MORTALITY RATE IN THE USA CONSTRUCTION INDUSTRY (2004 – 2014)

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ABSTRACT

Safety remains a major challenge in the construction industry throughout the world. Recent government statistics have revealed a high rate of fatalities in the U.S. construction industry. This study investigates the root causes of this issue and also shows that there is an inverse correlation between mortality rates in the construction industry with respect to time. To address this issue data is gathered from the survey of CFOI, Census of Fatal Occupational Injuries. This survey comprises of data which focuses on analyzing the reason for the deaths in every US industry. This data is then further categorized into six specific events explained by the BLS. The data obtained was followed by a quantitative analysis, with a subsequent statistical analysis in SPSS. Findings show that mortality rates reduced overall since 2004 and this also reflects the fact that there is an improved consistency in safety awareness programs among employers, suggesting that these programs have been effective.

Keywords: Construction safety, OSHA, Mortality Rate, Fatal Occupational Injuries

1. INTRODUCTION

According to (Koskela and Howell, 2002) there are various factors that affect safety to one degree or another such as each project is generally one of a kind – a unique prototype, each project is carried out in situ, exposed to the weather and with particular site conditions, each project is carried out by an assembled team that may be different on each project these factors may cause strenuous relations among various autonomous agents and therefore hampering construction safety on site.

In a construction project, uncertainties (Bertelsen, 2003, 2004, 2005; Bertelsen and Emmitt, 2005) are the result of temporary coalitions in a turbulent environment requiring semi-predictable or even unpredictable configurations of supply industries and technical skills. The need to 'know why' we build by looking first at the systemic nature and complexity that informs the construction industry's current paradigm. The author has analyzed past studies for application of current efforts to improve efficiency and effectiveness continue to generate significant differences between expectations and results (Solis, 2008).

Safety is one of the biggest challenges in the construction industry throughout the world (Becerik-Gerber and Siddiqui 2014), because of the indirect costs of poor safety performance (Sampson et al. 2014; Abudayyeh et al. 2006). Over the past decade, fatality rates generally range from 3 to 14 work related deaths per 100,000 workers. Fatality rates in the construction industry remain the highest among all other industry sectors in most regions, including North America, Australia, and Europe (Safe Work Australia 2015; CPWR 2013).

Construction work is ergonomically hazardous, commonly requiring numerous awkward postures, heavy lifting and other forceful exertions (Schneider & Susi, 1994). The construction work is also not repetitive in nature. Thus, a high chance and prevalence of work related injuries have been reported in the construction work. Mainly, the mortality rate in the construction industry is about 3 times higher than that for all workers combined (Sorock et al., 1993; Tallberg et al., 1993). This accident analysis is used to recognize the common factors contributing to occupational accidents.

The statistics of construction industry accidents in United States of America is compiled and maintained by the United States Department of Labor, Occupational Safety and Health Administration. To identify the occupational injuries and deaths, the census uses the source records, such as workers' compensation reports and employers' accident analysis reports. While information about each occupational death is obtained by cross-referencing multiple sources, such as death certificates, workers' compensation reports, and agency administrative reports. Data compiled by the United States Department of Labor are published annually for the preceding calendar year (Jeong, 1998).

The recent research topics have been focused on safety management. These have helped identify ways management practices and policies can help curb the injuries in the industry and effectively improve safety performance. Although these have added to the body of knowledge by which construction injuries can be reduced, they have failed to examine the actual field circumstances under which injuries have occurred (Hinze et al., 1998).

This thesis identifies the critical causes when it comes to the high mortality rate in the construction industry which in turn helps the industry by providing safety countermeasures to tackle these causes. The methodology used is a qualitative research method of past researches related to this research objective, and secondly a quantitative method to analyze the data received from the BLS. The expected findings should define evidence to support an inverse correlation, between mortality rates in the construction industry with respect to time. The limitations and assumptions on this study are: (1) the study is limited to the North American construction industry, (2) data excludes illness-related deaths unless precipitated by an injury event, (3) data retrieved from BLS is true, (4) falling from height is a major contributor to the mortality rate, (5) most accidents occurred from temporary construction.

