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SAFETY ASPECTS IN CONSTRUCTION PROJECTS

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Abstract: The effort of research in this report is a follow-up on a study that was conducted in early 1990s by Construction Industry Institute. The Construction Industry Institute study examines safety strategy of various construction firms to aid in identification of the best practices in construction industry to attain maximum safety. It was important because it identified methods and practices that have proven effective in reducing worker injuries. The Construction Industry Institute study was originally conducted to eliminate all accidents to achieve zero accident objectives. This follow-up uses pattern of Construction Industry Institute study to examine the safety aspects in construction industry in some parts of India.

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 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.

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

An effective safety program should include all of these in order to attain the goal of maximum safety. By obtaining the goal of maximum safety; 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.

Key Words: Safety strategy, Safety, Zero accident, Safety planning, Safety education, Likert scale

I. INTRODUCTION

1.1 GENERAL

Construction is a high-hazard occupation. It continues to be one of the most demanding and dangerous industries in India. 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 Labour 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'sCompensationlosses 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 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." 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 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." The construction sector is the second largest employer in India; however, according to Hämäläinen et al. (2010), accident statistics of the Indian construction sector are not properly and regularly published. Therefore, they are not easily available. However, it is expected that many fatal and non-fatal accidents would be happening in Indian construction due to its characteristics such as dynamic nature and involvement of many stakeholders including migrated labours in a project, and a less controlled environment. There is a system prescribed for compiling and recording these statistics the implementation at every places in country is not done in full seriousness. According to Zhou et al. (2015), this is one of the reasons for not conducting sufficient research on construction safety in India.

1.2 STATEMENT OF THE PROBLEM

Every day some 950 people die and over 720,000 workers get hurt because of occupational accidents. Annually, over 48,000 workers die because of occupational accidents in India. In Indian construction sector, the number of people dying in construction could be anywhere from 11,500 to 22,000. 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.

1.3 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. 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.

1.4 RESEARCH QUESTIONS

This study sought answers to the following research questions:

- What are the different approaches companies have for their safety practices?
- What do the company's feel are the most significant in terms of rating their safety practices?
- Are the safety practices the same as they were more than 30 years ago?

1.5 LIMITATIONS OF THE STUDY

The limitations for this study are:

- 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.
- 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.
- 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.

II. 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. 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.

2.1 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, "). 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 Construction Industry Institute study. The survey covered all nine groups suggested by the Construction Industry Institute study. All questions were addressed to the safety specialist of those construction companies.

2.2 INSTRUMENTATION

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

- 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.
- For the study, the research instrument was comprised of 10 questions.
- 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.
- 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.
- 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.

2.3 DATA ANALYSIS

In order to address the research goals of this study, relevant descriptive and analytical statistics was used to analyse 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 analyse 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 spread sheet. 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.

2.3 DATA COLLECTION

- National and International Journals
- Websites of Government Departments and Private Bodies
- Leading newspapers
- Online search engines

QUESTIONNAIRE

Appendix A

How would you rate the support level the safety department receives from top management?

1 being "Poor Support" and 5 being "Outstanding Support"

1 2 3 4 5

Do you have a written company safety program plan?

Yes No N/A

A. For your own employees? __
B. For your subcontractors? __

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

Do you conduct formal field safety inspection or audits on

jobs in progress?

Yes No

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

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

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

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

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

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

	2014	2015	2016	2017
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 per day (Field employees only)				
Total recordable cases				

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

- Management Commitment to Safety.
- Worker involvement
- Drug testing, worker involvement and safety orientation.
- Trust between workers and supervision / management. This is gained through planning, meetings, interaction in the field and in formal setting, communication on all levels, follows 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.
- Planning/Pre Task Management commitment
- Planning, pre-project and pre-task
- Safety education and pre-planning(pre project construction start)
- Management commitment and employee involvement
- 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.
- Worker involvement and top management support. There has to be full-buy in for the program from all levels.
- I did not understand what the "overall accident" refers to so I did not answer.
- It is a combination of all the above areas that make on Safety program work.
- Employee involvement
- Safety education: orientation and specialized training
- 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.
- Communication
- Orientation and training
- Having supervisors "buy-in" to the safety concept and the trickle-down from that.
- Management commitment and worker involvement.
- Management commitment
- Planning: pre-project and pre-task
- 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.

