Evaluating Company Safety Policies

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A safety survey was conducted of electrical contractors across the United States to measure safety performance. The survey investigated the various safety criteria, techniques, and practices such as drug testing, safety incentive programs, worker training, safety inspections, etc. used by electrical contractors. In order to properly identify characteristics of companies which tend to modify the EMR, a stepwise regression model was used. The study had 20 completed surveys, so the results must be interpreted with the study size in mind.

Key Words: Safety, electrical contractors, EMR, safety programs

Introduction

According to the National Safety Council, 75 percent of all accidents are preceded by one or more near-misses. Near-misses should serve as wake-up calls for employees to realize something is wrong and needs to be corrected. A split second of time or a fraction of an inch is the only difference between a near miss and a serious injury. Near-misses should serve as a red flag to let workers know that a jobsite behavior is wrong or unsafe and requires immediate attention. By recognizing near-misses and taking action to correct the underlying problems, employees not only help reduce the number of near-misses, but more importantly, they help reduce the number of actual accidents. Reacting and correcting a near-miss problem will make a difference between future injuries and a zero-accidents safety record (Nakutin, 2007).

A near-miss accident, especially a near-miss fatal accident, can be the stimulus to make a company realize that their safety program needs to be reappraised. However, it should not take a near-miss or accident for a company to make safety a priority. Project owner, architects, engineers, and contractors agree that safety management should be proactive rather than reactive. Being proactive is trying to prevent accidents and near-misses from occurring. Being reactive is rolling the dice and letting accidents and near-misses happen. Proactive safety management of a construction project requires preplanning, is time-consuming, and can be profitable by preventing incidents from occurring. On the other hand, reactive safety management requires no preplanning, yet it is time-consuming, and can costs contractors millions of dollars. Safety should be integrated with every aspect of the construction business because attention to safety protects the well-being of the employees and the company. The money saved on workers' compensation premiums can help pay for the company's safety program and present new opportunities to the company (Pinch, 2006).

Hinze and Parker (1978) studied the work practices and job policies of 40 construction job superintendents to see how the superintendents affected the safety performance of the workers under their supervision. These job superintendents were the top company representative on the job site and worked for 19 different union contractors. The job superintendents were for small contracting firms and large general contractors. The job superintendents were in charge of construction projects that ranged from a couple thousand dollars to $40 million. Hinze and Parker discovered that when excessive job pressures are placed on job superintendents and the workers it can have a negative impact on safety performance. Hinze and Parker also found that high productivity and good safety performance are related.

Hinze and Raboud (1988) conducted a safety study on six construction projects located in four provinces in Canada. The dollar value for these projects ranged from $5,000,000 to $400,000,000. Hinze and Raboud found that injury rates were lower on projects that employed a project safety officer and on those projects that included specific job site safety tours and included safety issues in regularly held coordination meetings. They also discovered that safety performance was adversely affected by decisions made through budgetary constraints.

Hinze and Harrison (1981) examined the characteristics of very large construction company's safety programs to determine if there was any consistency in the general character of their safety programs and if there were any noticeable safety performances that were affected by specific aspects of their safety programs. Hinze and Harrison surveyed 49 of the top 100 construction firms in the 1979 March issue of Engineering News Record. Of the 49 respondents only five of them had a dollar volume of less than $100 million. Hinze and Harrison discovered that the largest firms had the better safety performances because they were more formal with their safety programs. The larger firms had formal accident and cost reports, training for new employees, more rigid safety requirements, and offered incentives or rewards for good safety performances.

Jaselskis, Anderson, & Russell (1996) surveyed 48 contractors of different types and sizes on strategies the companies use for improving safety performance. They also examined the safety practices of 69 construction projects. Jaselskis, Anderson, & Russell found several items on the company level that affect safety performance such as upper level management support and number of informal safety inspections. On the project level, Jaselskis, Anderson, & Russell found that safety performance improved with several factors including increased project management experience, reduction in project team turnover, increased time devoted to safety for the project safety representative, increased number of formal meetings with supervisors and subcontractors, greater number of informal site safety inspections, reduced craft worker penalties, and increased budget allocation to safety awards.

