Identification of the Best Practices in the Construction Industry to Attain Zero Accidents

by

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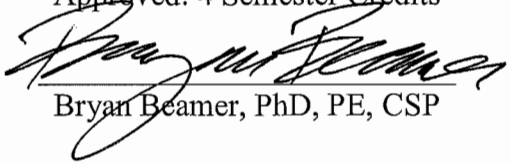

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ABSTRACT

The research effort in this report is a follow-up on a study that was conducted in the early 1990s by the Construction Industry Institute (CII). The CIIs study examines safety strategies of large construction firms to aid in the identification of the best practices in the construction industry. It was important because it identified methods and practices that have proven effective in reducing worker injuries. The CII study was originally conducted to eliminate all accident to achieve the zero accident objective. This follow-up study is an update of the original CII study.

To accomplish the objective of this study, three methods were employed 1) an extensive literature search identifying best safety practices was conducted, 2) several large construction company's statistics were reviewed, and 3) a survey instrument used among those companies to identify which safety practices are significantly related with safety performance.

Five major safety techniques which have highly contributed to excellent safety performance were identified in this study.

1. Management commitment to contractor safety
2. Safety planning: pre-project and pre-task
3. Worker involvement
4. Safety education: orientation and specialized training
5. Overall accident/incident investigations

An effective safety program should include all of these in order to attain the goal of zero accidents. By obtaining the goal of zero accidents; the direct and indirect costs associated with injuries are reduced, resulting in a higher profit margin and a more effective competitive position in the construction industry.

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TABLE OF CONTENTS

LIST OF FIGURES

Chapter I: Introduction

Construction is a high-hazard occupation. It continues to be one of the most demanding and dangerous industries in the United States (Eich, 1996). Workers are exposed to new hazards due to the changing nature of construction projects virtually every day. Construction workers require physical stamina because their work requires working in cramped spaces, lifting and carrying heavy objects, and working with potentially dangerous tools and equipment. Construction workers also have to deal with harsh weather conditions because much of the work is done outside or in partially enclosed structures. It has been reported that construction work has a high rate of injuries and accidents (BLS, 2008). In a report that The Bureau of Labor Statistics details in 2006, cases of work-related injury and illness were 5.9 per 100 full construction workers. This is significantly higher than the 4.4 rate for the entire private sector.

To negate the high rate of hazards, proactive construction personnel in the industry may need to take further steps to identify and eliminate the causes of accidents on job sites. Safety has become one of the most important aspects of concern on many construction projects. In his study of construction safety, Hinze (2002) found that "many construction firms have begun considering safety to be one of the main factors in reducing costs associated with work-related accidents and injuries, but by also contributing to an "on time" and "within budget" project delivery."

The cost benefit of good safety practices payoff with the reduction of cost in relation to worker injury. Costs are incurred whenever an injury occurs on a project. The costs associated with injuries consist of the direct and indirect costs of injuries. Injuries consist of the direct costs, which can be determined with accuracy after a Worker's Compensation injury claim is closed, and the indirect costs, which are rarely even estimated by construction firms. Coble, Richard, Hinze & Haupt (2000) stated "that the indirect costs consist of many costs that are incurred due

to injuries that relate to lost productivity, damaged materials/equipment, and the commitment of administrative time.

When Worker's Compensation losses are added to the costs of an injury the direct costs are twice to 20 times more (Nelson, 1996). With all the costs factored in, it seems apparent that the return on investment for good safety practices pays off.

Hinze and Wilson (2000) stated that it is important that an emphasis on safety be recognized or even be accepted as being a principle means by which injuries can be reduced. If safety is emphasized, the occurrence of injuries can be expected to be low and, conversely, if no emphasis is placed on safety, the occurrence of injuries can be expected to be high.

Eich (1996) put the problem this way:

> "Large construction firms in the United States have made important strides toward improving construction safety. The average injury rate for the largest firms has dropped by 26% since 1978. Large firms are dedicating more manpower, time, and resources to safety than in the past." (p.1)

The safety practices and performance in these individual firms are important to the entire industry. Large construction companies have the greatest impact on the overall safety record of the construction industry. They account for most of the revenue generated when compared to the total revenue of the industry (McGraw Hill, 2008). This has encouraged researchers to pay particular attention to the methods and practices used by these companies in the efforts to attain safety excellence.

For instance Hinze (1997) found the following:

> "Attention to safety in the construction industry has increased dramatically in the United States over the past few decades. Several factors have led to the greater emphasis on

safety. Although construction work has become safer, there is still much to be accomplished. Since there is now a strong concern for safety in the construction community, one can hope that further improvements will continue to reduce the numbers of fatalities and serious injuries in the industry." (p.3)

Statement of the Problem

In a report that The Bureau of Labor Statistics details in 2008, cases of work-related injury and illness were 5.4 per 100 full construction workers. With continuing high work-related injury and illness rates in the construction industry, the identification of safety practices may help reverse these high rates. Those safety practices that are successful in accomplishing low injury rates which make a difference in safety performance to move individual construction projects toward the goal of zero accidents.

Purpose of the Study

It was the purpose of this research to investigate the safety practices of large construction firms to identify those best practices that make one firm safer than the next.

This research was intended to be a follow-up on a study that was conducted in the early 1990s by the Construction Industry Institute (CII). The 1990s study defined measures needed to be taken in order to achieve safety excellence. This research intends to revisit those measures to ensure the effort in safety performance has not become idle.

Research Questions

This study sought answers to the following research questions:

1. What are the different approaches companies have for their safety practices?
2. What do the company's feel are the most significant in terms of rating their safety practices?

3. Are the safety practices the same as they were more than 15 years ago?

Methodology

To accomplish the objective of this study, three methods were employed 1) an extensive literature search identifying best safety practices was conducted, 2) several large construction company's statistics were reviewed, and 3) a survey instrument used among those companies to identify which safety practices are significantly related with safety performance.

Limitations of the Study

The limitations for this study are:

1. The scope of this study will survey only those companies that have been selected from the 2009 University of Wisconsin-Stout's Construction Program Industry Advisory Board.
2. The number of surveys returned may be minimal. The data in this study has to be received from voluntary participants from over 20 construction companies. The participants may be reached, but may decline to complete the survey. If the participants are too busy with their own employment, they may not have any desire or motivation to complete the survey.
3. The survey instrument will be a self written combination of a compilation of questionnaires to get the data appropriate for the research. The survey may contain unintentional errors and some responses may be intentionally left blank; however every attempt will be made to create a suitable and trustworthy instrument.
4. The survey used relies on human subjects, so the results are limited to the honesty of what the individuals submit. The individuals may render different numbers in order to make their company seem statistically better than they actually are.

