

**TO CREATE A RECORDING AND CLASSIFICATION SYSTEM FOR
FIRST-AID INJURIES IN THE CONSTRUCTION INDUSTRY**

A Thesis

by

BHAVANA SUDHAKARAN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2010

Major Subject: Construction Management

**TO CREATE A RECORDING AND CLASSIFICATION SYSTEM FOR
FIRST-AID INJURIES IN THE CONSTRUCTION INDUSTRY**

A Thesis

by

BHAVANA SUDHAKARAN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Approved by:

Chair of Committee,	Nancy Holland
Committee Members,	John Nichols
	Anne Nichols
Head of Department,	Joe Horlen

May 2010

Major Subject: Construction Management

ABSTRACT

To Create a Recording and Classification System for First-aid Injuries
in the Construction Industry. (May 2010)

Bhavana Sudhakaran, B.Arch., Hindustan College of Engineering, Chennai, TN, India

Chair of Advisory Committee: Dr. Nancy Holland

The construction industry is known for its high accident rate which leads to numerous fatalities every year. Currently, the Occupational Safety and Health Administration (OSHA) requires injury/illness recording forms to be completed only for injuries requiring medical treatment and fatalities. The assertion of this paper is that underlying problems can be best determined through the causes of first-aid injuries that have the potential to prevent serious injuries in the future. Therefore, by classifying and recording first-aid cases on project sites, the common trend type of injury can be followed and appropriate measures can be taken to eliminate hazards. The main objective of this research is to establish a comprehensive standardized database to record first-aid injury cases, injuries requiring medical treatment and fatalities all in one. The recording format described in this research will facilitate the analysis of the data in a more effective manner which can subsequently be used to develop pre-emptive measures to eliminate common causes for construction injuries.

In order, to create the Form, 900 sets of injury data were obtained from an industrial construction firm and analyzed. These data provided a good indication of the

classification system adopted by industries today. The proposed Injury and Illness Database/Form (I & I Form) has been created using Microsoft Access by keeping in mind all aspects of an accident/injury both from the side of the employee and the employer. The recording system has definitions for all types of injuries and illnesses which will help in classifying them easily universally. A pilot test was performed for the I & I Form by engaging 30 graduate students and the survey results showed that the Form was user friendly and self explanatory.

DEDICATION

I am dedicating this research paper to my parents and my sister who have always supported and encouraged me in my endeavors, enabling me to pursue my master's degree in the United States of America.

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Nancy Holland, who gave me the inspiration, constant encouragement and extensive guidance to work on this topic for my thesis. I am grateful to her for being wonderfully supportive during the entire duration of my master's study in Texas A&M University.

Special thanks to my committee members, Dr. John Nichols and Dr. Anne Nichols, for all their time and support.

I want to extend my gratitude to the construction science students who helped in the survey that was important to the completion of the thesis. Thanks also go to my friends and colleagues and the department faculty and staff for making my time at Texas A&M University a great experience.

NOMENCLATURE

OSHA	Occupational Safety and Health Administration
BLS	Bureau of Labor Statistics
WHO	World Health Organization
SIC	Standard Industrial Classification
IR	Incidence Rate
DART	Days away from work (or) Restricted Work (or) Transfer
VBC	Visual Basic Coding
CFOI	Census of Fatal Occupational Injuries

TABLE OF CONTENTS

		Page
ABSTRACT		iii
DEDICATION.....		v
ACKNOWLEDGEMENTS		vi
NOMENCLATURE		vii
TABLE OF CONTENTS.....		viii
LIST OF FIGURES		x
LIST OF TABLES.....		xi
CHAPTER		
I	INTRODUCTION: THE SIGNIFICANCE OF RESEARCH.....	1
II	BACKGROUND: LITERATURE REVIEW	5
III	CURRENTLY USED OSHA INJURY/ILLNESS RECORDING FORMS	11
	Form 300	14
	Form 300A	15
	Form 301	16
IV	PROPOSED INJURY & ILLNESS DATABASE/FORM.....	19
	Methodology Used to Develop the Proposed Injury & Illness Database/Form for First-aid Data	19
	Requirements of the Proposed Injury & Illness Database/Form....	20
	Proposed Classification System for Injuries and Illnesses.....	22
	Database Information Fields for the Proposed Injury & Illness Database/Form.....	24
	Definitions Provided for Item #44 in the Form.....	36

