17	Sulphur	70663	0
18	Baton Rouge	70801	0
19	Houma	70363	0
20	New Iberia	70560	0
21*	Harahan	70123	0
22	Chalmette	70043	0
23	White Castle	70788	0
24**	Abberville	70510	0
25	Pineville	71360	0

BELOW AVERAGE			
Company ID Code	City	Zip Code	Safety Score
53	Lafayette	70501	1.05
30	Geismar	70734	1.26
54	Minden	71005	1.45
49	Metairie	70002	1.45
43	Houma	70363	1.49
56	Bossier City	71111	1.59
44	Baton Rouge	70809	1.81
33	Gonzales	70737	1.81
36	Mandeville	70448	1.98
40	Baton Rouge	70814	2.00
52	Lake Charles	70615	2.08
37	Lake Charles	70601	2.17
61	Eunice	70535	2.61
32	Prairieville	70769	2.81
55	Bossier City	71112	2.97
51	Baton Rouge	70809	3.06
50	New Orleans	70118	3.94
66	Port Allen	70767	4.84
58	Baton Rouge	70809	4.94
31	Baton Rouge	70811	5.19
64	Oak Grove	71263	5.33
62	Mandeville	70448	5.62
57	Houma	70363	6.20
39	Covington	70433	6.20
29	Houma	70360	6.21

APPENDIX D: 2008 OSHA TCR NAICS 2362 SAFETY SCORES (continued)

Company ID Code	City	Zip Code	Safety Score
26*	Baton Rouge	70817	0
27	Harahan	70123	0
41	Baton Rouge	70812	0.33
35	Port Allen	70767	0.54
34	Galliano	70354	0.69
46	Harahan	70123	0.71
42	Baton Rouge	70817	0.75
47	Pierre Part	70339	0.85
48	Harvey	70058	0.93

Company ID Code	City	Zip Code	Safety Score
59)	Harvey	70058	6.23
63	Baton Rouge	70815	6.42
38	Metairie	70005	9.98
60	Alexandria	71303	10.03
28	Belle Chasse	70037	11.47
68	Leesville	71446	14.28
67	Denham Springs	70726	14.81
45	Westlake	70669	16.69
69	Lafayette	70506	25.52
65	Arnaudville	70512	31.52

Notes:

1. * Pilot Study - companies that did not respond (*n*=4) to the Pilot Study
2. ** Pilot Study - companies that did respond (*n*=4) to the Pilot Study

APPENDIX E: FINAL SEQ

Louisiana State University Commercial Construction Safety Survey

INSTRUCTIONS:

THANK YOU for taking part in this very important survey.

This survey is divided into two primary sections. The first section will be looking for the safety elements that your company is presently using in your safety program. The second section will be looking for the safety elements that were being used in the year 2008 as a follow-up to a study done in the year 2008. On the 2008 year questions you will be given a choice of "yes", "no" or "not sure". If you were not present during that year or don't recall, please press the "not sure" button.

Safety elements are generally defined as the individual parts that make up your safety program.

Some examples of safety elements are: (1) "formal safety program", (2) "formal safety committee that meets on a regular schedule" and (3) "on-site safety inspections".

All safety elements, in this questionnaire, will be identified by quotation marks in the context of the question.

In SECTION ONE you will be asked if your company has or is using a particular safety element. If you answer "no" or "not sure" you will be automatically directed to the next question. However, if you answer "yes", you will be asked one follow-up question: How important is the safety element in relationship to the other safety elements within your safety program? You will then be asked to select one of seven importance ratings on the Importance Scale. Please choose one of the seven buttons that best indicates the importance of that safety element among all your other safety elements.

In SECTION TWO you will be asked the same repeat question on each safety element except this time it will be for the year 2008 and will be in the context of "To the best of your knowledge ...." You will then select one of the following answers, "yes", "no", "not sure". In Section Two you WILL NOT be asked to rate the safety elements used in the year of 2008.

You can change the answers to any previous question by using the "PREV" button.

It should take approximately 20-30 minutes to complete the survey. You do not have to do the survey in one sitting. You can start and stop as many times as you wish and each time you stop, your answers will be automatically saved. When you are ready to resume the survey, just click the link again on the e-mail that was sent to you and your survey will come up again and be ready for picking up where you left off. There is also a progress bar on the pages of the survey to keep track of the amount of completion so that at any point you will know how much of the survey you have completed.