- Accountability and performance measurements backed by upper management
- 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
- Management Commitment to Safety, Safety Education, Worker Involvement

Appendix C:

Impacts on Safety Performance

- Our Safety Department grew 5 people to 19 people.
- Return to work program
- We have adopted an incident and injury philosophy.
- More refined JSA's (Job Safety Analysis), a growing and developing behavioural based safety process, and better and clearer expectations from all levels.
- Tying to safety milestones to the schedule prior to starting the job.
- Minor 2 in last four years, major 8 years ago with performance measurements
- We have increased our safety staff.
- 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.
- Participation in OSHA VPP program.
- Visible change in attitude towards a safe worksite being a profitable work site
- Safety Task Force, Weekly Safety Meetings, Take 5 for safety, Daily Task Hazard Analyses
- Getting everyone on the job site involved with safety. Open discussions were anyone can bring concerns to the table without fear of reprisal.
- We have improved and/or developed better Safety orientation, jobsite expectations, Preplanning, drug testing, training, etc.
- Preplanning safety and having supervisors understand that they are ultimately responsible for the safety on their projects.
- Required gloves to be worn, Daily pre-task planning log books, increased training
- Pre task meetings
- Every year we keep adding to our program like near-miss reporting.
- 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.
- 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
- Strong involvement from management and focus on safety education.

Appendix D:

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;
   - Supervisor safety only wales
   - Formal daily inspections conducted by a cross-section of crafts, management, supervision, and EHS
   - 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 through 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, P A, 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 superintendent.
17. Our safety person who is also a joumey man 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

III. RESULT & DISCUSSION

Construction is one of the most dangerous occupations in the India (K.B Sharma, 2009). The number of construction fatalities is unbalanced to the size of the workforce. Construction sector is the second largest employer in India. In Indian construction sector, the number of people dying in construction could be anywhere from 11,500 to 22,000. Considering the minimum estimate of fatal accidents, i.e. 11,500, Indian construction sector alone adds 23.95% (=11,500*100/48,000) fatality in the total 48,000 occupational accidents occurring annually in India. There are 1,226 fatalities and 200,000 serious injuries each year (BLS, 2008). That's about 100 workers killed and more than 1600 injuries every month.

3.1 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.

3.2 GOALS OF THE STUDY

This study sought answers to the following research questions:

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

3.3 PRESENTATION OF COLLECTED DATA

For the study of large construction firms, the research instrument was a survey containing 10 questions. The survey to identify safety practices in large construction. The target number of responses to the survey was 20 replies, a total of 26 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 June 2018 and the replies were received through the end of June 2018.

3.4 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.

3.4.1 RESULT FOR APPENDIX: A

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.

TABLE.1 MANAGEMENT SUPPORT

	Rating Order	Response Total	Response Percent
1	No Support	0	0%
2	Low Support	2	7.7%
3	Moderate Support	5	19.2%
4	Strong Support	12	46.2%
5	Outstanding	7	26.9%

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 range

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)	3.84%(1)	11.54%(3)	30.77%(8)	53.85%(14)
Safety Education: orientation and specialized training	0%(0)	3.84%(1)	34.62%(9)	30.77%(8)	30.77%(8)
Staffing for	0%(0	3.84	23.0	34.	38.46

safety on projects	)	%(1)	8%(6)	62 %(9)	%(10)
Worker evaluation and recognition/rewards programs	0%(0)	19.2 3%(5)	30.7 7%(8)	26. 92 %(7)	23.08 %(6)
Planning: pre-project and pre-task	0%(0)	0%(0)	7.69 %(2)	15. 38 %(4)	76.92 %(20)
Worker involvement	0%(0)	0%(0)	15.3 8%(4)	23. 08 %(6)	61.54 %(16)
Overall accident/incident investigations workday case	0%(0)	0%(0)	3.84 %(1)	15. 38 %(4)	80.77 %(21)
Overall drug and alcohol testing	38.46 %(10)	23.0 8%(6)	15.3 8%(4)	15. 38 %(4)	7.69% (2)
Safety meetings for supervisors	0%(0)	15.3 8%(4)	11.5 3%(3)	23. 08 %(6)	50.00 %(13)

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.