CHAPTER	Page
V SURVEY: TESTING THE FORM	38
The Three Sample Accident Scenarios	39
Result of the Survey	43
VI CONCLUSION	45
REFERENCES	48
APPENDIX A DEFINITIONS.....	49
APPENDIX B VISUAL BASIC CODING	50
APPENDIX C NEW FORM AND SURVEY	54
VITA	55

LIST OF FIGURES

FIGURE		Page
1	OSHA Considerations for Recordable/Non-recordable Data.....	13
2	Flow Chart for Injury & Illness and for the Continuous Improvement Program.....	22
3	Proposed Injury & Illness Database/Form.....	41

LIST OF TABLES

TABLE		Page
1	Level of difficulty faced in completing the Form	43

CHAPTER I
INTRODUCTION: THE SIGNIFICANCE
OF RESEARCH

The construction industry is associated with the largest number of work-related injuries in comparison to other industries. According to OSHA, injuries and illnesses are divided into two categories, Recordable or Non-Recordable injuries (First-aid).

- Recordable injuries are work related injuries that require medical treatment and involves restricted work, job transfer or days away from work.
- Non- Recordable injuries are work related injuries that require only first-aid treatment and does not involve job transfer or days away from work.

First-aid is the emergency care provided for injury or sudden illness before emergency medical treatment is available. The first-aid provider in the workplace is someone who is trained in the initial medical emergency procedures, using a limited amount of equipment to perform a primary assessment and intervention while awaiting arrival of emergency medical service (EMS) personnel (OSHA, 1970).

The Occupational Safety and Health Act of 1970 required all industry employers to keep a record of all work-related injuries and illnesses. A survey was developed by the Bureau of Labor Statistics (BLS) in collaboration with state governments to estimate the number of injuries associated with construction annually. These statistics are valuable data used for analysis by industries to help them understand

This thesis follows the style of *Construction Management and Economics*.

what the common injuries are thereby giving a direction to them to develop more efficient safety measures to ensure a reduction in their fatality rate.

The BLS survey was then developed further to include non-fatal accidents on construction sites that caused workers to take time away from work. The statistics also contained details such as the nature of injury and other demographic information (MDLI, 2007). These statistics are very important because prior to this, industries did not have any estimate of the number of injuries occurring in construction sites everywhere. These statistics also helped them realize that steps had to be taken to ensure a lower incidence rate.

‘The Pareto principle (also known as the 80-20 rule, the law of the vital few and the principle of factor sparsity) states that, for many events, roughly 80% of the effects come from 20% of the causes’ (Wikipedia, 2001). Many construction firms consider first-aid injuries unimportant and not worth keeping a track of. Companies are not keen on keeping first-aid records as there is a potential for increase in their insurance rates and also the paperwork is time consuming and cumbersome. However companies will soon realize that they were wrong in making this assumption as the reality is that often the cause of a first-aid injury can become a cause for a serious fatality. This means that an action or event that caused a first-aid injury today may tomorrow cause a major injury or fatality. The Pareto principal can be used to understand and study this phenomenon. Therefore one can assume that by eliminating 20% of the causes of first-aid injuries, we could avoid 80% of the major injuries. The use of trend analysis has proven to be extremely useful in cost and schedule control. Therefore, if the necessary data is

collected it could be analyzed to find the common trend in the documented first-aid injuries in turn providing an indication to the management of an impending danger. Thus, this information can then be used to take steps to reduce the risk associated with performing the particular activity that was responsible for the frequent injuries.

