

How We Can Better Learn from OSHA Forms: From a Bulletin Board to the Vision Board

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In the United States, construction firms that employ more than ten employees are required to annually post a summary of job-related injuries and illnesses utilizing a form called OSHA 300-A. This form potentially is a significant source of information for construction and safety managers who strive to reduce work-related injuries in their workplaces. However, *'how construction and safety managers benefit from OSHA recording forms'* has not been empirically studied. Therefore, this study aims to examine the use of OSHA 300-A by construction professionals. The results of surveying 44 construction practitioners indicated that most construction organizations do not review and analyze OSHA 300-A Form. Accordingly, this study proposes an easy and practical tool to help construction and safety managers analyzing OHSA 300-A. The suggested tool provides a method for prioritizing work-related accident causes which in turn assists practitioners focusing on a few yet important causes that cause the majority of occupational accidents. Thus, Construction firms, especially those suffering from high rates of incidents, can significantly improve their safety performance by adopting the proposed tool. The tool offers an easy, effective, and practical method to optimize the allocation of limited resources to address the most important causes of incidents. Also, this study equips construction and safety managers by providing reliable methods to roughly estimate the previous year's monetary value lost due to work-related accidents so that they can justify their proposed safety budget and corrective actions.

Key Words: Construction, Safety, OSHA, Accident, Form 300A

Introduction

Construction undergoes high rates of occupational fatal and non-fatal accidents. Despite the allotted efforts to improve safety management programs, the number of fatal injuries reported in construction has raised in the past few years. The number of fatal work-related injuries in 2015 was 22 percent more than the reported fatalities in 2011 (BLS 2015; BLS 2012). Similarly, the rate of non-fatal accidents in construction is unacceptably high. For instance, more than 200,000 non-fatal construction injuries are reported every year (BLS 2015). These fatal and non-fatal occupational injuries have severe impacts on construction workers, employers, and societies (Ikpe et al. 2012). Merely, the quantifiable cost of construction accidents in the United States exceeds $48 billion each year (Ahmed et al. 2006).

The Occupational Safety and Health Administration (OSHA) is a federal agency that regulates construction safety (OSHA 2010). To accomplish its mission, OSHA requires construction firms to complete an OSHA 300 Form for each work-related accident and annually post the OSHA Form 300-A for their employees to review. The primary goal of creating and reviewing OSHA forms is to learn and accordingly improve the overall site safety. According to 29 CFR 1904.41, only firms that hired more than ten employees during the last calendar year must complete and maintain OSHA recording forms. OSHA has provided templates for generic 300, 300-A, and 301 Forms for firms to follow which could be used to comply with 1904 OSHA requirements. The OSHA 300-A Form provides a summary of work-related injuries and illnesses that occurred during the previous year at the firm's workplaces. Specifically, OSHA 300-A log provides the following information: 1) the total number of employees, 2) the total work-hours by all employees,

3) the number of injuries/illnesses, and 4) the total number of days away from work, job transfer, and restriction (Olorunnishola et al. 2010). Accordingly, this information could improve the overall site safety if well quantified, reviewed, and analyzed. Reviewing the information alone is not enough for construction and safety managers to make smart decisions on improving safety. Accordingly, this article provides a practical tool to investigate OSHA forms further to improve overall site safety.

Also, the monetary value of accidents that may be estimated from OSHA 300-A could be used to strengthen management commitment and front-line supervisors buy-in because, aside from the human cost of an accident, monetary value can be enormous and shocking (Sawacha 1999). In addition to the proposed tool to review and analyze OSHA forms, this study equips construction and safety managers by providing reliable methods to roughly estimate the previous year's monetary value lost due to work-related accidents so that they can justify their proposed safety budget and corrective actions.

Methodology

A review of the literature revealed a research gap in quantifying the data presented in OSHA forms. Therefore, there is a need in the construction industry to provide an analytical tool to take advantage of the forms which are available to all construction firms with more than ten employees per calendar year. Before developing the proposed method, it was necessary to investigate the currently available methods to analyze OSHA forms, if any. Accordingly, in the first phase of the study, construction supervisors were approached to address two fundamental questions regarding OSHA 300-A Form as part of an online inquiry. The first question examined if the supervisors review the form annually (i.e., do you usually review the yearly OSHA 300A form?), and the second question inquired if they analyzed the data contained in the form (i.e., do you statistically analyze the OSHA 300A? For example, do you create charts out of the 300-A data or count the money spending based on the number of days away from work that listed in the 300-A Form?). The preliminary survey was administered over a period of two months using Qualtrics software. The goal of the survey was to make inferences about the currently practical use of OSHA forms. The survey sample size, 44, was a convenience sample compared to the common practice in construction research projects since a random probability sample is a difficult approach (Abowitz and Toole 2010, Keppel and Wickens 2004). Forty-four responses were received at the end of March 2017. The design of the survey did not prevent respondents from skipping questions if they desired or feel uncomfortable answering. Therefore, the number of responses received for each question may vary.