2. STRUCTURED LITERATURE REVIEW

2.1 CONSTRUCTIONINDUSTRY OVERVIEW

The construction industry is one of the largest industries of the United States economy. During 2007, the Bureau of Labor Statistics (BLS), U.S. Department of Labor, reports that the construction industry represented a value of $1,260.128 billion, which comes out to about 8% of the total gross domestic product of United States of America (Forbes and Ahmed 2011). The same report indicates that the construction industry employed 7.614 million people. In a way, the construction industry has been privileged, as any competition this industry faces is typically from within the country's borders, whereas the manufacturing industries, services industries and others need to deal with the global competition (Forbes and Ahmed 2011).

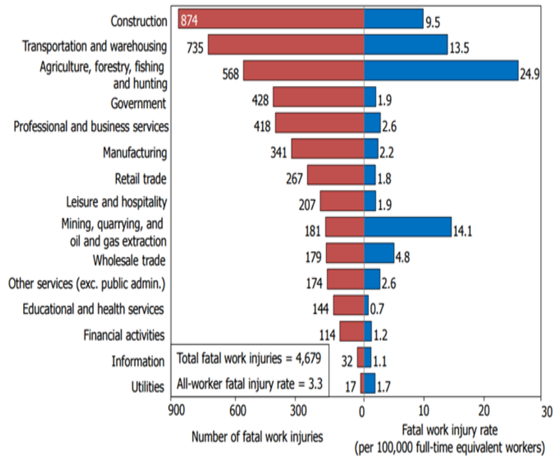

Fig. 1. Comparison of fatal injuries in various industries

Source: US Bureau of Labor Statistics, CFOI, 2015.

Construction fatalities in USA rose to 874 in 2014 from 828 in 2013. The number of fatal work injuries in construction industry in 2014 was the highest reported total since 2008. The fatal injury rate for workers in the private construction industry was 9.5 per 100,000 FTE workers in 2014 and 9.7 per 100,000 FTE workers in 2013. Heavy and civil engineering construction recorded a series low of 138 fatal injuries in 2014, down from 165 in 2013. Construction industry had the most number of fatalities amongst all other industries for the year 2014 as seen in the chart below. One in Five worker deaths in 2014 were in the construction industry.

2.2 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

Federal OSHA is a small agency; with their state partners they have approximately 2,200 inspectors responsible for the health and safety of 130 million workers, employed at more than 8 million worksites around the nation — which translates to about one compliance officer for every 59,000 workers. Federal OSHA has 10 regional offices and 90 local area offices. OSHA had a budget of $552,787,000 for the FY 2015.

Since 1970 OSHA has laid emphasis on assuring safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance. Before OSHA was created 43 years ago, an estimated 14,000 workers were killed on the job every year. Today, workplaces are much safer and healthier, going from 38 fatal injuries a day to 12. OSHA has started recordkeeping since 2003 with statistics for worker fatalities, injury, illness etc. According to the statistics gathered from United States Department of Labor, Occupational Safety and Health Administration (OSHA) they stated that 4,679 workers were killed on the job in 2014 (3.3 per 100,000 full-time equivalent workers) – on average, almost 90 a week or more than 13 deaths every day. Out of 4,251 worker fatalities in private industry in calendar year 2014, 874 or 20.5% were in construction—that is, one in five worker deaths last year were in construction.

Thus OSHA also created a database which stated the most violated standards which not only covered the construction industry but the general industry as a whole for the fiscal year

2015 which were classified as: (1) fall protection, construction, (2) scaffolding, general requirements, construction, (3) respiratory protection, general industry, (4) control of hazardous energy (lockout), general industry, (5) powered industrial equipment, general industry, (6) ladders, construction, (7) electrical, wiring methods, components and equipment, general industry, (8) machinery and Machine Guarding, general industry, (9) electrical systems design, general requirements, general industry. (Commonly Used Statistics, 2015).