If the workers are not providing productive, quality work, then the company will go out of business. If safety is not considered when developing productivity and quality goals, then someone is likely to get hurt or killed. Typically, everyone, i.e. electricians, carpenters, superintendents, project managers, etc. are taught productivity and quality are related. However, safety is often relegated to a list of rules and regulations. A successful safety program factors safety into the production and quality mix because it directly impacts both. Lost man-hours, recordable injuries, and increased insurance premiums affect a company's bottom line, just like production and quality (Cohen, 2006).

Methodology

For a safety program to be successful, all the pieces of a comprehensive safety program need to be in place. A nationwide study was performed that focuses on identifying/benchmarking the safety practices that are predominantly effective in helping electrical contractors pursue the goal of zero incidents. This study investigated the various safety criteria, techniques, and practices such as drug testing, safety incentive programs, worker training, safety inspections, etc. used by electrical contractors. Together these elements form a well-rounded comprehensive safety program and help create a culture of safety.

This study collects a multitude of information which results in a very large number of variables and factors. In order to properly identify characteristics of companies which tend to modify the experience modification rate (EMR), a stepwise regression model was used. With so much information being contained in the variables under study, care must be taken to avoid multicollinearity, a situation where the information given by one independent variable is contained in one or more other independent variables. When multicollinearity is present, the t-tests typically used in regression models to determine important predictor variables are distorted. To address this issue of multicollinearity among the predictor variables of interest, a stepwise regression model will be fit. Keller (2006) states, "Stepwise regression is an iterative procedure that adds and deletes one independent variable at a time. The decision to add or delete a variable is made on the basis of whether that variable improves the model."

In short, the stepwise regression model begins by fitting all models containing only a single predictor variable. The best model, determined by the largest F-statistic or smallest p-value subject to a minimum F value or maximum p-value, among all of these is then selected. If none of the single variable models produce a statistically significant model, then the process stops and none of the predictor variables are considered to give information to help determine adjustments to the response variable (EMR). If a single variable model is found to be significant, then the process continues to locate the next most-important predictor variable. The procedure continues until all statistically significant predictor variables have been determined. For the purpose of the current study, a predictor variable was considered significant if the corresponding p-value was less than 0.15.

Although this procedure does eliminate severe cases of multicollinearity among the predictor variables, it can also lead to some unexpected results. Often when multicollinearity is present, then the model must choose between two (or more) predictors. Although both give information about the response variable, which in our case is the EMR value, only one of the two (or more) can be included in the model during a step. As a result, because one variable had the same predictive power as another, the one with the smaller p-value (or larger F-statistic) is selected, although a better practical explanation might exist for the predictor that was excluded. This is even more common when there are few responses, hence less overall information in a study.

When surveys were finally collected, there were approximately 20 with complete information. As a result, multicollinearity is a problem as many variables are indistinguishable from one another (ie: columns in a worksheet are identical). An alternative analysis was conducted using 2006 EMR values to create three groups of companies: low EMR (0.72 or lower), mid EMR (0.73 to 0.85), and high EMR (0.86 or higher). This allows some descriptive statistics to be produced. Patterns can be examined based on these groupings which will allow further investigation of possible effects of these variables. Boxplots and bar graphs will be examined by EMR category for several variables.

The survey was designed to identify/benchmark the safety practices and trends that are predominantly effective in helping traditional and line electrical contracting firms pursue the goal of zero incidents. Identifying/benchmarking safety practices is an essential aspect of monitoring and evaluating a company's safety performance. It allows for the identification of problem areas where preventative action should be undertaken and provides necessary feedback regarding safety initiatives. This is important because if an electrical contractor does not know what the standard is then the contractor cannot compare their company against it. In addition, an electrical contractor needs to know where their competition stands. The survey contained 57 questions that were to help evaluate an electrical contractor's safety program in the areas of history, performance, program, training and orientation, administration, rules, inspections, and incentives. In addition, type of worked performed, hours worked, number of employees, and person responsible for reporting incidents were also included. The data was collected for the three years, 2004, 2005, and 2006, in order to help achieve the research goals. To help assist with collection of data, the survey was placed online at Survey Monkey for three weeks. The data was then downloaded into a Microsoft Excel file so the data could be manipulated.