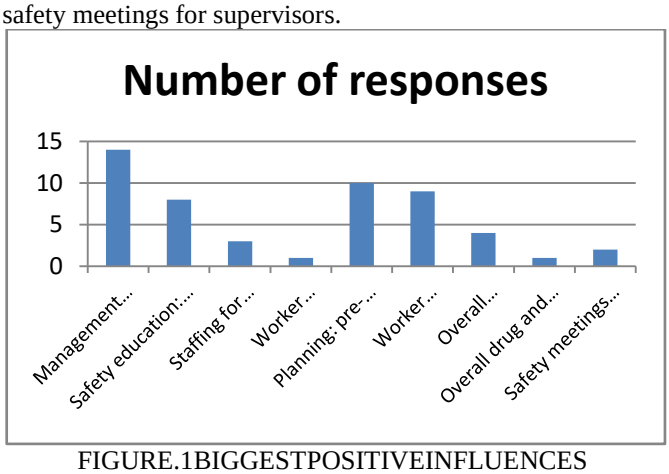

FIGURE.1BIGGESTPOSITIVEINFLUENCES

3.4.2 RESULT FOR APPENDIX : B

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 65.38% of the respondents replied "yes". The respondents identified there were many changes made that impacted their safety performance; however there were four safety attributes that stood out among the nine key safety attributes. Those attributes included: Safety education: orientation and specialized training, planning: pre-project and pre-task, worker involvement, and overall accident/incident investigations. The responses to the question are identified in Figure.

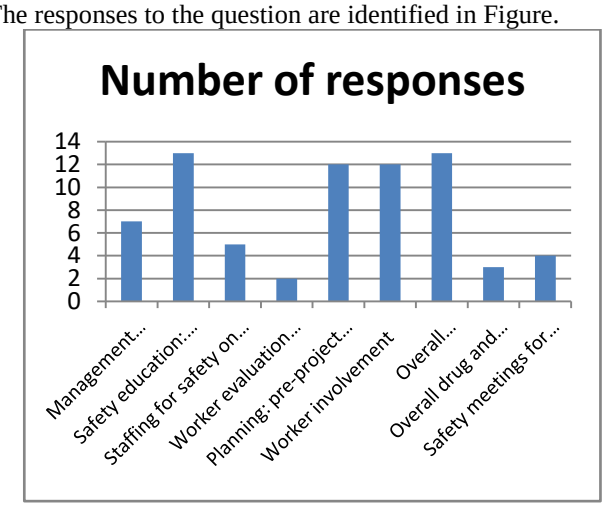

FIGURE.2. CHANGES IN COMPANY SAFETY

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. 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, and 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.

3.4.1 RESULT FOR APPENDIX: C

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 and range values 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.

TABLE.3 OVERALL DATA COLLECTED ON OSHA 300 FORM

	2014	2015	2016	2017
Total number of deaths	12	9	10	06
Total number of cases with days away from work	44	35	30	32
Total number of cases with job transfer or restriction	20	16	10	09
Total number of other recordable cases	55	43	37	33
Total number of hours work per day (Field employees only)	8	8	8	8
Total recordable cases	131	103	87	88

The mean recordable case rate dropped from a 32.75 to a 22.00 from the years 2014 to 2017. That was a drop of a 10.75 recordable rate in those four years.