After obtaining data from construction experts in phase I, in the next phase, a simple and practical tool to help construction and safety managers analyzing OHSA 300-A and methods to roughly estimate the previous year's monetary value lost due to work-related accidents are proposed.

Findings

After the data had been gathered, the data were analyzed accordingly. The respondents involved in different types of construction as follows: twenty-two respondents (53.66%) indicated that they work in building construction; eleven respondents (26.83%) in special trades contracting; and eight respondents (19.51%) in heavy and civil engineering construction. The profile of the respondents falls within one of the following categories: company owner, project managers, superintendent, labor, and safety officer. In term of experience, the participants were highly experienced with an average of 23.3 years of experience in the construction industry and the standard deviation of 9.5 years.

Twenty-five responses (56.82%) indicated that the respondents' organizations do review their OSHA 300-A forms, which means nineteen (43.18%) respondents do not review the forms. Furthermore, thirty-four (80.95%) respondents indicated that their establishments do not analyze the OSHA forms. These findings are significant and indicate a crucial need to help construction and safety professionals to benefit from the recorded OSHA 300-A forms and extract valuable lessons learned from the catastrophic and costly accidents that the companies have experienced in the past calendar year. In fact, past research has revealed that by reviewing the previous accidents and investigating the leading causes of accidents and providing effective training to construction workers, most construction accidents can be prevented (Namian et al. 2018; Zuluaga et al. 2016). The current research assists construction and safety professionals to take advantage of the OSHA 300-A forms by proposing an easy yet practical analytic tool which facilitates the review of OSHA forms, and obtain insightful lessons to improve construction safety.