Demographics

The survey collected some demographic information such as the year the company was established, company location, and the job title of the person completing the survey. Based on these demographics, the 20 survey respondents were fairly well-diversified. Figure 1 shows the state in which the company is located. Table 5 shows the number of years the survey participants have been in business. Table 6 shows the job titles of the participants who completed the survey. After reviewing the demographics, it shows that the participants served as a fair representative sample of electrical contractors from across the United States.

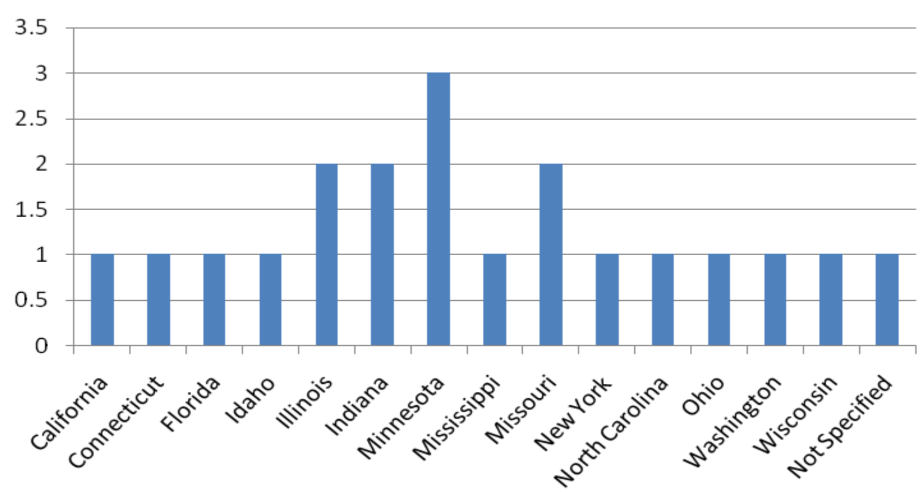

Figure 1: Study Participants Location

Table 5
Number of Years in Business

Number of Participants	Number of Years in Business
1	0 to 19 years
5	20 to 39 years
7	40 to 60 years
7	61 to 100 years

Table 6
Job Titles of Survey Participants

Number of Participants	Job Titles
5	Safety Manager/Director
10	President/CEO/Owner
5	Other/Not Specified

Results

After the results were collected, there were a total of 60 survey replies from electrical contractors with a final count of 20 that were completely answered. The other 40 surveys contained missing data which eliminated them from being used in the stepwise regression analysis. This limited amount of information restricts analyses severely and prevents clear explanations of some results. Consequently, the output should be examined with this limitation in mind.

A stepwise regression analysis was performed where all variables from 2004 and 2005 were included in an attempt to determine which variables were highly correlated with, and hence possibly influenced, the 2006 EMR rates. Some results seem to have reasonable explanations, while others seem contrary to logic. This supports that the study is very limited by the low response rate. With these limitations in mind, the following results appeared from the analysis.

The stepwise regression model located the most influential variables in determining the 2006 EMR rates for the 20 companies as given in Table 7. The short variable name is given, followed by a column labeled “Effect” which gives the expected change in 2006 EMR rate based on an increase of 1 unit for the variable. In general, a positive value in the “Effect” columns implies that the EMR rate will increase if the variable value increases, while a negative effect would imply a lower EMR rate as the particular variable value increases. Finally, a description of the variable is included as the short names are rather cryptic.