Recommendations on how the OSHA reports could be made more meaningful are found in the (Hinze, Pedersen & Fredley, 1998) study. First, injuries should be coded into one of the 20 possible cause categories, rather than the traditional five groups of falls, struck-by, electric shock, caught in/between, and other. Additional or secondary cause codes also were developed. If these cause codes were adopted and used to describe all accidents recorded by OSHA, relevant data retrieval may be more effective.

The leading causes of worker deaths on construction sites were falls, followed by electrocution, struck by object, and caught-in/between. These "Fatal Four" were responsible for more than half (58.1%) the construction worker deaths in 2014, BLS reports (OSHA, 2014).

Furthermore, the data is classified into following sub-categories for better understanding:

- Falls — 349 out of 874 total deaths in construction in CY 2014 (39.9%)
- Electrocutions — 74 (8.5%)
- Struck by Object — 73 (8.4%)
- Caught in/between — 12 (1.4%) (OSHA, 2014).

Fatal work-related falls continue to remain one of the leading causes of death in the workplace (Kisner & Fosbroke, 1994). From 1980 to 1989, the construction industry had the highest annual average rate of deaths resulting from falls with 6.56 per 100,000 workers National Institute for Occupational Safety and Health (NIOSH, 1993). In 1994, 10.4 % of the 5,923 deaths that occurred in private industry were caused by falls (Bureau of Labor Statistics, 1996). Proportionate mortality ratios identified significantly higher proportions of deaths resulting from falls off ladders in electrical trades and plumbing and heating trades.

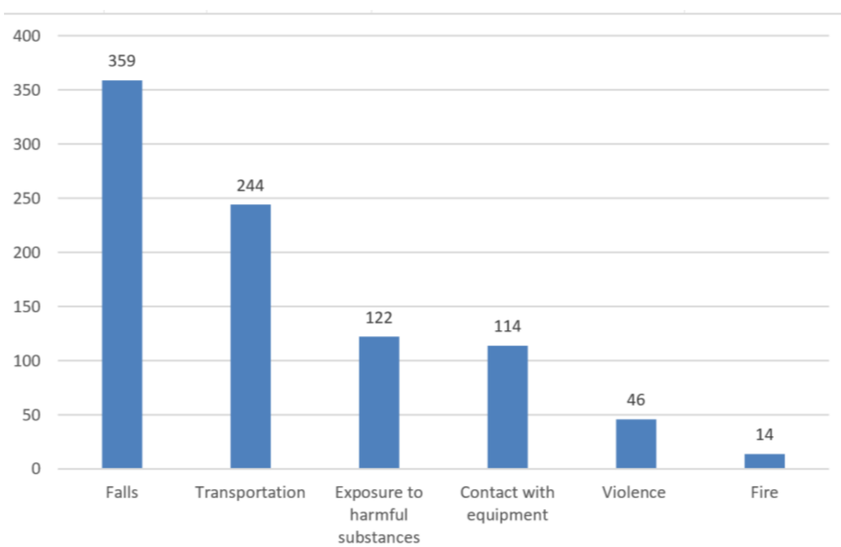

Fig. 2. Total deaths in Construction Industry in 2014

Source: US Bureau of Labor Statistics, CFOI, 2015.