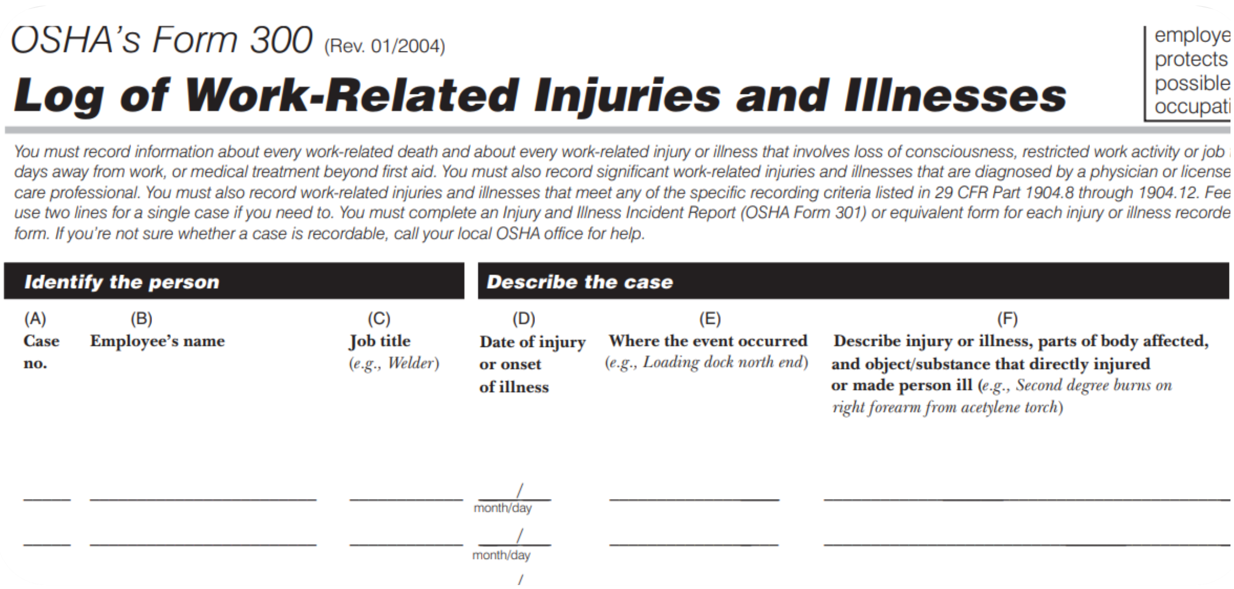
Proposed Analyze of OSHA Forms

Quality tools such as a scatter diagram, cause-and-effect diagram, and Pareto chart could be used to investigate and analyze construction firms' safety performance (Karakhan, 2017). Accordingly, this study illustrates how to use a Pareto chart to identify the leading causes of work-related accidents by utilizing OSHA forms. The Pareto (pah-ray-toe) chart, named after Italian economist and sociologist Vilfredo Pareto (1848-1923), uses the principle that a minority of causes result in a majority of problems (Goetsch & Davis, 2010). The Pareto chart is generated by sorting data from highest to lowest in frequency to identify the most active or more frequent factors. It is essential to thoroughly investigate every indecent (i.e., fatal and non-fatal accidents and near-misses) and immediately adopt corrective actions. However, reviewing OSHA 300-A is crucial and can reveal invaluable insights into overall safety performance because of the following:

- The causes of one incident cannot be overgeneralized
- one accident can barely reveal leading indicators of safety performance such as safety climate and culture, upper management commitment, and safety training (Hinze et al. 2013).
- Concentration on an accident can be distracting to overlook in-depth analysis of a company's safety performance
- Immediate corrective actions that usually taken after an incident can lead to a false sense of security assuming that all the accident root causes have been addressed
- Analysis of one accident without considering a record of accidents oversimplify the complex, sophisticated, and dynamic matter of safety performance, potentially leading to a wrong direction (Lingard et al. 2017).

Identifying the most significant and frequent factors is crucial due to the true dynamic nature of construction environments. Construction companies, especially those that suffer from high rates of incidents, can significantly improve their safety performance by adopting the proposed tool. The tool offers an easy, effective, and practical method to optimize the allocation of limited resources to address the most important causes of incidents. Previous studies have indicated numerous factors (approximately 100 factors) that impact safety performance of construction workers (Namian et al. 2016). This identification can help focus on the factors that are repeated most and cause the majority of events instead of being distracted and confused by a wide variety of factors. Pareto charts usually suggest that the data often follow the 80-20 rule, in which 20 percent of the causes cause 80 percent of organization events (desirable or undesirable). Therefore, the Pareto chart could be used in safety management to find the fewer yet most effective factors that caused 80 percent of work-related accidents listed on Form 300-A. In this method, after calculating the percentage of each cause, the Pareto chart will be graphed to illustrate the cumulative percentages of the causes of work-related accidents and sorting them starting from the highest percentage. A cascading Pareto chart could be a Pareto chart of the immediate causes used to find the fundamental cause of an incident, or all incidents. The main idea of a cascading chart is to identify the causes of 80% of work-related accidents which are predicted to represent only 20% of the causes.

The information that is required to create a Pareto chart is found on OSHA 300 and 300-A Forms. The total number of work-related accidents could be found on Form 300-A, and the direct cause of each accident could be often found on Form 300 under column F. While Form 300 does not call for the cause of an incident, the cause is often included under column F on Form 300 (see Figure 1). However, if the direct cause is not listed on Form 300 A, safety professionals should be able to find the direct cause on the OSHA 301 Form or the incident report. Identifying the direct cause is necessary to create the Pareto chart. It is also recommended to narrow the direct causes down to limited categories to only include fall, ergonomics, struck-by, caught in/between, electrocution and others. According to OSHA's statistics, falls, struck-by, caught-in/between and electrocutions are the top four causes of construction fatalities (2018). After creating the Pareto chart, it needs to be analyzed to shed lights on the safety performance of construction firms. In the following section, step-by-step instruction is provided to analyze Pareto charts.


OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

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protects
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You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or license care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Fee use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorde form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Identify the person			Describe the case		
(A) Case no.	(B) Employee's name	(C) Job title (e.g., Welder)	(D) Date of injury or onset of illness	(E) Where the event occurred (e.g., Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g., Second degree burns on right forearm from acetylene torch)
			/ month/day		
			/ month/day		

Figure 1. OSHA 300 Form (source: www.OSHA.gov)

Step-by-Step Pareto Analysis

To demonstrate and instruct how to analyze a Pareto chart, a simulated set of data consisting of 163 work-related accidents is analyzed using a Pareto chart. The direct causes of the 163 accidents are as follows:

- Ergonomics – 75 accidents,
- Fall – 56 accidents,
- Struck by – 24 accidents,
- Others – 8 accidents.