Thank you very much for taking part in this very important construction safety survey. You will receive a copy of the survey study results for taking part in this survey. If you have any questions, please feel free to contact me at any time on my cell phone.

Cliff Dunlap
985-201-7399

AUTHORIZATION

Are you the designated safety person in your company that is authorized to respond to the questions in this survey?

◯ yes

◯ no

APPENDIX E: FINAL SEQ (continued)

CONSENT FORM

CONSENT FORM

Dear Participant:

This survey is to determine the general safety practices that are being used in the commercial non-residential construction industry.

The purpose is to understand those safety practices and how they can help reduce future injuries and fatalities in the workplace. This study has been approved by the LSU Institutional Review Board (IRB) and their contact information can be found on the following page.

Your answers to the questionnaire will be kept completely confidential and your identity will be protected. Participation and non-participation is completely your decision. You can also decide not to participate at any time.

Your participation in the survey is on a voluntary basis and will be greatly appreciated if you decide to participate. If you choose to participate in the survey you will receive a copy of the survey study results.

As mentioned earlier, no personal information will appear in the study or its conclusions. All personal information will be kept in the strictest of confidence. Your name and company name will be deleted from all information of the consolidated raw data. This will break any link between the response and any name that was with the original response. By participating in the study you will be greatly contributing to the understanding of safety practices that can ultimately lead to the lowering of injury and fatality rates in the workplace.

By agreeing to this consent form, it is believed that you have read and understood the idea and purpose of this survey and voluntarily give your consent to participating in it.

For questions regarding this project, please feel free to contact:

Institutional Review Board (IRB)
Dr. Robert Matthews, Chair
Louisiana State University
203 B-1 David Boyd Hall
Baton Rouge, LA 70803

APPENDIX E: FINAL SEQ (continued)

P: (225) 578-8692
F: (225) 578-6792
Email: irb@lsu.edu

Principal Investigators:

Cliff Dunlap, PhD Graduate Student
Construction Management and Industrial Engineering Department
Patrick Taylor Hall (CEBA)
LSU Campus
P: (985) 201-7399
Email: cdunla3@lsu.edu

Isabelina Nahmens, Ph. D.
Assistant Professor
Construction Management and Industrial Engineering Department
Patrick Taylor Hall (CEBA)
LSU Campus
P: (225) 578-0943
Email: nahmens@lsu.edu

Do you understand and agree with the terms and conditions of the Consent Form shown above?

- ◯ yes
- ◯ no

SECTION ONE

Does your company have a "designated safety budget as part of the normal operating budget"? 1

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is a "designated safety budget as part of the normal operating budget" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company "pay employees for the hours they spend attending voluntary off-hour safety training sessions"? 2

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "pay employees for the hours they spend attending voluntary of-hour safety training sessions" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company encourage "communication between management and company employees on safety issues"? 3

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to encourage "communication between management and company employees on safety issues" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company encourage "management support in the use of safety principles and practices"?

- ◯ yes
- ◯ no
- ◯ not sure

4

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is it to encourage "management support in the use of safety principles and practices" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company "take into account a subcontractor safety record when awarding contracts"? 5

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "take into account a subcontractor safety record when awarding contracts" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

APPENDIX E: FINAL SEQ (continued)

Does your company have the "owners of the projects attend company safety meetings" at times? 6

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to have the "owners of the projects attend company safety meetings" at times in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "formal safety program"? 7

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is a "formal safety program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have "formal safety goals that are updated periodically"? 8

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important are "formal safety goals that are updated periodically" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company have a "continuous safety improvement program"? 9

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "continuous safety improvement program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "formal safety committee that meets on a regular schedule" during each year? 10

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is a "formal safety committee that meets on a regular schedule" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company "invite subcontractors to the safety committee meetings" from time to time? 11

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "invite subcontractors to the safety committee meetings" from time to time in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company have a "formal personal protective equipment training program"?

12

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "formal personal protective equipment training program " in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company "supply new employees with company required personal protective equipment free of charge"?

13

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is it to "supply new employees with company required personal protective equipment free of charge" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have "formal site-specific housekeeping plans"? 14

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important are "formal site-specific housekeeping plans" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company have "site-specific safety procedures"? 15

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important are "site-specific safety procedures " in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

16

SECTION ONE

Does your company conduct "on-site safety inspections"?

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important are "on-site safety inspections" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "safety risk management program"?

17

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "safety risk management program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company have a "job site heat stress prevention program"? 18

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "job site heat stress prevention program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "designated safety budget as part of the normal operating budget"?