Definitions of Terms

Direct Cost: Are terminated losses, covered by Worker's Compensation Insurance. (Friedman, 2000)

Interval scale: The scale of measurement is interval if the data have the properties of ordinal data and the interval between is expressed in terms of a fixed unit of measure. (Anderson, Sweeney & Williams, 1993)

OSHA Lost Time Injury: A work-related injury or illness resulting in days away from work. ("*General recording criteria,"* n.d.)

OSHA Recordable: A work-related injury or illness resulting in death, days away from work, restricted work or job transfer, medical treatment beyond first aid, or loss of consciousness. ("*General recording criteria,"* n.d.)

OSHA Recordable Incident Rate: (Number of *OSHA* Recordable Incidents x 200,000) / (Number of Hours Worked) ("*General recording criteria,"* n.d.)

Severity Rate: (Number of lost work days x 200,000) / (Number of Hours Worked) ("*General recording criteria,"* n.d.)

Workers Compensation: A system that requires employers to provide workers who suffer job related injuries (and fatalities) with medical treatment and monetary compensation to replace lost income. (Fishback, 2000)

Chapter II: Literature Review

The OSHA Act of 1970, created by the Occupational Safety and Health Administration (OSHA, 29 CFR 1926), requires employers of construction workers to provide a safe working environment for their employees. The purpose of the Act is to assure safe and healthy working conditions for men and women by authorizing enforcement of standards developed under the Act. As a result of this Act, there have been changes that have occurred over the years in the way safety is viewed and how it is approached. Researchers have paid close attention to the techniques used by construction companies in their efforts to provide safe and healthy working conditions for their employees. There have been numerous studies performed in this area of construction safety to identify best safety practices.

This study intends to conduct a survey which will be the means of collecting recent data to identify safety practices of large construction companies in which the data will be analyzed in order to identify current trends of best safety practices. The results of this survey depend on the quality of the data collected. The value of the data collected will be contingent on the effectiveness of the questions asked on the survey. The meaning of the questions must be completely clear to all respondents, if the questions are unclear quality data will not be collected and analyzed effectively to identify the current trends of best safety practices. Therefore the purpose of the review of literature is to examine available information and relevant studies that relate to construction safety, and to research information on how to effectively write a survey in order to successfully evaluate data collected from the survey.

Trends in Safety Performance

A. Five High-Impact techniques

In 1993, the Construction Industry Institute (CII) conducted a study that contributed significantly in defining the measures needed to achieve safety excellence to show owners and contractors the real value of an effective safety program. The study showed a comprehensive view of what the safety programs of large construction firms were like at the time.

The study identified effective safety techniques (Five High-Impact Zero Accidents Technique) to allow companies with good construction safety programs to advance in safety excellence. The Five High-Impact techniques identified in the CII's 1993 study: (I) Pre-Project/Pre-Task Planning, (II) Safety orientation and training, (III) Safety Incentives, (IV) Alcohol and Substance Abuse Program, and (V) Accident and Near Miss Investigation are presented in more detail for clarification:

I) *Pre-Project/Pre-Task Planning*: As part of the pre-project planning program it is the responsibility of the project manager to perform a complete project safety analysis, to develop safety techniques needed to eliminate hazardous exposures to be implemented on the jobsite. As part of the pre-task planning program the workers are to assess the routine tasks of the day, and are to hold a meeting on how to eliminate hazards associated with the tasks prior to beginning any new task assignment.

II) *Safety orientation and training*: As part of safety orientation and training all workers should be given an explanation of the projects commitment to safety and the company's rules and site requirements to eliminate workers injury. Topics for training include Cardio Pulmonary Resuscitation (CPR), First Aid, Fall Protection, and Drug Testing.

III) *Safety Incentives*: The Safety Incentive program is a technique used to reward a commitment to safety by giving out awards to craft workers for working safely.

Safety incentives come in two basic forms: gift items or monetary awards (Hinze, 2002). The intentions of safety incentives are to improve safety performance.

IV) *Alcohol and Substance Abuse Program*: The implementation of an alcohol and substance abuse program involves testing workers who are under the influence of alcohol or other controlled substances. Recommended testing times include pre-employment screenings, post-accident, and random screenings.

V) *Accident and Near Miss Investigation*: The Accident and Near Miss Investigation program focuses on reporting all jobsite accidents to management in order to examine the root cause of those accidents. Results of these investigations are communicated to all employees in order to prevent future occurrences (Liska, Goodloe, and Sen, 1993).

B. Best Practices

In the construction industry, organizations have begun adopting best practices to improve safety and business practices (FFC, 2007). The CII defines a best practice as a process or method that, when executed effectively, leads to enhanced project performance. Hinze (2002) found that in their pursuing mission for safety excellence, the CII's 1993 study that identified the five high-impact techniques were extended in 2002, and revealed the importance of using these best practices in construction projects.

These best practices were grouped into nine groups: (I) Demonstrated Management Commitment, (II) Staffing for safety, (III) Planning: pre-project and pre-task, (IV) Safety education: orientation and specialized training, (V) Worker involvement, (VI) Evaluation and recognition/reward, (VII) Subcontract management, (VIII) Accident/incident investigations, and (IX) Drug and alcohol testing.

These various techniques identified in CII's 2002 study are outlined as follows:

I) *Management commitment*: for safety is essential to convey to others in the firm that costs, schedule, and quality do not take priority over safety. This can be demonstrated in a variety of ways. The circumstances may dictate those means that are perhaps most feasible. The commitment must be sincere and it must somehow be conveyed to the worker level. Without this clear communication, safety performance will very likely be compromised.

II) *Staffing for safety:* requires full-time safety personnel to ensure that the safety needs of the projects are being satisfied. Additional safety personnel will be required when the number of workers is increased. These safety personnel form the core of the training program on the project and they will provide the day-to-day safety support for the field personnel.

III) *Safety planning: pre-project and pre-task:* comprise of site specific safety programs that ensure the projects have a safe start and the pre-task safety plans ensure that the daily tasks are performed with safety integrated into the daily work routine.

IV) *Safety training and education:* should begin with formal jobsite orientation of every worker. As is true in most settings, the learning process is never completed. As time goes by and as jobsite conditions change, it is necessary to provide additional training to workers. This training tends to be focused on the needs of individuals, whether they are field workers, supervisors, or managers.

V) *Worker participation and involvement:* is essentially based on the view that workers are not just a valuable resource to be protected but also a resource that can contribute to achieving the goal of zero accidents. Such involvement can be achieved through

several means, including observations of worker behavior, input through worker safety perception surveys, and by worker participation on safety committees.