A spreadsheet of all incidents with their direct causes must be created similar to Table1 which represents the data used to illustrate the proposed method. The first step is to arrange the accidents based on the frequency of their direct causes from high to low. The second step is to calculate the cumulative percentage as shown in Table 1.

Table 1. Types of Accidents and Frequency of Occurrence

Accidents Cause	Frequency	Percentage (%)	Cumulative (%)
Ergonomics	75	46.0%	46.0%
Fall	56	34.4%	80.4%
Struck By	24	14.7%	95.1%
Others	8	4.9%	100.0%
Total	163	100%	-

Based on the results shown in Table 1, a Pareto chart can be generated presented in Figure 2. The Pareto chart uses the accident causes as the X-axis and the cumulative percentage of the causes as the Y-axis. Once the Pareto chart is created, construction firms can identify the most influential causes which in turn would help construction safety managers focus on a few causes that lead to the majority of accidents.

In this simple hypothetical example, the Pareto chart shows that the direct cause of 80.4% of work-related accidents are ergonomic and fall. Consequently, there is a need for further analysis to determine the root causes of these two identified causes (i.e., ergonomic and fall). For example, if it is found that a high percentage of ergonomics-related accidents results from heavy lifting, a new lifting policy that includes purchasing new lifting tools can be adapted to minimize the risk of exposure to economic hazards. Similarly, further investigation of fall cases can be performed in the same manner to determine the specific reasons for why fall is an issue in the workplace. Depending on the results of the analysis, corrective actions can be taken to reduce the occurrence of accidents in that particular area. As a result, focusing on a few causes that led to the most of work-related accidents (i.e., 80 percent or more) could lead to significantly lower work-related accidents.

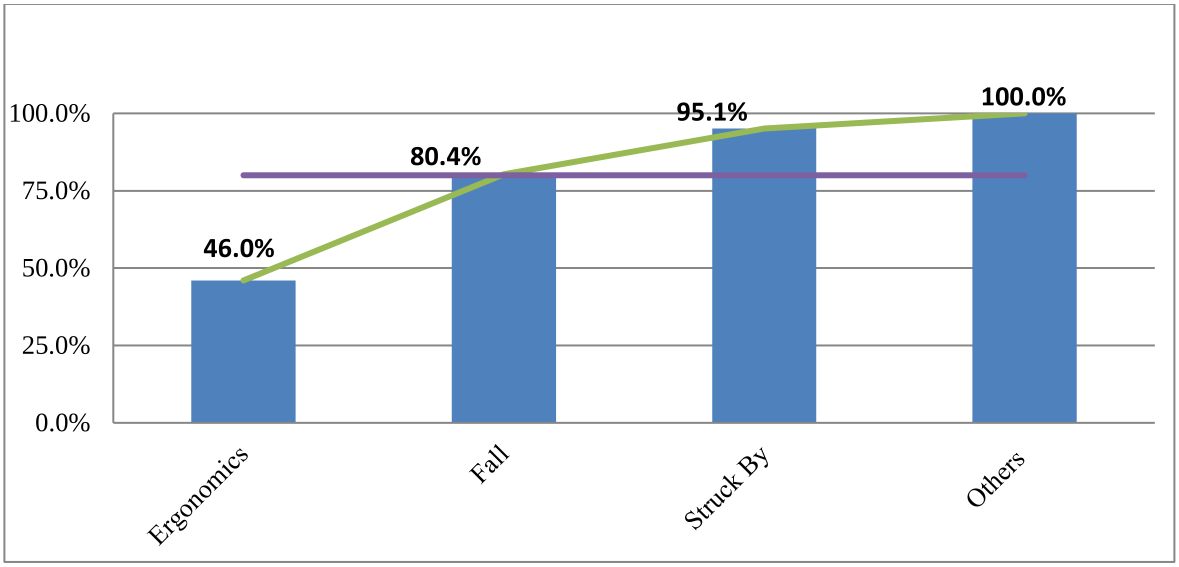

Figure 2. Incidents' Causation Illustrated in Pareto Chart

The Cost of Accidents

Calculating the cost of work-related accidents is another crucial element to improve the overall safety management and increase the allocated safety budget and management commitment. OSHA 300-A could provide a venue to roughly estimate part of accidents' cost that occurred in the previous year. The number of days away from work and job restriction on OSHA 300-A Form could be used to roughly calculate the cost. The calculated cost of previous year work-related accidents could be used to justify the budget that is needed to improve accident prevention techniques such as providing personal protective equipment (PPE) and safety training. OSHA 300-A includes the total number of days away from work, job transfer, and restriction. Equation (1) and (2) can be used to estimate the cost of days away from work as well as the days of job transfer and restriction.

$$\text{Cost}_{\text{(Days away from work)}} = (D * \$) * 2 \quad (1)$$
$$\text{Cost}_{\text{(Job restriction and transfer)}} = D * \$ \quad (2)$$

where,
D: Number of days
$: The average hourly/daily wage of the injured employee
2: A factor to satisfy the logic that firms will hire or allocate another employee to fulfill the injured employee duties. This factor must be removed when calculating the cost of job restriction and transfer.