- ◯ yes 1 - A
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is a "designated safety budget as part of the normal operating budget" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very unimportant
- ◯ 2
- ◯ 3
- ◯ 4 - Neither unimportant nor important
- ◯ 5
- ◯ 6
- ◯ 7 - Very important

SECTION ONE

Does your company require that "employees verify if they have been injured on the job site when they sign out each day"?

19

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it that "employees verify if they have been injured on the job site when they sign out each day" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company require a "job hazard analysis prior to the start of a new type of operation or procedure"? 20

- ○ yes
- ○ no
- ○ not sure

SECTION ONE

How important is a "job hazard analysis prior to the start of a new type of operation or procedure" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ○ 1 - Very important
- ○ 2
- ○ 3
- ○ 4 - Neither important nor unimportant
- ○ 5
- ○ 6
- ○ 7 - Very unimportant

21

SECTION ONE

Does your company have a "root cause safety analysis training program for key employees that deal with safety issues"?

- ○ yes
- ○ no
- ○ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is a "root cause safety analysis training program for key employees that deal with safety issues" in relationship to the other safety elements within your safety program?

Please choose one of seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "temporary labor safety training program"? 22

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "temporary labor safety training program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company use "third party safety inspections"? 23

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important are "third party safety inspections" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have "task-specific procedures"?

- ◯ yes
- ◯ no
- ◯ not sure

24

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important are "task-specific procedures" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company "survey employees to find out what their safety needs are"?

25

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "survey employees to find out what their safety needs are" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company "check references before hiring a new employee"? 26

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "check references before hiring a new employee" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have an "assigned safety person for each job site"? 27

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is it to have an "assigned safety person for each job site" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "formal emergency response plan for injured employees"?

- ◯ yes
- ◯ no
- ◯ not sure

28

SECTION ONE

How important is it to have a "formal emergency response plan for injured employees" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company "formally address worker safety risk concerns"? 29

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "formally address worker safety risk concerns" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "procedure for rejecting defective materials"?

- ◯ yes
- ◯ no
- ◯ not sure

30

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is it to have a "procedure for rejecting defective materials" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "formal policy for reassigning injured workers to light duty tasks"?

31

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to have a "formal policy for reassigning injured workers to light duty tasks" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company have a formal policy to "use skilled and trained persons for performing high risks tasks"? 32

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "use skilled and trained persons for performing high risks tasks" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have "on-site safety plans for subcontractors"? 33

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important are "on-site safety plans for subcontractors" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company give "safety performance evaluations for key personnel"?

34

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to give "safety evaluations for key personnel" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company do "ergonomic task analyses on critical tasks"? 35

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important are "ergonomic task analyses on critical tasks" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have "regularly scheduled on-site worker safety meetings"? 36

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important are "regularly scheduled on-site worker safety meetings" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "new employee orientation safety training program"?

37

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "new employee orientation safety training program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company have "regularly scheduled safety training programs for existing employees"? 38

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important are "regularly scheduled safety training programs for existing employees" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "substance abuse testing program"? 58 - A

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is a "substance abuse testing program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither unimportant nor important
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company encourage "employee feedback on safety training program effectiveness"?

39

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to encourage "employee feedback on safety training program effectiveness" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company use "external safety training programs"? 40

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important are "external safety training programs" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company use "pair-up training of inexperienced employees with experienced employees for learning new tasks"?

- ◯ yes
- ◯ no
- ◯ not sure

41

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is the use of "pair-up training of inexperienced employees with experienced employees for learning new tasks" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company "use simulation models for equipment training"?

42

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "use simulation models for equipment training" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company offer "safety training for subcontractors"? 43

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is "safety training for subcontractors" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have "project specific safety training on new projects"? 44

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is "project specific safety training for new projects" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company require an "OSHA 10 hour training course for all job site employees"?

- ◯ yes
- ◯ no
- ◯ not sure

45

SECTION ONE

How important is an "OSHA 10 hour training course for all job site employees" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company ask "employees to be involved in safety issues"? 46

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it for "employees to be involved in safety issues" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION O 47

Does your company ask "employees to report unsafe working conditions and safety violations"?

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is it for "employees to report unsafe working conditions and safety violations" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company encourage "employees assisting other employees on safety issues"?

48

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to have "employees assisting other employees on safety issues" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company remind employees that "taking safety risks is not part of their job"?

49

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it for employees to know that "taking safety risks is not part of their job" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "safety incentivve reward program"?