Another important fact that companies are missing out on is that first-aid injuries also incur big losses to a company annually in thousands of dollars. For ex: If a certain construction company has to spend approximately \$30 on each first-aid case in terms of money and work delay, then if the company has about 30 cases a month, then that amounts to \$900 and for a year it will come up to \$10,800. This shows that thousands of dollars can be saved by documenting first-aid injuries. A first-aid injury on site will also result in lower labor productivity and perhaps reduced quality workmanship by the injured employee and those around him for a few hours after the injury or for the rest of the day. This is a loss to the company in many terms. Near-misses can be used as indicators for impending danger on construction sites. A Near-miss is an incident on the job site that could have caused an injury but just stopped short of causing harm to any individual.

Since the need to document first-aid cases has been explained, the need for classification has to be understood. By giving proper definitions for all kinds of injuries, it is easier and convenient for a person to determine how to classify a particular kind of injury. It could also include the cause of the injury. This common language can be communicated through a program which can be used in all kinds of industries to classify and record their first-aid related injuries. Thus the characteristics of a good database

system is to have common definitions established using a standard classification system which can be used country wide making it a set format and thus more user-friendly.

The records from the database could be used as a measure to evaluate the effectiveness of the safety programs being used in the particular industry. Finally as mentioned before, through the data recorded by various industries it is possible to identify what the common first-aid cases are and thus take steps to minimize the injury rate.

CHAPTER II

BACKGROUND: LITERATURE REVIEW

An accident is defined as an unplanned event generally associated with negative consequences such as fatalities, injuries, near misses, damaged materials and shattered nerves (Wikipedia, 2001). OSHA requires industries to only document recordable injuries to be produced for inspection when asked. Recordable injuries could include days away from work, days of restricted work activity or no loss of restricted work days.

A record made of an injury or illness on the OSHA recordkeeping forms only shows three things:

- That an injury or illness has occurred.
- That the employer has determined that the case is work-related (using OSHA's definition of that term).
- That the case is non-minor, *i.e.*, that it meets one or more of the OSHA injury and illness recording criteria (OSHA, 1970).

This research promotes the documentation of non-recordable injuries and illnesses (first-aid).

The Standard Industry Classification (SIC) Number developed by the BLS is the widely used identification number for the various industries. Only construction related industries will be considered for the purpose of research. Construction comes under Division 'C' and has three major groups under it (BLS, 1884). This SIC classification is used in the proposed I & I Form.

They are divided as given below (BLS, 1884):

Division C: Construction

- Major Group 15: Building Construction General Contractors and Operative Builders.
- Major Group 16: Heavy Construction Other Than Building Construction Contractors.
- Major Group 17: Construction Special Trade Contractors

In the BLS website, the latest OSHA recordable case rates and incidence rates for nonfatal work-related injuries and illnesses in 2007 is given. The data for the construction industry shows that out of 7,790.6 (annual average employment in thousands), there were 5.4 recordable cases and 2.6 other recordable cases. It also included 1.9 cases with days away from work and 0.9 cases with job transfers or restrictions. The incidence rate was 5.2 with the number of cases being 371,700. In 2007, the rate for non-fatal occupational injuries and illnesses requiring days away from work declined by 4% in 2006 to 122 per 100,000 full-time workers and the number of cases decreased by 24,630 cases. The laborers and movers had the highest number of cases but had a 7% decline from 85,120 to 79,000 (BLS, 1884).

When all types of industries are considered, these are the following case and demographic data recorded for non-fatal injuries in 2007 statistics are as follows: Sprains and strains contributed to 2% of the injuries, decreased from 5% in 2006. Cases due to overexertion reduced by 7% and cases involving the most affected part of the body called the trunk (including shoulder and back) decreased by 4% from 2006. The

number of injuries due to slippery surfaces increased by 7% in 2007 even though it has been previously known as the most common cause for accidents with 20% of the injuries. For construction workers, 35% of the injuries resulted from contact with objects and equipment (BLS, 1884).