VI) *Recognition and reward:* embrace the traditional incentive programs which offers no assurance of good safety performance, some techniques were noted to offer guidance. If incentives are offered, for example, they need not be costly, they should be given often, and they should be based on a specific goal. Good safety performance should also influence evaluations that may directly impact wage increases.

VII) *Subcontractor management:* implies that the safety agenda of the general contractor must extent beyond its own employees. If the safety program is to be effective, it must involve the subcontractors whereby they are included in the orientation training, the drug testing, the safety planning, etc.

VIII) *Accident/incident reporting and investigations:* must be conducted diligently to identify the root causes. Near misses are now included in those events that are to be investigated. These near misses are to be regarded as inexpensive "wake-up calls" that may be instrumental and very valuable in avoiding costly injuries.

IX) *Drug and alcohol testing:* continues to reveal its importance to the achievement of good safety performance. Rehabilitation is currently not widely employed in the industry but may be an area to be given consideration in the future (Hinze, 2002).

The study found that by employing the best practices, construction companies have had beneficial results in terms of safety, cost, and schedule. These nine key topic areas of safety achievement have proven to enhance overall project safety performance.

These preceding studies identified the best safety practices of the early 1990s and early 2000s. It is the purpose of this research to investigate the current safety practices of large

construction firms to identify those best practices that make one firm safer than the next. This study intends to be a follow-up on those earlier studies to revisit those safety measures to ensure the effort in safety performance has not become idle.

Development of an effective Survey

Once the two preceding studies were defined, the identification of ways to write an effective survey was needed in order for quality data to be collected. By establishing an effective survey the goals of this study will be clearly understood by the participants resulting, in the best, most accurate, answers.

Surveys are often conducted simply because it's the only way to get information needed. Alreck and Settle (1995) stated that even when the information is available through other means, survey research may be an easier, quicker, less expensive, or more accurate way to get the required information. The role of a survey can be described as a medium for conversation between two people in a way which the researcher articulates questions to which he or she wants to know the answers.

The first task with any survey is to define the objectives that the study is to answer (Fine, 2006). Once the objectives are specific, the major part of writing a survey is determining what data is needed to be collected. To do this the survey must not only collect the data required, but collect the data in the most accurate way possible. Brace (2004) explains that "this will help determine which type of questions to ask and the type of language to use in order to carry out the 'conversation' with respondents in a way that they will understand and will help them to provide the information that is sought".

Different types of questions will help determine the information that is obtained. The survey should pose questions that are relevant to the objectives of the study and stay away from

questions that are not relevant. The best way to be sure that a question is focused directly on the objectives of the survey is to ask as precisely as possible exactly what the goal for the survey is. In addition, the questions need to be stated in plain, and easy to understand language. If the question is not clear then there is a good chance that the respondent may interpret the question differently than intended.

Alreck and Settle (1995) stated that an effective survey will avoid leading questions. A leading question is one that attempts to guide the respondent's answer in a particular way. As well as avoiding leading questions, the survey should avoid long questions (Brace, 2004). Long questions tend to cause boredom in the respondent, leading to higher levels of respondent's abandonment of the survey.

An important part of any survey is to inform the respondents of the survey's end date (Fine, 2006). By encouraging the respondents to complete the survey as soon as possible, the opportunity for the analysis of data will happen even quicker. Alreck and Settle (1995) stated that the last item any survey should include is an expression of gratitude to the respondents who spend the time to take the survey. Furthermore, as a general rule for any survey, keep it short, simple, and to the point.

Analysis of data

Brace found (2004) that "a survey that is going to provide accurate, good-quality information needs to be thought about and planned, before a single question is written." The questions asked of respondents are the ultimate foundation of the survey. They are the elements that perform the actual examination of the respondents. When generating questions it is important for data to be collected and analyzed in the way that is required for an accurate breakdown of information. The questions are the most essential component of the survey and the

validity of the results relies heavy on the way the questions are articulated (Fine, 2006). Survey questions can be generated and information can be analyzed in many different ways.

Alreck and Settle (1995) stated that effective survey questions have three important attributes: focus, conciseness, and simplicity. Every question in the survey should focus directly on a single, specific issue. A well-crafted survey question is asked in a variety of ways. There are two basic types of survey questions to choose: open-ended and closed-ended (Waddington, 2000).

Open-ended "unstructured" questions are questions to which there is not one definite answer. The responses require some thought and some details to reasonably answer the question. The answers don't indicate the range along which respondents should answer. Alreck and Settle (1995) stated that these responses can be very useful, often yielding quotable material, however the drawback is that the responses are more difficult to interpret, and seldom comparable.

The analysis of the responses can be difficult, time consuming, and relatively expensive. To analyze the responses, a procedure known as "coding" is used (Brace, 2004). Manual coding requires a sample of the answers to be examined and the answers grouped under commonly occurring themes, usually known as a "code frame". Code framing is a slow and labor-intensive process. Many researchers use computerizing coding systems to analyze data; however these systems are costly to operate.

Dillion (1997) states that open-ended questions are used for a number of reasons:

- Tell you what the responded considers being important.
- Have maximum latitude to speak freely.
- Share more than just facts.

Open-ended questions have a tendency to be easier to be formulated, and harder to analyze, where as closed-ended questions are harder to be formulated and easier to be analyzed (Brace, 2004). It takes time and effort to compose closed-ended questions where it takes only a few minutes to compose open-ended questions. There is a tendency for the researcher to hurry the composition task and worry about editing and coding later, after the data have been collected as stated by Alreck and Settle (1995).

Closed-ended "structured" questions are questions that have a finite set of answers. They ask a question and they list the alternative answers the respondent might choose. Waddington (2000) stated that "the benefit of closed-ended questions is that they are easy to standardize, and data gathered from closed-ended questions lend themselves to statistical analysis."

Alreck and Settle (1995) stated that experienced researchers prefer to use structured questions whenever they're feasible because they have many important advantages. The meaning of the closed-ended question must be completely clear to all the respondents. "It takes considerable time and effort to compose a closed-ended question; however if done carefully and thoroughly, it will save time and effort later and increase the reliability and validity of the data." (Fine, 2006)

One of the most commonly used approaches to measuring attitude is the itemized rating scale, specifically the Likert scale. The Likert scale is a rating scale which utilizes an interval scale on which respondents are asked a series of attitude dimensions (a battery), for each of which they are asked whether, and how strongly, they agree or disagree, using one of a number of positions on a five-point scale (Brace, 2004). A major advantage of this scale is the ability to obtain a summated value. This type of rating scale provides a straightforward way of asking

attitudinal information that is easy and versatile to analyze, and that provides comparability across time (Brace, 2004).