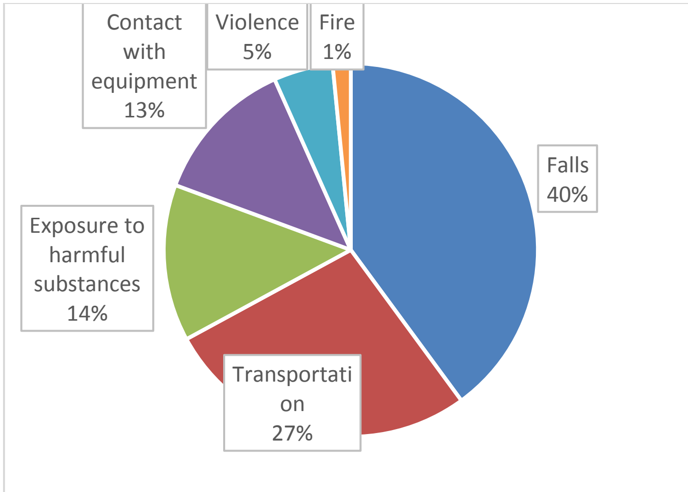

Fig. 3. Pie chart representation of total deaths in 2014

A study was made in which a report that primarily focused on occupational falls in the construction industry, where 87.9% were known to be due to a falls from one level to another (Catlledge, Hendricks & Stanevich, 1996). From 1980 to 1989, there were 2798 deaths due to occupational falls in construction, representing 49.6% of all fatal occupational falls across all industries. Most of these incidents occurred among young white males. In observing the time between the date of injury and the date of death, 66% of the fall victims died on the same day as the injury, whereas 5.7% lived more than 90 days before dying.

A study tried to identify the contributing factors to occupational fatal fall with respect to the victim's individual factors, site conditions, company size, fall site and cause of fall. Individual factors included age, gender, experience, and the use of personal protective equipment (PPE). Accident scenarios were derived from accident reports. Significant linkages were found between causes for the falls and accident events (Chi et al., 2005). Falls from scaffold staging were associated with a lack of complying scaffolds and bodily action. Falls through existing floor openings were associated with unguarded openings, inappropriate protections, or the removal of protections. Falls from building girders or other structural steel were associated with bodily actions and improper use of PPE. Falls from roof edges were associated with bodily actions and being pulled down by a hoist, object or tool. Falls through roof surfaces were associated with lack of complying scaffolds. Falls from ladders were associated with overexertion and unusual control and the use of unsafe ladders and tools. Falls down stairs or steps were associated with unguarded openings. Falls while jumping to a lower floor and falls through existing roof openings were associated with poor work practices (Chi et al., 2005).

The (Huang & Hinze, 2003) purpose of the study was to identify the root causes of fall accidents and to identify any additional information that might be helpful in reducing the incidence of construction worker falls in the future. While data from January 1990 through October 2001 were examined, particular emphasis was placed on fall accidents that occurred in the last 5 years of this time interval, a period when more data were accumulated and coded in the OSHA investigation reports. Results show that most fall accidents take place at elevations of less than 9.15m (30ft), occurring primarily on new construction projects of commercial buildings and residential projects of relatively low construction cost.

Workdays lost to injuries on the job more than doubled from 2.5 million in 1972 to over 6.3 million in 1988. The 6.3 million days lost from work in 1988 in the construction industry were shared by a little more than 40,000 construction workers, implying workers averaged losing 157 days each from work in 1988 (Vossenas, 1990).

A study presents an analysis of nonfatal (1981 through 1986) and fatal (1980 through 1989) traumatic occupational injuries in the construction industry using the Supplementary Data System and the National Traumatic Occupational Fatalities databases (Kisner and Fosbroke, 1996). The lost workday case rate in construction was 10.1 per 100 full-time workers, which was nearly 2.5 times the occupational injury rate for all industries combined. The construction industry had an overall fatality rate of 25.6 per 100,000 full-time workers. This rate was more than 3.5 times the occupational fatality rate for all industries in the United States for the same period. To prevent occupational injuries and fatalities in the construction industry, intervention measures need to target specific occupations: machine operators, transportation workers, and craftspeople. Intervention measures also need to target such causes of injury as falls, electrocutions, and motor vehicle incidents.

3. RESEARCH METHODOLOGY

The first step to define this objective was conducting a Structured Literature Review (SLR) to find out similar research, identify a research question and a possible methodology.

3.1 STRUCTURED LITERATURE REVIEW PROCESS

The SLR in the research process focuses on reviewing what others have done in similar areas of knowledge, however, it does not necessarily need to be about the identical own topic of investigation. This part of the research describes theoretical and empirical perspectives, about previous findings related to the research topic (Leedy and Ormrod 2010). As per Naoum (2012) the five main steps to conduct SLR: (1) identify sources of information, (2) understand how the sources work, (3) collect and reviewing existing publications on the topic, (4) systematically organize the publications, (5) assessing and writing up the literature review.