For example, the form 300-A shows that 350 days away from work and 150 days of job transfer and restriction have occurred during the previous year. Assuming the average pay within an organization is $15 per hour (i.e., $120 per day) then the total loss will be $84,000 for days away from work and $18,000 for job restriction and transfer. These numbers plus the other cost of accidents could change the way many organizations perceive the role of safety professionals and their proposed budgets.

Limitations

Despite the benefits, the study has several limitations. First of all, the study's first phase sample size was a convenience sample and, therefore, the findings from the survey cannot be generalized across the nation. Second, in many cases, the availability of data on safety accidents and how they occurred is limited. The current accident investigation practices identify only the direct cause such as fall or electrocution rather than the proximate or root causes of accidents that led to the occurrence of accidents (Al-Bayati and York. 2018; Gibb et al. 2014). The causal analysis will lead to errors in identifying the direct cause as well as the root causes which may affect the effectiveness of the suggested remedies. Furthermore, decisions and the related actions that are based on accidents' direct causes only, rarely improve the overall site safety without enough attention to the root causes. Finally, the proposed method depends on the frequency of direct causes during the previous year. However, reducing the number of accidents may not be the firms' best approach to improve construction safety in their workplaces. For example, a firm may have dozens of laceration injuries with relatively low risk and cost associated with them, and a single back sprain which can cost thousands of dollars in workers' compensation. A Pareto chart with the number of incidents would consider the lacerations a top priority, whereas a different method using the cost associated with the incidents would prioritize back sprains. Additionally, the severity of the hazards should be considered. Non-life-threatening injuries should not be given priority over hazards which are immediately dangerous to life and health. Unsafe conditions with an unacceptable risk should be corrected immediately regardless of their frequency. The simulated data represent a relatively high number of accidents that most construction projects do not experience such a high number of accidents in one year. However, companies that have numerous projects across the country can integrate different projects' data or integrate the data of several years to amplify the benefit of adopting the suggested tool.

Conclusion

Construction is among the most dangerous industries concerning the high number of occupational fatal and non-fatal accidents (BLS 2015). Despite the efforts to improve safety management programs, the number of fatal injuries reported in construction continues to be unacceptably high in past years (BLS 2011; BLS 2015). To improve construction safety, it is essential to thoroughly investigate the previous accidents and their causes to prevent future accidents. However, accidents and their causes are complicated. OSHA forms provide a basic summary of the previous year accidents. Accordingly, construction firms should review and analyze their OSHA forms to prioritize the causes of the previous year recorded work-related accidents, given the limited budget and resources available to allocate to safety enhancement programs. However, a survey of 44 construction professionals and practitioners revealed that almost half of the construction firms do not review OSHA forms and most of them do not analyze the recorded results. To address this issue, this study provides a practical yet straightforward technique to construction firms, so they can utilize the Pareto charts to determine the most common accidents and their causes. The resulted data would allow construction firms to take appropriate actions to reduce the work-related accidents. Using the 80-20 rule could improve the overall site safety by identifying a few causes that led to a significant number of injuries. The main advantage of the suggested method is utilizing forms which are available in all firms with more than ten employees in the United States. Accordingly, the method has a potential and can be beneficial for safety professionals looking for a straightforward and practical tool to adopt. However, until the root causes of these accidents are genuinely identified and resolved, similar work-related accidents may continue to occur. Furthermore, this study equips construction and safety managers by providing reliable methods to roughly estimate the previous year's monetary value lost due to work-related accidents, so they can justify their proposed safety budget and corrective actions. The findings of the current research are beneficial for practicing construction professionals seeking to investigate causes of construction accidents in their firms and effectively yet swiftly improve the safety performance of their construction workers in the workplaces. Construction companies, especially those that suffer from high rates of incidents, can significantly improve their safety performance by adopting the proposed tool. The tool offers an easy, effective, and practical method to optimize the allocation of limited resources to address the most important causes of incidents.

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