Conclusion

The purpose of the review of literature was to examine available information and relevant studies that related to construction safety. The information gathered from the literature review provided an outline of a variety of effective safety techniques that construction companies are implementing. The literature review also gave details on how to write an effective survey and how to analyze data from specific sets of questions. The next chapter includes the methodology in which the study was conducted.

Chapter III: Methodology

Research has shown that the development and implementation of effective safety programs reduces accidents (Smith and Roth, 1991). Project safety is an issue which is supported by everyone in concept. Unfortunately, when it comes to spending time and money on safety, many people do not feel it is vital to the success of their projects. The purpose of this research is to investigate the current safety practices of large construction firms to identify those best practices that make one firm safer than the next. This research is intended to be a follow-up on a study that was conducted in the early 1990s by the Construction Industry Institute (CII). The 1990s study defined measures needed to be taken in order to achieve safety excellence. This research intends to revisit those measures to ensure the effort in safety performance has not become idle.

Subject Selection and Description

To accomplish the objective of this study, a survey was set up to gather information of those safety practices that influenced safety performance. Thus, the gathering of information and an analysis sought to identify those safety practices that were significantly related with safety performance. Safety performance was measured in terms of the number of OSHA recordable injuries incurred per 200,000 hours of worker exposure ("*General recording criteria,*" n.d.).

The survey instrument was a self written combination of a compilation of questionnaires to get the data appropriate for the research. The survey asked questions about the best practices suggested by the 2002 CII study. The survey covered all nine groups suggested by the CII study. The survey was sent out to 44 members or prospective members of the University of Wisconsin – Stout Construction Program Advisory Board during March 15th – 27th in 2009. These members

or prospective members were asked to forward this survey to their safety specialist to have them complete it.

The target number of responses to the survey was 20 replies. All questions were addressed to the safety specialist of those construction companies.

Instrumentation

A copy of the survey instrument can be found in Appendix B. The survey instrument consisted of the following information:

1. The purpose of this study was to identify the current safety practices that were being implemented, particularly by those firms with the better safety records.
2. For the study, the research instrument was comprised of 10 questions.
3. Several of the survey questions that were asked could be answered by a short answer, with a "yes" of "no" response, with an open-ended question to elaborate on their choice for response.
4. The majority of the survey questions included an itemizing rating list which involved rating items on a scale of 1 to 5 to obtain people's position on certain safety techniques, specifically the Likert scale. Likert scales help to state the issue and obtains the respondents' degree of agreement or disagreement.
5. The remaining questions involved using structured items requesting information that was mostly numerical in nature. Asking information about the companies OSHA 300 forms of the past four years to identify trends in safety performance over the years.

The first main portion of the survey that was collected included questions which covered some project-related safety issues specifics such as: Management commitment to safety, written safety programs, safety inspections/audits, safety education and training, planning for safety,

safety incentives, drug testing, accident/incident investigations, and safety meetings for supervisors.

The last main portion of the survey included questions reflecting current trends in the construction safety practices of large construction firms such as: Safety performance of the firm, including worker hours expended and the number of near misses, OSHA recordable injuries, and OSHA lost time injuries.

This survey instrument and study was reviewed and approved by the University of Wisconsin – Stout's Institutional Review Board (IRB). They determined that the study meets the ethical obligations required by federal law and University policies. The respondents' names weren't included on any documents linking information back to them, nor could they be identified from any of the information presented in the findings. They were completely anonymous and their responses were confidential.

Data Analysis

In order to address the research goals of this study, relevant descriptive and analytical statistics was used to analyze the appropriate data. The three main categories of questions asked in the survey are outlined as follows: short answer questions with a simple "yes" of "no" response together with an open-ended question to elaborate on their choice for response, itemizing rating list questions, and structured item questions requesting information that was mostly numerical in nature.

With the aim to analyze several of the survey questions that were open-ended, the questions were designed to ask the responded to solicit opinions with minimal interference or interpretation of a desired outcome from the survey questionnaire. The most frequent responses

would be pooled together to indicate a strong correlation of those particular safety practices that are considered effective safety techniques.

By the means necessary to interpret the survey questions that were created using an itemized list, the numerical values were applied to a Likert scale, in order to administer analytical statistics on the data. The numerical scores assigned were 5 – High importance; 4 – Moderate importance; 3 – Neutral; 2 – Little importance; 1 – Low importance.

The values indicated from the nominal scale will indicate a particular percentage for the items. Those percentages will be compared to each other and the noteworthy percentages that are at the 4 – Moderate importance, and the 5 – High importance level will indicate a strong correlation of those particular safety practices that are considered effective safety techniques.

The remaining survey questions were specifically related to numerical information. The questions asked information about the companies OSHA 300 forms of the past four years. This was done to identify trends in safety performance over the years. An analysis of variance will be applied to the data collected. Anderson, Sweeney and Williams (1993) stated that "the variance is based on the difference between each data value and the mean, therefore the analysis of variance is an analysis of the variation in the outcomes of an experiment to assess the contribution of each variable to the variance".

The numerical values for each year will be collected from the survey and entered on a spreadsheet. Mean and range values were calculated to identify trends in the current safety practices. The spreadsheet will indicate the current trends in how effective these safety techniques have impacted the construction industry.

Chapter IV: Results and Discussion

Construction is one of the most dangerous occupations in the U.S (Mroszczyk, 2009). The number of construction fatalities is unbalanced to the size of the workforce. Construction makes up only 5.5% of the workforce, yet experiences 21.5% of the fatalities. There are 1,226 fatalities and 200,000 serious injuries each year (BLS, 2008). That's about 100 workers killed and more than 16,000 injuries every month.

Purpose of the Study

It is the purpose of this research to investigate the safety practices of large construction firms to identify those best practices that make one firm safer than the next.

Goals of the Study

This study sought answers to the following research questions:

1. What are the different approaches companies have for their safety practices?
2. What do the company's feel are the most significant in terms of rating their safety practices?
3. Are the safety practices the same as they were more than 15 years ago?

Presentation of collected Data

For the study of large construction firms, the research instrument was a three-page survey containing 10 questions. The survey to identify safety practices in large construction firms was sent out to the 44 members or prospective members of the University of Wisconsin – Stout Construction Program Advisory Board. The target number of responses to the survey was 20 replies, a total of 25 replies were received. Some of the completed surveys contained only portions of the information requested, most notably excluding information about their OSHA 300 forms. Also, three requests to take the surveys were returned due to an "out of the office"

response by the individuals asked to participate in the survey. The surveys were sent out on March 17, 2009 and the replies were received through the end of March 2009.