50

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is a "safety incentive reward program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "discipline procedure for employees that commit unsafe acts"? 51

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "discipline procedure for employees that commit unsafe acts" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company have an "investigation procedure for worker related accidents"? 52

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is an "investigation procedure for worker related accidents" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have an "investigation procedure for near-miss accidents"? 53

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is an "investigation procedure for near-miss accidents" in relationship to the other safety elements within your safety program

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company "maintain safety performance statistics for improving safety on the job site"? 54

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to "maintain safety performance statistics for improving safety on the job site" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company issue "detailed safety reports to employees on a regular basis"? 55

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is it to issue "detailed safety reports to employees on a regular basis" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION 56

Does your company have a "procedure for making corrections to unsafe conditions at the job site"?

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

How important is a "procedure for making corrections to unsafe conditions at the job site" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

Does your company have a "substance abuse awareness program"?

57

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "substance abuse awareness program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very important
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very unimportant

SECTION ONE

APPENDIX E: FINAL SEQ (continued)

Does your company have a "substance abuse testing program"? 58

- ◯ yes
- ◯ no
- ◯ not sure

SECTION ONE

How important is a "substance abuse testing program" in relationship to the other safety elements within your safety program?

Please choose one of the seven buttons below.

- ◯ 1 - Very unimportant
- ◯ 2
- ◯ 3
- ◯ 4 - Neither important nor unimportant
- ◯ 5
- ◯ 6
- ◯ 7 - Very important

SECTION TWO

Please answer the following question to the best of you present knowledge.

Did your company have a "designated safety budget as part of the normal operating budget" during the year of 2008? 1

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "pay employees for the hours they spent attending voluntary off-hour safety training sessions" during the year of 2008? 2

- ◯ yes
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company encourage "communication between management and company employees on safety issues" during the year of 2008? 3

- ◯ yes
- ◯ no
- ◯ not sure

Did your company encourage "management support in the use of safety principles and practices" during the year of 2008? 4

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "take into account a subcontractor safety record when awarding contracts " during the year of 2008? 5

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have the "owners of the projects attend company safety meetings" at times during the year of 2008? 6

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "formal safety program" during the year of 2008? 7

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have "formal safety goals that were updated periodically" during the year of 2008? 8

- ◯ yes
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company have a "continuous safety improvement program" during the year of 2008? 9

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "formal safety committee that met on a regular schedule" during the year of 2008? 10

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "invite subcontractors to the safety committee meetings" from time to time during the year of 2008? 11

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "formal personal protective equipment training program " during the year of 2008?

- ◯ yes 12
- ◯ no
- ◯ not sure

Did your company "supply new employees with company required personal protective equipment free of charge" during the year of 2008?

- ◯ yes 13
- ◯ no
- ◯ not sure

Did your company have "formal site-specific housekeeping plans" during the year of 2008?

- ◯ yes
- ◯ no 14
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company have "site-specific safety procedures" during the year of 2008? 15

- ◯ yes
- ◯ no
- ◯ not sure

Did your company conduct "on-site safety inspections" during the year of 2008? 16

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "safety risk management program" during the year of 2008? 17

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "job site heat stress prevention program" during the year of 2008? 18

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have "employees verify if they have been injured on the job site when they sign out each day" during the year of 2008? 19

- ◯ yes
- ◯ no
- ◯ not sure

Did your company require a "job hazard analysis prior to the start of a new type of operation or procedure" during the year of 2008? 20

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "root cause safety analysis training program for key employees that deal with safety issues" during the year of 2008? 21

- ◯ yes
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company have a "temporary labor safety training program" during the year of 2008? 22

- ◯ yes
- ◯ no
- ◯ not sure

Did your company use "third party safety inspections" during the year of 2008? 23

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have "task-specific procedures" during the year of 2008? 24

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "survey employees to find out what their safety needs were" during the year of 2008? 25

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "check references before hiring a new employee" during the year of 2008? 26

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have "an assigned safety person for each job site" during the year of 2008? 27

- ◯ yes
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company have a "formal emergency response plan for injured employees" during the year of 2008? 28

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "formally address worker safety risk concerns" during the year of 2008? 29

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "procedure for rejecting defective material" during the year of 2008? 30

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "formal policy for reassigning injured workers to light duty tasks" during the year of 2008? 31

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "use skilled and trained persons for performing high risks tasks" during the year of 2008? 32

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have "on-site safety plans for subcontractors" during the year of 2008? 33

- ◯ yes
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company give "safety performance evaluations for key personnel" during the year of 2008? 34