3.2 RESEARCH STRATEGY DEFINITION

As per Leedy and Ormrod (2010), there are three main research strategies that are used in the academia: (1) quantitative research, (2) qualitative research, (3) mixed methods research: is a strategy that uses qualitative and quantitative means to have a better definition of the research topic. However, as the researcher wants to have a better outcome of the results and obtain a more real picture, it was decided to pursue a Mixed method research strategy, so all qualitative data obtained in the research process, could be analyzed through Quantitative methods to provide a better degree of certainty to the research objective.

3.3 DATA COLLECTION METHOD

The data is collected from the BLS Occupational Injury and Illness Classification System. The data comprises of statistics for FY 2004 to FY 2014 which are gathered from the Census of Fatal Occupational Injuries (CFOI. The data before FY 2004 was not definitive enough and was not based on the categories mentioned below and hence was not used. This survey comprises of data which focuses on analyzing the reason for the deaths in every US industry. This data is then further categorized into six specific events explained by the BLS, they are: (1) violence, (2) transportation, (3) fires, (4) falls, (5) exposure to harmful substances, (6) contact with equipment. The data collected is shown in Table 1 below.

3.4 SCOPE OF STATISTICAL ANALYSIS

The data obtained was followed by a quantitative analysis, with a subsequent statistical analysis.

The research topic is: To identify whether there is a relation between mortality rates in the construction industry with respect to time. To answer the main research question through the use of the data from the survey, a quantitative analysis was performed. Statistical Package for Social Science (SPSS) is the software used throughout the whole study to perform the statistical analyses.

The data was analyzed using SPSS in which the data obtained was arranged according to the years in descending order. Further a scatter plot was plotted with the help of the data. Keeping fatality on the Y-axis as dependent variable and years on the X-axis as independent variable. In order to address the topic we used the scatter plot defined above to see whether the trend line was upwards or downwards to give us the answer. Following which Linear Regression and Correlation tests were also performed on the data set in SPSS. Statistical analysis in other words the General Linear Model multivariate analysis is performed to the data, so confidence about the trends is obtained. This test gives us the significance value for every variable which helps us determine how every variable is affected over time.

The null hypothesis for this study is that there is an inverse correlation between the mortality rates in the construction industry with respect to time.

3.5 RESEARCH LIMITATOINS

There are several considerations in the scope of this study, they affect directly or indirectly the results on this thesis:

- The research was focused in the analysis of data gathered from US construction industry only.
- Data obtained from CFOI survey is assumed to be true.
- It was assumed that the literature available and highly related to this topic is representative for the topic understanding.

4. DATA ANALYSIS

4.1 QUANTITATIVE ANALYSIS

A total of eleven years’ worth of data was obtained from CFOI and used in the study. From which we were able to systematically categorize the data in the form of years and their corresponding mortality rates and the reasons for those deaths. The data was formulated in a simple table shown below for better understanding of the data.

Table 1. Census of Fatal Occupational Injuries

Year	Fatality	Violence	Transportation	Fires	Falls	Exposure to harmful substance	Contact with equipment
2104	899	46	244	14	359	122	114
2013	828	36	223	13	302	111	140
2012	806	35	234	9	290	102	136
2011	738	32	197	11	262	112	122
2010	774	30	188	26	264	126	138
2009	834	41	213	14	283	132	151
2008	975	38	241	26	336	132	201
2007	1204	41	296	24	447	182	206
2006	1239	42	323	30	433	191	216
2005	1192	31	318	40	394	164	244
2004	1234	31	287	34	445	170	267

Source: US Bureau of Labor Statistics, CFOI, 2015.

Following which Linear Regression and Correlation tests were also performed on the dataset in SPSS. The Linear Regression and Correlation tests are aimed at understanding how two variables are related to each other. For this we may consider the variables are called X and Y. Y being the dependent variable and X being the independent variable which in our case means Y is the fatality and X is years. And we want to know how X influences Y. Now the basic tool of Regression is a scatter plot. This simply plots the data in a graph. X is along horizontal axis and Y is along vertical axis.