Results

The methodology used to collect the data included a three category questionnaire. The three main categories of questions asked in the survey are outlined as follows: itemizing rating list questions, short answer questions with a simple "yes" of "no" response together with an open-ended question to elaborate on their choice for response, and structured item questions requesting information that was mostly numerical in nature.

Category One

The first category was designed to utilize an itemizing rating list with the intent to comprise comparable data obtained from the respondents' position on certain issues relating to current safety techniques. The respondents were asked to rate the level of top management support the safety department receives. The results are identified in Table 1.

Table 1: Management Support

Rating Order	Response Total	Response Percent
1 - No Support	0	0%
2 - Low Support	0	0%
3 - Moderate Support	1	4%
4 - Strong Support	8	31%
5 - High Support	17	65%

The other rating question designed to make use of an itemizing rating scale was based on the respondent's answers to how important certain safety attributes that were identified in the

CII's 2002 study were important to safety performance (see Table 2). Most of the respondent's replies were in the four to five scale ranges.

Table 2: Safety Attributes Rating

	Unimportant 1	Of Little Importance 2	Moderately Important 3	Important 4	Very Important 5
Management commitment to contractor safety	0%(0)	0%(0)	4%(1)	12%(3)	84%(21)
Safety Education: orientation and specialized training	0%(0)	4%(1)	0%(0)	28%(7)	68%(17)
Staffing for safety on projects	0%(0)	4%(1)	20%(5)	40%(10)	36%(9)
Worker evaluation and recognition/rewards programs	0%(0)	12%(3)	28%(7)	24%(6)	36%(9)
Planning: pre-project and pre-task	0%(0)	0%(0)	4%(1)	16%(4)	80%(20)
Worker involvement	0%(0)	0%(0)	12%(3)	16%(4)	72%(18)
Overall accident/incident investigations workday case	0%(0)	0%(0)	8%(2)	38%(9)	54%(13)
Overall drug and alcohol testing	4%(1)	4%(1)	8%(2)	48%(12)	36%(9)
Safety meetings for supervisors	0%(0)	4%(1)	4%(1)	24%(6)	68%(17)

In conjunction with rating the safety attributes, an open-ended question was composed to identify which of the previous safety attributes have the biggest positive impact on the company's safety program (see Appendix C for all the raw data). The respondents have identified the following to be the biggest positive influences in their own safety programs: management commitment to contractor safety, safety education: orientation and specialized

training, planning: pre-project and pre-task, worker involvement, and safety meetings for supervisors. (see Figure 1)

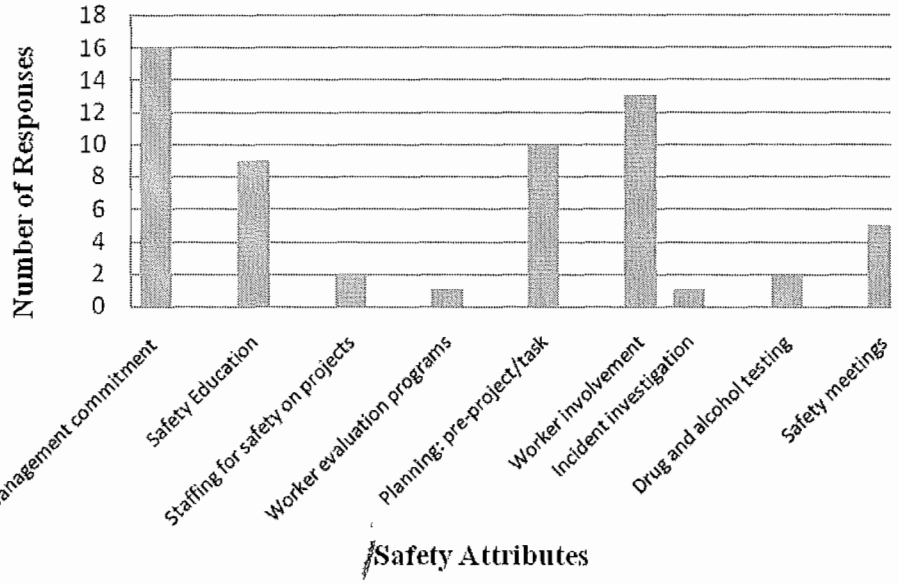


Figure 1. Biggest Positive Influences

Category Two

The second category of the questionnaire was designed to ask open-ended questions with the aim for the respondent to elaborate on the choice they made for short answer questions that were a simple "yes" of "no" response. It was the intent to let the respondents give some wide range of answers to the questions that were semi-structured so that the most probable answers could be generally manageable and put into meaningful categories for easy analysis.

The respondents were asked if there were any changes in their company in the past four years that have significantly impacted the safety performance of the company, and 80% of the respondents replied "yes" (see Appendix D for all the raw data). The respondents identified there were many changes made that impacted their safety performance; however there were three safety attributes that stood out among the nine key safety attributes. Those attributes included: planning: pre-project and

pre-task, worker involvement, and overall accident/incident investigations. The responses to the question are identified in Figure 2.

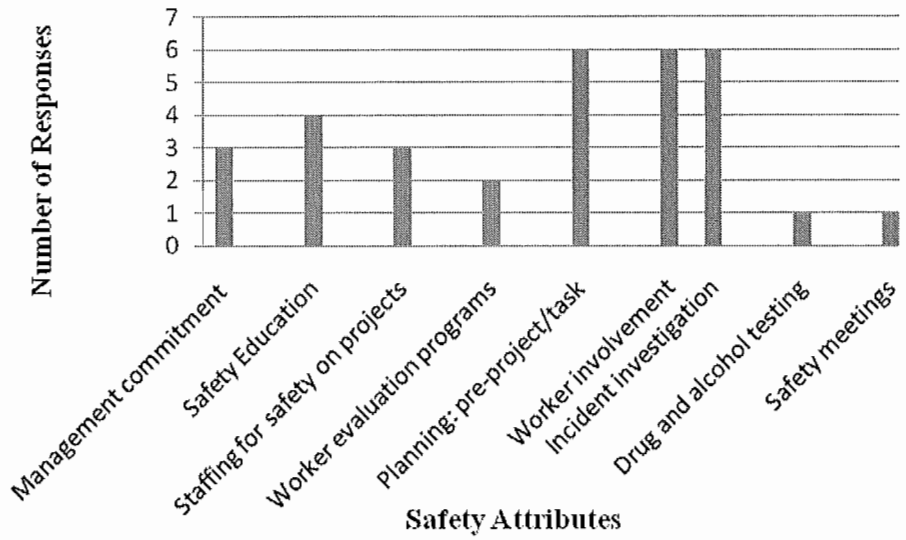


Figure 2. Changes in Company Safety

The respondents were asked if their company conducts field safety inspections or audits on jobs in progress, to which 100% of the respondents replied "yes". There was a follow-up question which asked to identify who conducts the field safety inspections or audits. The objective of this question was to identify the kind of involvement companies are getting in their safety program (see Appendix E for all the raw data).