As far as the number of different types of non-fatal injuries recorded in 2007, 135,350 cases occurred in the construction industry. Of these there were 44,380 (sprains, strains and tears), 17,350 (fractures), 20,380 (cuts, lacerations and punctures), 8,380 (bruises and contusions), 1,250 (heat burns), 540 (chemical burns), 870 (amputations), 280 (carpel tunnel syndrome), 320 (tendonitis), 6,750 (multiple trauma), 10,740 (soreness and pain) and 24,100 (other nature). In these the number of the various body parts affected were 10,590 (head), 41,210 (trunk), 31,830 (upper extremities), 34,340 (lower extremities), 1600 (body systems), 12,900 (multiple body parts) and 1000 (all other body parts) (BLS, 1884).

The sources for the above mentioned injuries in construction in 2007 were recorded as follows: 1,290 (chemical and chemical products), 5,770 (containers), 2,930 (furniture and fixtures), 8,440 (machinery), 29,880 (parts and materials), 29,320 (slippery surfaces), 11,640 (hand tools), 7,330 (vehicles) and 38,740 (other sources). The statistics for events or exposures leading to the injury or illness were - 47,870 (contact with objects), 19,870 (fall to lower level), 12,570 (fall to same level), 3,770 (slip without fall), 23,540 (overexertion), 1,610 (repetitive motion), 5,040 (exposure to harmful substances or environment), 5,310 (transportation accidents), 320 (fires and explosions), 480 (assaults and violent acts) and 14,970 (other events) (BLS, 1884).

The BLS website provides calculators that allow users to determine the injury and illness incidence rates in the work place and tools to compare a company's rates with the averages for the nation or the specific industry type they are involved in. These calculators require the number of hours actually worked by all employees at the concerned establishment in the given year, the total number of non-fatal work-related injury and illness cases, the number of cases involving days away from work, the number of cases involving job transfer or restricted work activity only. They also require the year, area, super sector and industry in order to obtain an estimate. The BLS website also provides databases for workplace injuries with special notices, top picks, multi-screen data search, tables and text files (BLS, 1884).

In 2008, the rate of fatal injury for all U.S. workers was 3.6 fatal work injuries per 100,000 full-time equivalent (FTE) workers, down from the final rate of 4.0 in 2007. Fatal work injuries in the private construction sector in 2008 declined by 20% from 1,204 cases in 2007 to 969 cases in 2008. Fatal workplace falls, which was high in 2007, also declined by 20% in 2008. The number and rate of fatal work injuries among 16 to 17 year-old workers were higher in 2008. According to the BLS analysis, economic factors likely played a role in the fatality decrease. In addition, average hours worked at the national level fell by one percent in 2008. Budget constraints at some of these governmental agencies may have delayed the receipt and processing of the documents that are used by our State partners to classify and code Census of Fatal Occupational Injuries (CFOI) cases. Thus, the average net increase in CFOI cases as a result of updates over the past two years has been 153 cases, but the updated 2008 counts

scheduled for release in April 2010 have the potential to be larger because of these delays (BLS, 1884).

The following give a little background information to understand Injury statistics:

- Calculation of Incidence Rate (IR) (*Total number of injuries and illnesses X 200,000 / Number of hours worked by all employees= Total recordable case rate*).
- DART rate – IR involving days away from work(column H), days of restricted work or job transfer(column I) *{(number of entries in column H + number of entries in column I) X 200,000/ number of hours worked by all employees= DART IR}* .
- Comparing company IR's to the BLS (*Bureau of Labor statistics*) IR data obtained by the yearly survey of occupational injuries and illnesses (BLS, 1884).

Injuries caused by a slip or trip were studied in 2006 using data from the construction phases of the Denver International Airport. Slips and trips contributed to 18% of all the injuries that occurred on the construction site which resulted in 25% of worker's compensation payments of approximately 10 million dollars. Of this, slips made up 85% of the cause of falls, some of them even causing musculoskeletal injuries. Many of these accidents could have been avoided if sufficient care were given to the walking and working surfaces to make them slip free. It was found that, due to the size of construction projects a lot of emphasis will have to be made on environmental and organizational solutions in order to change the site to protect the workers as the project evolves with time (Lipscomb *et al.*, 2006).