Table 7
Influential Variables in Determining 2006 EMR Rates

Variable	Effect (+/-)	Description of Variable
WkVol4	+0.0202	2004 Workers’ Compensation divided by Company Volume
Comm4	-0.00369	Percent of all work that was Commercial in 2004
Line5	-0.0066	Percent of all work that was Line work in 2005
FldOcd305	+0.0055	Number of field workers with 30-hour OSHA cards in 2005
DayLst5	+0.00042	Number of days lost due to injury in 2005
Orate5	+0.0026	OSHA Incident Rate in 2005
NoLT4	-0.00007	Number of Lost Time Injuries in 2004
Ind4	-0.00128	Percent of work that was Industrial in 2004

From this table, we find some results that are expected, while there are also some confusing interpretations which are a limitation of the study and hence show the difficulty encountered due to such limited responses. The first variable selected was the amount of 2004 workers' compensation in $1,000s divided by company volume in $1,000,000s. The coefficient of +0.0202 implies for each additional $1,000 in workers' compensation per million dollars of company volume, the 2006 EMR value is expected to increase by approximately 0.0202. The next two variables to be included in the model were the % of all work that was considered commercial in 2004 and the % of all work that was considered line in 2005. Both coefficients are negative indicating that for each additional % of overall work done in the commercial field in 2004, the 2006 EMR was decreased about 0.00369 and for each additional % of overall work done in line work, the 2006 EMR was decreased about 0.0066. The most puzzling result is perhaps the +0.0055 coefficient for number of field workers with 30-hour OSHA cards. It seems that the more workers with the cards, the lower the EMR would be due to the extra training for these employees. However, the positive coefficient implies that each additional employee with these cards led to a company having their 2006 EMR increased about 0.0055. This clearly deserves more investigation in future studies to determine the underlying factor. Next is the number of days lost due to injury in 2005, where each additional lost day increased the 2006 EMR by approximately 0.00042. The OSHA incident rate in 2005 was significant as each additional point in the rate increased the 2006 EMR rate about 0.0026. The last two variables are from the 2004 year. The number of lost time injuries in 2004 is another puzzling effect as each additional injury in this category was associated with a decrease of 0.00007 in the 2006 EMR. The final variable to enter the model is the % of overall work that was industrial. Each additional % of work that was industrial in 2004 was connected with a decrease of 0.00128 in the 2006 EMR.

Although some of these results agree with what is logical, others do not. The limited study size greatly limits the believability of these results. An alternative approach was considered to examine possible characteristics of companies based on EMR rates. The respondents were categorized as presented in Table 8. Several variables were examined to see what values were common or different among companies with the different category ratings. This can assist in understanding why the stepwise regression analysis could not differentiate between EMR rates more precisely, but also helps to understand the complexity of this issue.

Table 8

EMR Classifications

Category	**Ranges of EMR**
Low	0.72 or less
Medium	0.73 to 0.85
High	0.86 or higher

In Figure 2, the number of man hours in 10,000s for 2006 is reported. Notice how the mid-EMR group exhibits the least variability and least amount of man hours, while the low-EMR group has a slightly higher median amount of man hours including more variability. Also, the high-EMR group has much more variability than the other groups in terms of man hours.