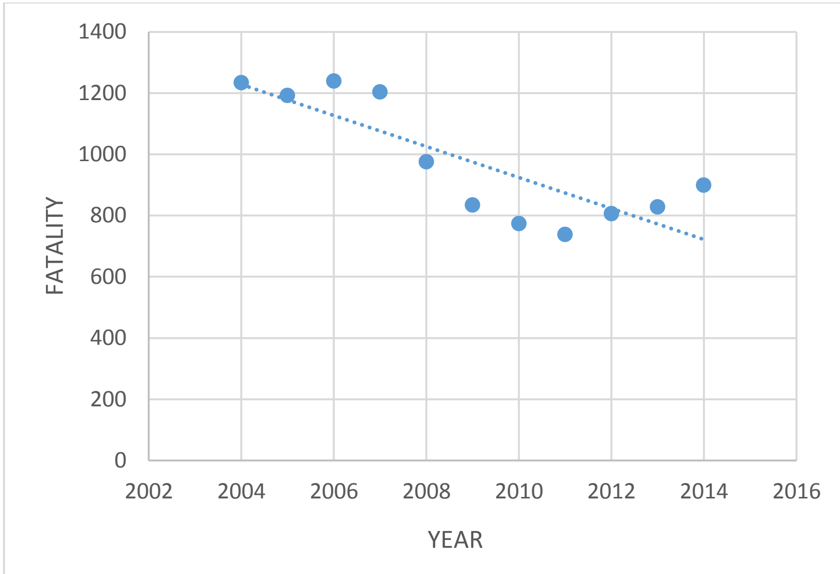

Figure 4. Total Fatalities vs Year.

Now we need an algorithm to construct the trend line that in some sense best fits the data. So we use the usual method of least squares, this method tries to make the squared distance between the line and data as small as possible. From the scatter plot above we see that the trend may not be linear but it is decreasing. So what we do is we draw the trend line through the data which gives us the prediction equation. A prediction equation is a line such as, y = c + mx. Here the slope of the line is given by m from the equation. The slope tells us that how much the line changes if we add a unit to X axis. In the equation given above, c is generally irrelevant because it is where the line happens to go through at X=0. So the equation that we get from the scatter plot above is y = 671.38181 -50.57272x. This translates to the fact that when we add a unit to X axis there is a change of 50.57272 to the trend line and as the trend line is downwards this change is a negative change in the mortality rate as time passes by. Below is the regression table.

Table 2. Output Summary

Regression Statistics	
Multiple R	0.82967
R square	0.68836
Adjust R square	0.65373
Standard error	118.961
Observations	11

ANOVA	df	SS	MS	F	Significance F
Regression	1	281336.08181	281336.08181	19.8796	0.0015803
Residual	9	127367.5545	14151.95050		
Total	10	408703.6363			

	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	671.38181	76.929112	8.72727	0.0000109	497.3560	845.407561
X	50.57272	11.342578	4.458662	0.0015803	24.914031	76.231423

From the Table 2, we get the value for R squared. Pearson Correlation is the root of R squared. So we get R= 0.8296987 and since the trend line is going downwards we can interpret that the Pearson correlation is negative. Also P-value is 0.001, so the null hypothesis can be rejected with 99% confidence. In other words, we can say with 99% confidence that time affects the mortality rates.

4.2 GENERAL LINEAR MODEL

The General Linear Model is a model that incorporates normally distributed dependent variables and categorical independent variables. The GLM procedure in SPSS allows us to use the multivariate function. This test gives us the significance value of every variable used, this number helps us determine a relationship with time individually for every variable.