In a survey of injuries from nine hospitals in rural Iowa, it was found that 189 of 1843 patients with injuries reported were employed by the construction industry. The injury rate was 2.5 times higher for construction workers than people with other occupations. The work injury rate was 7.63 per 100 construction workers while it was approximately 1.4 per 100 other employed people. The majority of injuries seen were open wounds, burns, fractures, dislocations, and contusions which occur often on construction work sites (Zwerling *et al.*, 1996).

A study was done in South Korea to understand the characteristics of occupational injuries in terms of the size of the company, age of the injured person, the cause of the accident, injury type, work experience of the person and the agency type. From the data collected, three conclusions were found:

- The most common type of injury is falls from a height.
- The lower portion of the body is most prone to non-fatal injuries and
- Most of the injuries happened due to the temporary nature of the construction fabric such as poor scaffolding strength (Byung, 1998).

These studies indicate that construction workers face grave safety issues on a daily basis on their work site. Therefore, it is the responsibility of the industry to take more stringent measures to be taken to ensure the well being of workers. The use of the proposed I & I Form by the industry will bring them a step closer to the objective of documenting all types of injuries, analyzing the data and providing feedback to field management that will enhance safety procedures in order to reduce injuries and fatalities in the construction industry.

CHAPTER III
CURRENTLY USED OSHA INJURY/ILLNESS
RECORDING FORMS

The OSHA Act of 1970 requires certain employers to prepare and maintain records of work related injuries and illnesses. OSHA's recordkeeping regulations are numbered as 29CFR Part 1904. OSHA currently uses recordkeeping forms 300, 300A and 301. The three types of Injury and Illness recordkeeping forms used by OSHA are as given below (OSHA, 1970):

- Log No.300 (Each injured worker is named, the extent of the injury, or the nature of the illness- recordable only)
- Log No.300A (annual summary report) and
- Log No.301-formerly 101 (provides details of a single injury).

The forms must be completed within 7 days of the occurring incident. The summary, Form 300A has to be posted on February 1 of the year following the year covered by the form and remain posted till April 30 of that year. The summary and log must be kept for 5 years. Forms only have to be sent to OSHA when they ask for them. The Log No.300A (summary) is posted to enable employees to be aware of the injuries and illnesses occurring in the work place. There are some partially exempt industries that don't have to keep records. OSHA has a recordkeeping handbook that can be used as a guide by companies to follow the right procedure for injury recordkeeping (OSHA, 1970).

Recording or reporting a work-related injury, illness, or fatality does not mean that the employer or employee was at fault, that an OSHA rule has been violated, or that the employee is eligible for workers compensation or other benefits.

Presently OSHA requires that injuries and illnesses with the following characteristics be recorded:

- Death
- Loss of consciousness
- Days away from work
- Restricted work activity or job transfer
- Medical treatment beyond first-aid
- Diagnosis of a significant injury/illness by a physician or other licensed health care professional
- Work related Cancer or chronic irreversible disease
- A fractured or cracked bone or a punctured eardrum.
- Any needle-stick injury or cut from a sharp object that is contaminated by another person's blood or potentially infectious material.
- Any case of an employee to be medically removed under provisions of an OSHA standard
- Tuberculosis infection
- Change in employee's hearing levels.
- Certain conditions, (colds, flu, blood donations) are not recorded

Currently, OSHA considers first aid as an initial treatment (not requiring sutures or prescription medication), visit to doctors and/or diagnostic procedures to be non-recordable. For a pre-existing injury or illness to be considered work related, an injury requires a significant degree of aggravation (OSHA, 1970).

Fig.1 shows the analogy used by OSHA currently to determine whether an injury or illness is work related or a new case and if it meets the general recording criteria thereby determining if it is recordable.