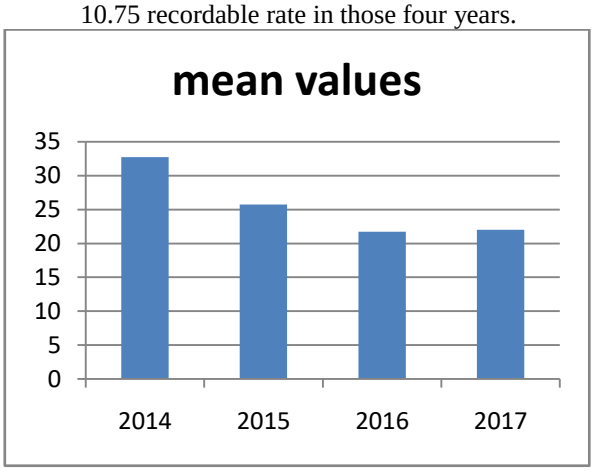

FIGURE 3. MEAN VALUES OF RECORDABLE CASE RATES

IV. CONCLUSION

4.1 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:

- Management commitment to contractor safety
- Safety planning: pre-project and pre-task
- Worker involvement
- Safety education: orientation and specialized training
- 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.

4.1.1 Discussion

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

- Management commitment to contractor safety:
  Liska et a1 (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.
- 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).
- 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).
- 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).
- 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 show the mean recordable

rates dropped from a 32.75 to a 22.00 from the years 2014 to 2017. That was a drop of a 10.75 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.

4.2 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 programs that achieves zero accidents to one that is not as good.

4.2.1 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.

4.3 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.

REFERENCES

[1] Aksorn, Thanet &Hadikusumo, B.H.W. (2007). Gap Analysis Approach for Construction Safety Program Improvement. Journal of Construction in Developing Countries. 12, 77-97.

[2] Census of Fatal Occupational Injury Summary, 2010 Technical information: (202)691-6170 iifstaff@bls.gov

[3] www.bls.gov/iif/oshcfoil.htm.

[4] Brace, Ian (2004). Questionnaire Design: How to plan, structure and write survey material for effective market research. Sterling, Virginia: Kogan Page Limited.

[5] Bureau of Labor Statistics (BLS), U.S. Department of Labor, Career Guide to Industries, 2008-09 Edition, Construction, on the Internet at http://www.bls.gov/oco/cg/cgs003.htm (visited January 27, 2009).

[6] Eich, William. (1996) Safety Practices of Large Construction Firms, Master's Thesis, University of Washington.

[7] Makim, A,-M.,Winder, C. Managing hazards in workplace using organisational safety management system: A safe place, safe person and safe systems approach journal of risk research 2009.12: 329-343.

[8] Fine, Dana (2006). 14 Tips for Writing an Effective Online Survey. Retrieved March 19,2009,from knol: A unit of knowledge Web site: http://www.esurveys.com/surveyarticles/ survey-writing -tips/writing-effective-online-surveys-060413/page l.html

[9] Hinze, Jimmie (1997). Construction Safety. Saddleback, NJ, Prentice-Hall, Inc.

[10] Hinze, Jimmie (2002). Making Zero Accidents a Reality. CII Research Rep. 160-11, the University of Texas at Austin, EEUU.

[11] Hinze, J.Raboud, P. (1988). Safety on Large Building Construction Projects. Journal of Construction Engineering and Management, 114(2), 286-293.

[12] Hinze, J. & Wilson, G. (2000). Moving Towards a Zero Injury Objective. Journal of

[13] Construction Engineering and Management. 399-403..

[14] Hunt, R.J. (2004). Best practice utilization: A case study in a zero-injury culture. IRMI, Retrieved January 20,2009,

[15] Liska, R. W., Goodloe, D., &Sen, R. (1993). Zero Accident Techniques. CII Research Rep. 86,Clemson University.

[16] Smith, G. R. & Roth, R. D. (1991). Safety Programs and the Construction Manager. Journal of Construction Engineering and Management, 117(2), 360-371.

[17] Tarcisio, A.S., Formoso, C.S., &Cambraia, F.B. (2005). Analysis of a safety planning and control model from the human error perspective. Engineering, Construction and Architectural Management. 12,283-298.

[18] Patel, D A (2015) Estimating The Number Of Fatal Accidents And Investigating The Determinants Of Safety Performance In Indian Construction