Table 3. General Linear Model

Source	Dependent Variable	Type III Sum of Squares	df	Mean squares	F	Significance
Corrected Model	Fatality	281336.082[a]	1	281336.082	19.880	0.002
	Violence	20.945[b]	1	20.945	0.704	0.423
	Transportation	11261.536[c]	1	11261.536	8.983	0.015
	Fires	801.900[d]	1	801.900	27.233	0.001
	Falls	25323.282[e]	1	25323.28	8.247	0.018
	Exposure to harmful substance	6802.045[f]	1	6802.045	22.225	0.001
	Contact with equipment	24810.036[g]	1	24810.036	75.823	0.000
Intercept	Fatality	4736922.604	1	4736922.60	334.719	0.000

	Violence	3730.935	1	3730.935	125.480	0.000
	Transportation	286382.344	1	286382.344	228.443	0.000
	Fires	3940.526	1	3940.526	133.825	0.000
	Falls	561502.604	1	561502.604	182.871	0.000
	Exposure to harmful substance	101468.890	1	101468.890	331.537	0.000
	Contact with equipment	198003.143	1	198003.143	605.129	0.000
Time (Year's)	Fatality	281336.082	1	281336.082	19.880	0.002
	Violence	20.945	1	20.945	0.704	0.423
	Transportation	11261.536	1	11261.536	8.983	0.015
	Fires	801.900	1	801.900	27.233	0.001
	Falls	25323.282	1	25323.282	8.247	0.018
	Exposure to harmful substance	6802.045	1	6802.045	22.225	0.001
	Contact with equipment	24810.036	1	24810.036	75.823	0.000
Error	Fatality	127367.555	9	14151.951		
	Violence	267.600	9	29.733		
	Transportation	11282.645	9	1253.627		
	Fires	265.009	9	29.445		
	Falls	27634.355	9	3070.484		
	Exposure to harmful substance	2754.500	9	306.056		
	Contact with equipment	2944.873	9	327.208		
Total	Fatality	10861679.0	11			

	Violence	15053.00	11
	Transportation	717062.00	11
	Fires	6347.00	11
	Falls	1376069.00	11
	Exposure to harmful substance	226278.00	11
	Contact with equipment	368139.000	11
Corrected Total	Fatality	408703.636	10
	Violence	288.545	10
	Transportation	22544.182	10
	Fires	1066.909	10
	Falls	52957.636	10
	Exposure to harmful substance	9556.545	10
	Contact with equipment	27754.909	10

a. R Squared = 0.688 (Adjusted R Squared = 0.654)
b. R Squared = 0.073 (Adjusted R Squared = -0.030)
c. R Squared = 0.500 (Adjusted R Squared = 0.444)
d. R Squared = 0.752 (Adjusted R Squared = 0.724)
e. R Squared = 0.478 (Adjusted R Squared = 0.420)
f. R Squared = 0.712 (Adjusted R Squared = 0.680)
g. R Squared = 0.894 (Adjusted R Squared = 0.882)

From Table 3, we can say that fatality has a relationship with time because its significance is 0.02 which is <0.05 and the R squared value is 0.654 which means it is highly influenced over a period of time and for that reason we reject the null hypothesis. In other words, 65% of variance can be explained by Total Fatalities. Violence makes no difference over time because the significance is 0.423 and the R Squared value is -0.03 which means it does not make a much of a difference over time and for that reason we cannot reject the null hypothesis.

Transportation, Fires, Fall and Exposure to harmful substance are all highly significant since their significance values are less than 0.05 and they also have high R Squared values which give us a reason to reject the null hypothesis. Contact with equipment has a significance of 0.000 and a very high R Squared value 0f 0.882 which leads us to the conclusion that you can reject the null hypothesis. In other words, 88% of variance can be explained by the variable Contact with Equipment alone.