The respondents identified a wide range of individuals that were responsible for conducting safety inspections/audits on jobs in progress. The individuals identified included: corporate safety directors, corporate management, safety committees, safety specialist, project managers, field superintendents, field engineers, foreman, and craft workers. There were a whole host of people identified, but the most often identified as the person responsible for the safety inspections/audits was the safety specialist.

Category Three

The third category of the questionnaire was designed to ask a structured item question requesting information that was mostly numerical in nature. The question gathered significant background information on the OSHA 300 Form, which includes data relating to every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid.

The numerical values were collected to calculate the mean (see Figure 3) and range values (see Figure 4) for every each year to identify trends in the current safety practices. The trends will indicate how effective the current safety techniques have impacted the construction industry.

The mean recordable case rate dropped from a 4.38 to a 2.8 from the years 2005 to 2008. That was a drop of a 1.58 recordable rate in those four years.

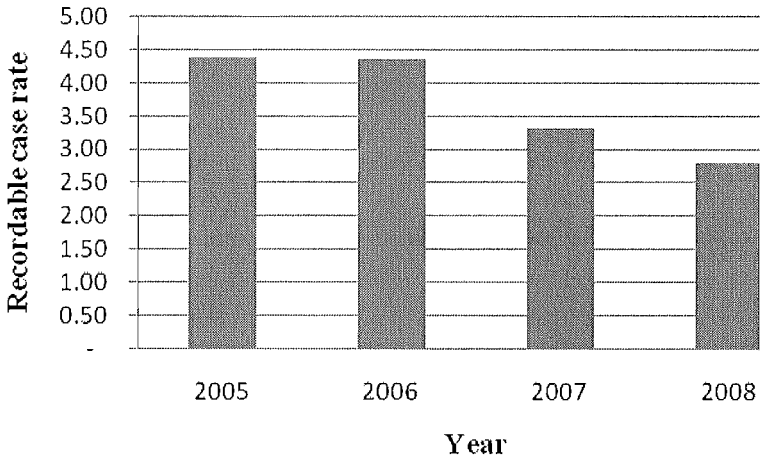
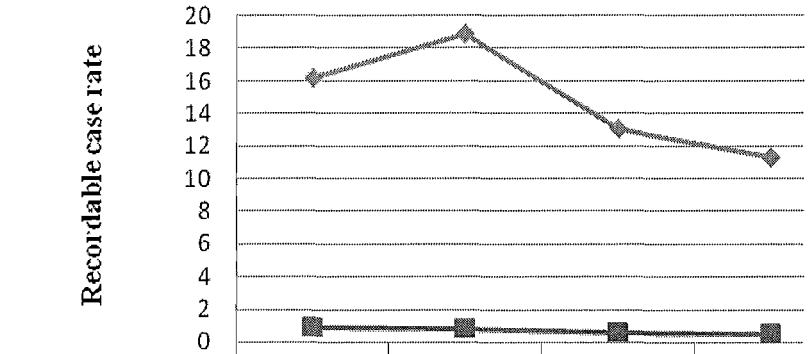


Figure 3. Mean values of recordable case rate

The range of recordable case rate dropped from a 15.25 to a 10.77 from the years 2005 to 2008. That was a drop in range of a 4.48 recordable rate in those 4 years. This range indicated in Diagram 4 not only identifies a drop in rate, it also acknowledges a drop in the upper limit rate

from a 16.15 recordable case rate down to an 11.28 recordable case rate. That was a drop in case rate of 4.87 in those for year.



	2005	2006	2007	2008
Maximum value	16.15	18.86	13.03	11.28
Maximum value	0.9	0.85	0.56	0.51

Figure 4. Range of recordable case rates per year

Chapter V: Conclusions and Recommendations

"Over the years, the construction industry has had among the highest rates of reported work-related deaths and injuries," as stated by Pollack and Chowdhury (2001). With the continuing high work-related death and injuries, the identification of safety practices may help reverse these high rates. Therefore, it was the purpose of this research to investigate the safety practices of large construction firms to identify those best practices that are successful in accomplishing low injury rates which make a difference in safety performance to move individual construction projects toward the goal of zero accidents. This research was intended to be a follow-up on a study that was conducted in the early 1990s by the Construction Industry Institute (CII). The 1990s study defined measures needed to be taken in order to achieve safety excellence. This research intended to revisit those measures to ensure the effort in safety performance has not become idle.

The goals of this study were to:

1. Recognize the different approaches companies have for their safety practices.
2. Analyze the position companies are taking in terms of rating their safety practices in order to identify the most significant.
3. Examine current safety practices to identify if they are the same as they were more than 15 years ago.

This chapter will first present the conclusions from the findings discussed in Chapter IV. Besides presenting a list of the top five major safety techniques which highly contribute to excellent safety performance, this section of the chapter will also further explain some information on what are the more important aspects of each technique and identify those techniques which are not as significant in contributing to excellent safety performance. The

second part of this chapter will include recommendations not only relating to this research but also for future studies on construction safety.

Conclusions

The results collected by the researcher shows clear indication that efforts to improve safety performance are not idle. The results have identified five major safety techniques which have highly contributed to excellent safety performance, which are identified as follows:

1. Management commitment to contractor safety
2. Safety planning: pre-project and pre-task
3. Worker involvement
4. Safety education: orientation and specialized training
5. Overall accident/incident investigations

An effective safety program should include all of these in order to attain the goal of zero accidents, and to reduce direct and indirect costs associated with injuries thus resulting in a higher profit margin and a more effective competitive position in the construction industry.

Discussion

The five preceding techniques are presented in more detail for clarification:

1. *Management commitment to contractor safety:* Liska et al (1993) stated as part of management commitment to contractor safety all of top management down to line supervisors must express that safety of the workers are to be managed in the same way as quality, and productivity. Without this clear commitment, safety performance will very likely be compromised.