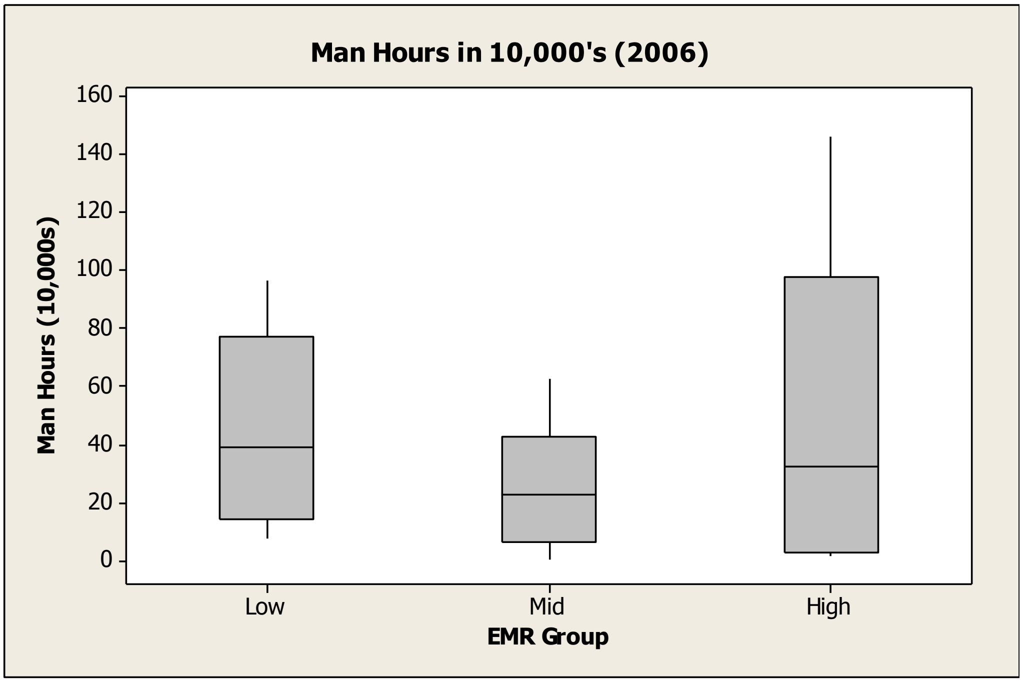

Figure 2: 2006 Man Hours in 10,000's

Virtually all categories of companies were comparable in setting corporate safety goals in 2005. According to Figure 3, about 3 in 4 of all companies set corporate safety goals in 2005. This could be an area to address in terms of compliance among all companies, but it is not a variable which can be used to determine EMR as the pattern is virtually identical across all levels of companies.

Figure 3: 2005 Corporate Set Safety Goals

From Figure 4, it seems that making safety part of supervisor's performance evaluations is counterproductive. Notice how the low-EMR groups did not include safety in the supervisors' performance evaluations, while the other groups did include it. This is clearly an area where further study might reveal other procedures to enhance safety for the low-EMR companies that were not a variable in this particular study.