- ◯ yes
- ◯ no
- ◯ not sure

Did your company do "ergonomic task analyses on critical tasks" during the year of 2008? 35

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have "regularly scheduled on-site worker safety meetings" during the year of 2008? 36

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "new empolyee orientation safety training program" during the year of 2008? 37

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have "regularly scheduled safety training programs for existing employees" during the year of 2008? 38

- ◯ yes
- ◯ no
- ◯ not sure

Did your company encourage "employee feedback on safety training program effectiveness" during the year of 2008? 39

- ◯ yes
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company use "external safety training programs" during the year of 2008? 40

- ◯ yes
- ◯ no
- ◯ not sure

Did your company use "pair-up training of inexperienced employees with experienced employees for learning new tasks" during the year of 2008? 41

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "use simulation models for equipment training" during the year of 2008? 42

- ◯ yes
- ◯ no
- ◯ not sure

Did your company offer "safety training for subcontractors" during the year of 2008? 43

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have "project specific safety training for new projects" during the year of 2008? 44

- ◯ yes
- ◯ no
- ◯ not sure

Did your company require an "OSHA 10 hour training course for all job site employees" during the year of 2008? 45

- ◯ yes
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company ask "employees to be involved in safety issues" during the year of 2008? 46

- ◯ yes
- ◯ no
- ◯ not sure

Did your company ask "employees to report unsafe conditions and safety violations" during the year of 2008? 47

- ◯ yes
- ◯ no
- ◯ not sure

Did your company encourage "employees assisting other employees on safety issues" during the year of 2008? 48

- ◯ yes
- ◯ no
- ◯ not sure

Did your company remind employees that "taking safety risks was not part of their job" during the year of 2008? 49

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "safety incentive reward program" during the year of 2008? 50

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have a "discipline procedure for employess that commit unsafe acts" during the year of 2008? 51

- ◯ yes
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company have an "investigation procedure for worker related accidents " during the year of 2008? 52

- ◯ yes
- ◯ no
- ◯ not sure

Did your company have an "investigation procedure for near miss accidents" during the year of 2008? 53

- ◯ yes
- ◯ no
- ◯ not sure

Did your company "maintain safety performance statistics for improving safety on the job site" during the year of 2008? 54

- ◯ yes
- ◯ no
- ◯ not sure

Did your company issue "detailed safety reports to employees on a regular basis" during the year of 2008?

- ◯ yes 55
- ◯ no
- ◯ not sure

Did your company have a "procedure for making corrections for unsafe conditions at the job site" during the year of 2008?

- ◯ yes 56
- ◯ no
- ◯ not sure

Did your company have a "substance abuse awareness program" during the year of 2008?

- ◯ yes 57
- ◯ no
- ◯ not sure

APPENDIX E: FINAL SEQ (continued)

Did your company have a "substance abuse testing program" during the year of 2008?

58

- ◯ yes
- ◯ no
- ◯ not sure

You are almost finished!!

You have now completed both sections of this questionnaire.

Please list any safety elements that your company is PRESENTLY USING that were not covered in this questionnaire.

Just click on the box below and type in your response.

Please feel free to add any additional comments on safety and it's importance to the commercial construction industry.

Just click on the box below and type in your response.

You have now finished the questionnaire!

Thank you very much for participating in this Louisiana State University Commercial Construction Safety Survey.

If you have any further questions or comments, please feel free to contact:

Cliff Dunlap
Phone: 985-201-7399

VITA

Cliff Dunlap has had extensive experience and a number of senior executive positions in the international manufacturing corporate world. His primary focus has been in the area of lean manufacturing with a number of corporate recovery assignments that involved putting recovery plans together and the closely monitoring the results for improving profitability, efficiency and employee morale at troubled companies or divisions. His career has been a mix of senior executive engineering research positions and operational positions. Throughout his career, safety issues have been at the forefront a number of times at both the research/development side of product line development as well the day to day operational side.

Cliff has also developed a lecture series that deals with issues at each department level from the board room to maintenance and safety and covers such subjects as ethics, leadership, human resources, value engineering, corporate structure, continuous improvement, efficiency, quality assurance and employee morale. He has lectured at the university and the corporate level.

Affiliations:

1. COSS Certified Occupational Safety Specialist
2. Member of Phi Kappa Phi Honors Society

Education:

1. Bachelor of Arts Degree from Ambassador University
2. Attended West Texas A&M Graduate School in Engineering Technology