2. *Safety planning: pre-project and pre-task:* As part of safety planning: pre-project and pre-task, site specific safety programs ensure the projects have a safe start and daily tasks are performed with safety integrated into the daily work routine (Hinze, 2002).
3. *Worker involvement:* As part of worker involvement all workers are not just viewed as an asset that should be protected, be as a valuable resource that gives input on how to contribute to the goal of zero accidents. Such input on project safety includes the participation on safety committees, input through safety surveys, and hazard analysis procedures on the workplace safety (Hinze, 2002).
4. *Safety education: orientation and specialized training:* As part of safety education orientation and specialized training all workers should be given an explanation of the projects commitment to safety and the company's rules and site requirements to eliminate workers injury. Topics for training include Cardio Pulmonary Resuscitation (CPR), first aid, fall protection, and drug testing (Hinze, 2002).
5. *Overall accident/incident investigations:* As part the overall accident/incident investigation program all jobsite accidents/incidents must be reported to management in order to examine the root cause of those accidents. Results of these investigations are communicated to all employees in order to prevent future occurrences (Hinze, 2002).

While some techniques will not be implemented in exactly the same manner, the general objective of these techniques will not be different. These top five safety techniques have positively impacted the recordable case rates of those construction companies that have integrated them into their safety program for the past four years. The trends discussed in Chapter

IV show the mean recordable rates dropped from a 4.38 to a 2.8 from the years 2005 to 2008. That was a drop of a 1.58 recordable rate in those four years by implementing these techniques.

Whereas those top five safety techniques have positively impacted the construction industry's recordable case rates, there were a few techniques which were not of significant importance when it comes to impacting the recordable case rate. These include: staffing for safety on projects, worker evaluation and recognition/reward programs, overall drug and alcohol testing, and safety meetings for supervisors.

Recommendations

The researcher recommends that the construction industry examine the research results and implement the top five safety techniques that would not only result in an effective comprehensive safety program, but also lead to the lowering of recordable case rates.

Some of the safety techniques that were not of positive influence for construction companies (i.e. staffing for safety on projects, worker evaluation and recognition/reward programs, overall drug and alcohol testing, and safety meetings for supervisors) should be avoided since they received low responses as of the respondents. The techniques noted above make the difference between an excellent safety program that achieves zero accidents to one that is not as good.

Recommendations Related to This Study

Some of the surveys that were returned contained only portions of the information requested, most notably excluding information about their OSHA 300 forms. It is recommended to find a better way to get more responses to such request.

The researcher also would point out that, although this survey project was limited to the University of Wisconsin Stout Construction Program Advisory Board, it is recommended to

distribute this survey to a wide population of construction companies to find if safety is implemented differently for other construction firms.

The researcher would note that, although additional information on more construction firm's OSHA 300 form, and a wider population of construction firm's would have been helpful, the survey instrument nevertheless accomplished its goal by revealing safety techniques as rated to construction safety.

Recommendations for Further Study

If future studies are conducted pertaining to safety techniques, there are two areas on relevance. Firstly, the researcher recommends this type of study be repeated occasionally, perhaps every five years, to make clear that efforts to improve safety performance are not idle. The other study the researcher recommends would include a more detailed investigation of a specific safety technique to determine the best way to implement that technique.

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Appendix A: Human Research Subject Consent Form

Title: Identification of the Best Practices in the Construction Industry to Attaining Zero Accidents

Investigator:
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Research Sponsor:
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University of Wisconsin-Stout
P.O. Box 790
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(715) 232-5178

Description:
The objective of this research is to investigate the safety practices of large construction firms to identify those practices that make one firm safer than the next. This research is intended to be a follow-up on a study that was conducted in the early 1990s by the Construction Industry Institute (CII). The 1990s study defined measures needed to be taken in order to achieve safety excellence. This research intends to revisit those measures to ensure the effort in safety performance has not become idle.

Risks and Benefits:
There are no risks to the subjects for the voluntary participation in this survey. In most cases the information asked in this survey is required to be displayed to the public.

By identifying methods and practices that have proven effective in reducing accidents, the construction community will be provided with guidance for the effective means to achieve the zero accident objective.

Time Commitment:
Your time commitment in the participation in this study will be approximately 20 minutes.

Confidentiality:
Your name will not be included on any documents. I know that you can not be identified from any of this information. This informed consent will not be kept with any of the other documents completed with this project.

Right to Withdraw:
Your participation in this study is entirely voluntary. You may choose not to participate without any adverse consequences to you. Should you choose to participate and later wish to withdraw from the study, you may discontinue your participation at this time without incurring adverse consequences.

IRB Approval:
This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

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Statement of Consent:
By completing the following survey you agree to participate in the project entitled, Identification of the Best Practices in the Construction Industry to Attain Zero Accidents.

Appendix B: Survey Instrument

This project has been reviewed by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46

1. How would you rate the level of support the safety department receives from top management? 1 being "Poor Support" and 5 being "Outstanding Support"

   1 2 3 4 5

2. Do you have a written company safety program plan?

	Yes	No	N/A
A. For your own employees?	____	____	____
B. For your subcontractors?	____	____	____

3. If you answered "Yes" for question "B", skip this question, however if you answered "No", do you require subcontractors to have their own safety program that you review prior to awarding work to them?

   Yes ____ No _____

4. Do you conduct formal field safety inspection or audits on jobs in progress?

   Yes ____ No _____

5. If you answered "Yes" for question 4, please indicate who conducts the inspections/audits on the projects?

   _____

   _____

6. To complete this portion of the survey please follow the instructions noted below:
   1. First read all items listed below. 2. Then please rate the items on a scale of 1 to 5 with regards to how important you feel they are towards effective safety performance. With 1 being "low" and 5 being "high".

   _____ Management commitment to contractor safety
   _____ Safety education: orientation and specialized training
   _____ Staffing for safety on projects
   _____ Worker evaluation and recognition/reward programs

_____ Planning: pre-project and pre-task

_____ Worker involvement

_____ Overall accident/incident investigations workday cases

_____ Overall drug and alcohol testing

_____ Safety meetings for supervisors

7. Of the items listed above, which factors have the biggest positive impact on your company's safety?

_____

_____

_____

8. Are there other changes in safety that your company has made in the past 4 years that have significantly impacted the safety performance on your construction sites?