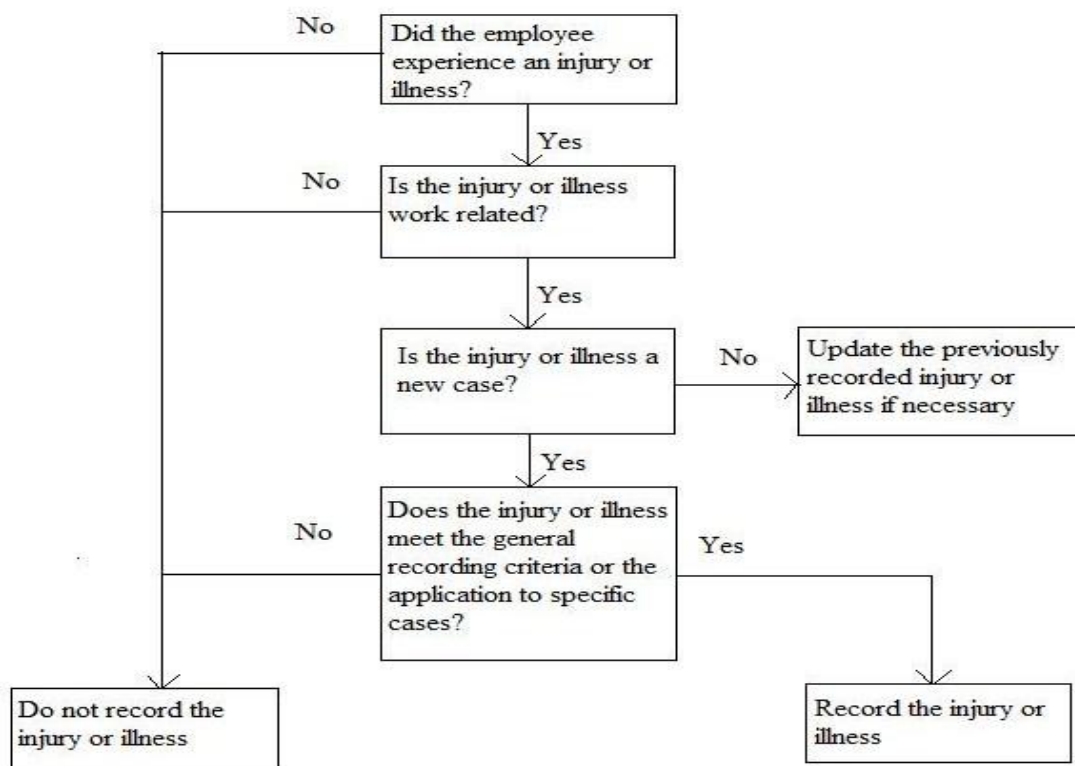


Fig.1 OSHA Considerations for Recordable/Non-recordable Data. (OSHA, 1970)

Form 300

The OSHA Form 300 (OSHA, 1970) is a Log of work related injuries and illnesses (Rev.01/2004). In this Form, the employer is required to provide the following details:

1. Establishment Name, City and State and Year of Entry.
2. Identification of the Injured or Ill Person:
 - Case no
 - Employee name
 - Job title
3. Describe the Injury/Illness Case to Include:
 - Date of injury or onset of illness
 - Where the event occurred
 - Describe injury or illness, parts of body affected, and object/substance that directly injured or made the person ill.
4. Classification of the Case with Respect to the Most Serious Outcome:
 - Death
 - Days away from work
5. Work Status of Injured/Ill Person:
 - Job transfer or restriction
 - Other recordable cases

Totals are to be calculated to transfer to Form 300A.

6. Number of Days the Injured/Ill worker was either:

- Away from work
- On job transfer or restriction

Totals also to be calculated to transfer to Form 300A

7. Type of Injury/Illness

- Injury
- Skin disorder
- Respiratory condition
- Poisoning
- Hearing loss
- All other illnesses

Form 300A

The OSHA Form 300A (OSHA, 1970) contains the summary of work related injuries and illnesses (Rev.01/2004). The data required in the Form is as follows:

1. Establishment Information:

- Name
- Address
- Industry description
- SIC – Standard Industrial Classification (4 digit) or NAICS – North American Industrial Classification (6 digit).