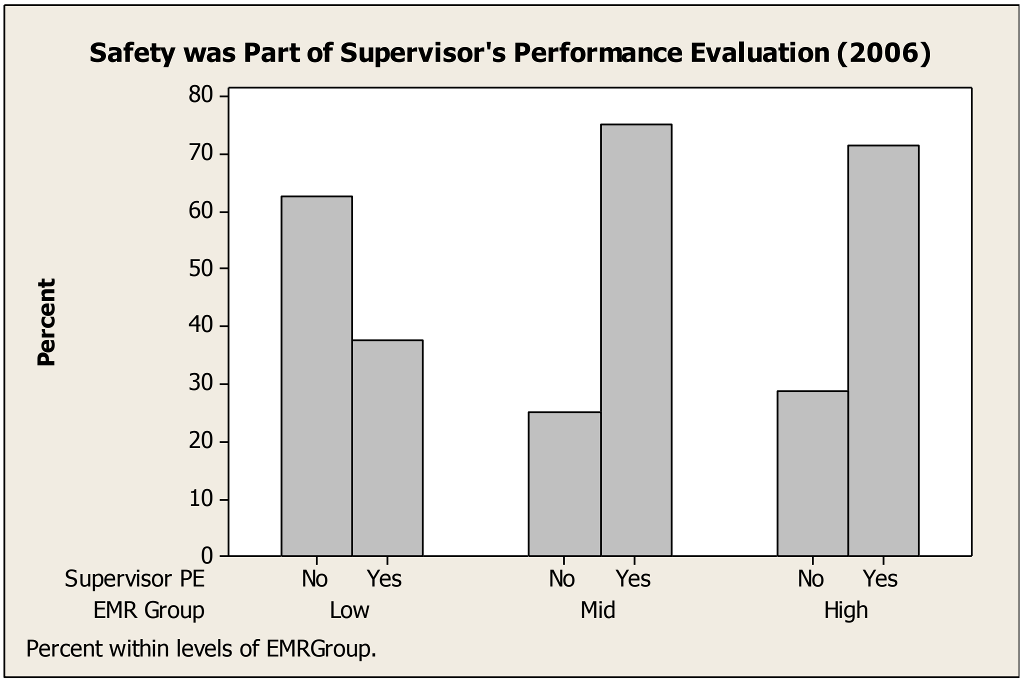

Figure 4: Safety as Part of a Supervisor's Performance Evaluation

Figure 5 displays the ratio of safety program dollars to volume (per $1 million). Notice how the low-EMR group and the high-EMR group exhibit similar characteristics, while the mid-EMR group spent a higher proportion of money on the safety incentive program and had much more variability in the amount spent.

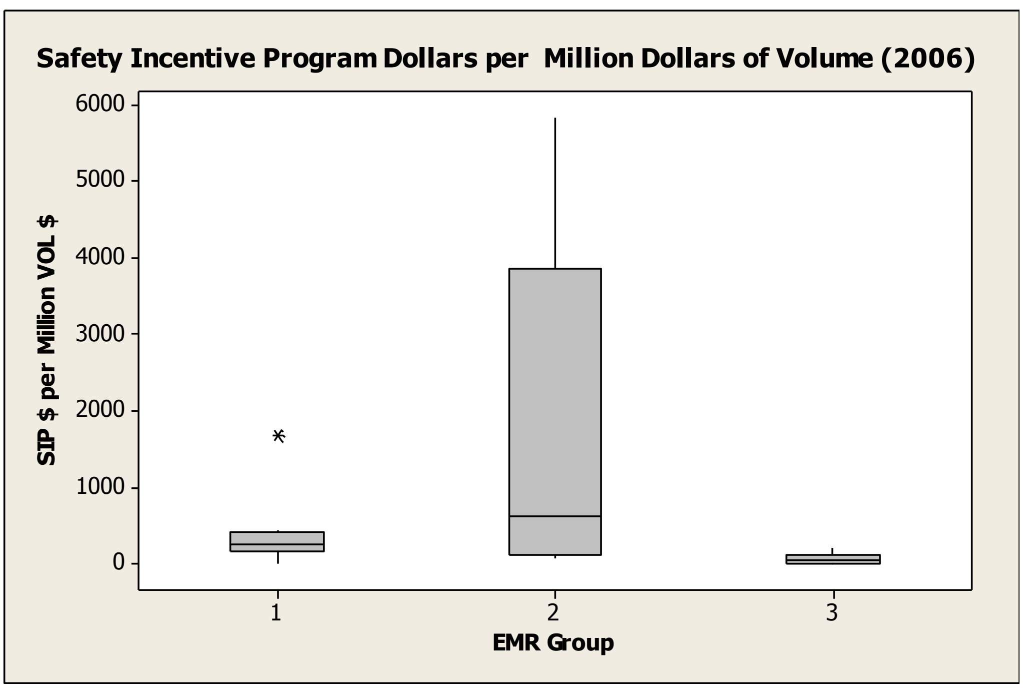

Figure 5: 2006 Safety Incentive Dollars per Company's Dollar Volume

Conclusion

The small study size of 20 completed surveys is a limitation of the study. Results must be interpreted with the study size in mind. Generalizations should not be made to the larger body of all electrical contractor companies. However, it does seem that areas of future study should include type of work performed along with number and severity of injuries as part of factors in EMR.

By identifying or benchmarking safety practices an electrical contractor will be able to uncover gaps in its safety performance and then target these areas for improvement. Electrical contractors who value safety will include it into their selection process when deciding to bid on a particular project. Electrical contractors will be able to use this information to help evaluate other specialty contractors, general contractors, construction managers, and project owner's safety attitude and culture. Other techniques and trends may eventually lead to improvements, but the best approach for now is incident prevention. This study could be a practical tool for continuous safety improvement for successful safety programs that help ensure that a company strives for safety excellence.

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