   Yes ____ No ____

9. If you answered "Yes" to question 8, please indicate those changes to the company.

_____

_____

10. Using information from the OSHA 300 forms, please complete the following table for information regarding the past 4 years:

	2005	2006	2007	2008
Total number of deaths				
Total number of cases with days away from work				
Total number of cases with job transfer or restriction				
Total number of other recordable cases				
Total number of hours work (Field employees only)				
Total recordable case rate				

Appendix C: Biggest Positive Influences in Company's Safety Program

1. Management Commitment to Safety.
2. Worker involvement
3. Drug testing, worker involvement and safety orientation
4. Trust between workers and supervision / management. This is gained through planning, meetings, interaction in the field and in formal setting, communication on all levels, follow through on what supervision and management says they will do, and support. Commitment upfront, proper staffing at the proper time in the project, getting all levels of employees the training and tools they need to be successful, planning the day-to-day work as well as the long term goal planning, ensuring this is properly communicated to all levels, getting input from ALL employees, and constant feedback to include recognition for a job well done and corrections to short-comings.
5. Planning/Pre Task Management commitment
6. Planning, pre-project and pre-task
7. Safety education and pre-planning(pre project construction start)
8. Management commitment and employee involvement
9. Active, VISIBLE involvement of Senior Management on an on-going basis. Accountability for performance of safety tasks, such as conducting effective safety meetings and performing pre-job safety instruction of each work task each day. Having high company standards and expectations
10. Worker involvement and top management support. There has to be full-buy in for the program from all levels.
11. I did not understand what the "overall accident..." refers to so I did not answer.

12. It is a combination of all the above areas that make on Safety program work.
13. Employee involvement
14. Safety education: orientation and specialized training
15. Setting clear safety expectations and giving the employees what they need to succeed--whether it's training, tools, or knowing management will back them when they make good safe decisions.
16. Communication
17. Orientation and training
18. Having supervisors "buy-in" to the safety concept and the trickle-down from that.
19. Management commitment and worker involvement.
20. Management commitment
21. Planning: pre-project and pre-task
22. Our Pre-construction Safety Meetings for High Hazard Work Activities, such as, Steel Erection, Pre-Cast/Tilt-up Erection, Deep Excavation/Trenching > than 20feet, Decking, Roofing Pre-Lift/Pre-pick Plans with crane and/or helicopter and Concrete pours. Along with Weekly/Bi-weekly safety meetings with contractors foreman.
23. Accountability and performance measurements backed by upper management
24. Management Commitment to safety, Safety education: orientation and specialized training, planning: pre-project and pre-task, worker involvement, Overall accident/incident investigations workday cases, safety meetings for supervisors
25. Management Commitment to Safety, Safety Education, Worker Involvement

Appendix D: Impacts on Safety Performance

1. Our Safety Department grew 6 people to 28 people.
2. Return to work program
3. We have adopted an incident and injury philosophy.
4. More refined JSA's (Job Safety Analysis), a growing and developing behavioral based safety process, and better and more clear expectations from all levels.
5. Tying to safety milestones to the schedule prior to starting the job.
6. Minor one in last four years, major 10 years ago with performance measurements
7. We have increased our safety staff
8. This is key: We started working on the safety culture, transforming it from on that tolerated some risk and did not believe that "zero incidents" is possible to one that has a clear expectation of reaching zero and will not tolerate some of the things it did in the past.
9. Participation in OSHA VPP program.
10. Visible change in attitude towards a safe worksite being a profitable work site
11. Safety Task Force, Weekly Safety Meetings, Take 5 for safety, Daily Task Hazard Analyses
12. Getting everyone on the job site involved with safety. Open discussions were anyone can bring concerns to the table without fear of reprisal.
13. We have improved and/or developed better Safety orientation, jobsite expectations, Pre-planning, drug testing, training, etc.
14. Preplanning safety and having supervisors understand that they are ultimately responsible for the safety on their projects.

15. Required gloves to be worn, Daily pre-task planning log books, increased training
16. Pre task meetings
17. Every year we keep adding to our program like near-miss reporting.
18. Our Pre-Construction Agenda meetings have had a significant impact on how we approach work activity on the jobsites and re-writing our safety program, so that, it is more detail oriented to outlining the expectations, responsibilities of each personnel assigned to a project.
19. As the safety culture continues to evolve and improve, programs in general continue to improve and "dig into eth weeds" as well as increased auditing and accountability systems
20. Strong involvement from management and focus on safety education.

Appendix E: Performer of field inspections/audits on jobs

1. Supervisors, and safety Coordinators
2. Project manager and / or safety director…or management
3. Field Superintendents, HSSE representatives, and Project Managers
4. Field safety inspections are conducted in several ways;
    a. Supervisor safety only walks
    b. Formal daily inspections conducted by a cross-section of crafts, management, supervision, and EHS
    c. Weekly safety committee walks with a cross section of craft, supervision, management and EHS.
5. Safety specialist, Employees, Subcontractors and Taskforce (Safety Committee)
6. Project Team members, subcontractors, project safety reps,
7. In most cases our safety director

    On select larger projects we will subcontract to a safety consultant to perform this work.
8. Safety Rep. on larger sites and Superintendents on smaller sites.
9. Everyone from District Manger on down to different levels of frequency.

    District Mgr—quarterly

    Construction/ Operations Manager and HSE Manager—monthly

    Field people (Superintendents, Project Mgrs., Field Engineers, Foreman)—weekly
10. Safety committee members, supervisors, managers, safety department personnel, corporate safety team
11. Daily walk throughs are done by site Superintendent

    PM review of progress pictures

CSM will do safety review during scheduled visit

12. Safety Task Force, made up of Safety Dept, PE, PA, PS, and PMs, company wide
13. Safety Specialist, Committee and Supervision
14. Safety Representative, Safety Captain or Area Safety Manager and Safety Take Force.
15. Safety Director, Project Superintendents, or Field Supervisors
16. Corporate safety and project supt
17. Our safety person who is also a journeyman and also sometimes the project managers
18. Safety Director audits projects once per month minimum. Safety committee members audits 1 jobsite per month
19. Safety Dept members, Field Foreman
20. Safety staff
21. Superintendent does a daily checklist, Project manager does a weekly checklist and safety department also does a week audit.
22. There are several aspects to this question: Inspections are conducted by Site Superintendents and/or Project Managers on a weekly basis, Corporate Safety Coordinators at least once a month, individual subcontractors Safety Directors, Site Safety Committees/monthly, and when used Safety Consultants/ on a weekly to biweekly to monthly basis.
23. Weekly by a project team member (superintendent, safety officer, project engineer). Monthly inspections conducted by safety task force members.
24. Documented safety inspections are typically conducted by our onsite Safety Coordinators, Project Safety Managers, and Regional Health and Safety Managers
25. Construction Sites: PM, Account Manager

Office Locations: Safety Manager, VP of Region, Office Manager, Location Office Safety Representative