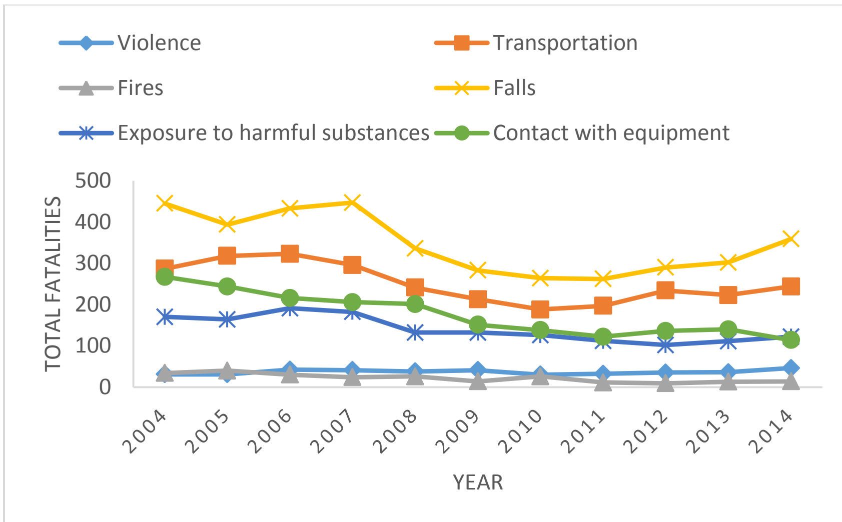

Figure 5. All variables vs year.

From the line chart above, we see that Contact with Equipment has the most significance in bringing the overall mortality rate down, as we can also tell from the R Squared and significance values in Table 3 above. We can also see from the figure above that the variable Violence does not seem to change much over the period of time, which is suggested by the R Squared and significance values. This gives us an added level of confidence in the trend.

5. CONCLUSION

The above results from Regression, Correlation and the GLM, prove that there is an inverse correlation between the mortality rates in the construction industry with respect to time. Rates of injury, safety events have reduced overall since 2004, so we can say that the construction industry in the US is becoming safer day by day even though there were more deaths per fulltime employees in the construction industry as compared to any other industry in 2014. We can also say that safety programs and other initiatives taken by the contractors in keeping their workplace safe seem to be working.

We now know that falling from height has been the major reason behind the mortality rate in the construction, the authors suggest that more research could be carried out in that area so that those numbers can be brought down and therefore significantly reduce the fatalities in the construction industry. Contact with Equipment has the most significance in bringing the overall mortality rate down. Violence does not seem to change much over the period of time. The researcher suggests that more research could be carried out in that area in an effort to significantly reduce fatalities in the construction industry.

The limitation of this study can be accounted for the inherent locality characteristic of safety climate. And although regulations vary by jurisdiction, and the globalization of the construction industry and pressure from the public is leading contractors and international firms to use consistent safety practices at all of their sites. Another limitation is that the data is self-reported to BLS, CFOI. And although strict protocols are in place so that the employers provide true responses, it is a possibility that some of the responses are incorrect. However with that being said the data is very consistent with the findings 10 years ago, this also provides some measure of confidence in the results.

In the methodology the main research objective was analyzed through a mixed method research strategy. The data was collected from CFOI for the last available 10 years. A qualitative analysis was performed on the data, which led to a quantitative analysis using statistical methods. The results from the statistical tests confirmed the trend, which served as the basis to confirm the statement about the main research objective.

The significance of this study is that we are now able to recognize how the 7 listed categories of OSHA and how they are affecting the overall mortality rate. Contact with Equipment and exposure to harmful substances are the variables that have the most significance in bringing the overall mortality rate down. The variable violence does not seem to change much over the period of time and has no significant contribution to the mortality rate over the specified period. This study also allows us to focus now on those categories that are not contributing as significantly to affect the mortality rate and we need to have more studies and research done in those domains of safety and help bring their numbers down.

6. FUTURE RESEARCH

Through the development of this thesis, several topics and ideas emerged, raw material to be used by the academia in the benefit of the construction industry.

After SLR, the researcher concluded that there is much more information that may be obtained from the data. Next is a list of potential research topics for future research, which could be benefited from the data:

1. How to reduce falls related fatalities in the construction industry.
2. Future cross sectional studies be undertaken on a regular basis to track safety performance.
3. Studies in other jurisdiction could provide insight into ways in which regulatory environments affect safety performance.
4. Future research could also focus on benchmarking national and international safety culture indices.

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