2. Employment Information:

- Annual average number of employees

- Total hours worked by all employees last year.
3. Number of Recordable Cases:
 - 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
 4. Number of Lost/ Restricted Work Days:
 - Total number of days away from work
 - Total number of days of job transfer or restriction
 5. Total Number of each Specific Type of Injury/ Illness:
 - Injury
 - Skin disorder
 - Respiratory condition
 - Poisoning
 - Hearing loss
 - All other illnesses

Form 301

The OSHA Form 301 (OSHA, 1970) contains details for the injuries and illnesses incidence report. The data required in the Form is as follows:

1. Information about the Employee:
 - Full name

- Address
 - Date of Birth
 - Date hired
 - Gender
2. Information about the Physician or other Health Care Professional who Treated the Injured/Ill Worker as well as Medical Treatment Details:
- Name of physician
 - If treatment was given away from the worksite, where was it given?
 - Facility name and address.
 - Was employee treated in an emergency room? (Y/N)
 - Was employee hospitalized overnight as an in-patient? (Y/N)
3. Information about the Case:
- Case number from the Log
4. Date of Injury/ Illness
5. Time Employee began Work (AM/PM)
6. Time of Event (AM/PM).
7. Injury/Illness Details
- What was the employee doing just before the accident occurred?
 - What happened? (How did the injury take place?)
 - What was the injury or illness?
 - Part of body affected and how it was affected?
 - What object or substance directly harmed the employee?

8. If the employee died, when did death occur (date)?.

With respect to lost work days or restricted activity, the count begins the day following the injury and ends when the employee returns to work or after a maximum of 180 days. OSHA also excludes some public transportation and motor vehicle accidents from the reporting of fatalities and catastrophes. OSHA changes the entry if the outcome changes later; only the most serious outcome is recorded in each case (OSHA, 1970).

CHAPTER IV

PROPOSED INJURY & ILLNESS DATABASE/FORM

Methodology Used to Develop the Proposed Injury & Illness Database/Form for

First-aid Data

New discoveries cannot be made without knowledge of the past. Thus, a study of the currently used OSHA forms and requirements for recordkeeping is advantageous. OSHA and the BLS do not require that one uses their forms, only that the same information should be provided. In order to reduce processing requirements, the proposed Injury & Illness Database/Form (I &I Form) should meet the needs of the employer for documenting both recordable and non-recordable injuries. This will make the I & I Form compliant with the law and provide information that can be used to develop safety program components that will prevent future injuries and illnesses.

In addition to analyzing regulatory requirements for inclusion in the proposed I & I Form, a data set of over 900 injury records was provided by an industrial construction firm from one of its projects. The analysis of these data set provided additional insights into the proposed database requirements.

Development of the database was based on the conclusions drawn from articles that were reviewed, OSHA recordkeeping rules and regulations, review of OSHA recorded injuries and illness citations and cases as well as the review of the industrial injury data set. The proposed Injury/Illness Database/Form was created by using Microsoft Access and Visual Basic coding and adding additional fields, data and

definitions with improved search options. The Form would also calculate the monetary losses incurred by the company for each injury occurring on the job site.

The proposed I & I Form was tested by 30 graduate students for ease of use and completeness. Three sample accident scenarios were created using as many different descriptions as possible to determine if the users would repeatedly select the same categories to complete the record fields. The respondent's assessment of the database format was then used to make changes as required.

Requirements of the Proposed Injury & Illness Database/Form

It was determined that the proposed first-aid database must meet the following requirements:

1. The database must be user-friendly such that the mechanics of using it could be performed by an individual with little training.
2. Repetitive data such as project name, number and address should only be entered once for a particular company and then they can be converted into macros (fixed information) which will remain throughout the duration of the project.
3. The database format and terms should be applicable to multiple types of projects such as industrial, commercial or civil.
4. The database should contain data required for both recordable injuries and illnesses and non-recordable first-aid injuries. This would allow for the documentation of all cases and the conversion of non-recordable cases to recordable when necessary.

5. The database should allow one to sort through the different fields easily to prepare reports for investigation or tracking purposes as well as comply with OSHA/BLS requirements.
6. The database should result in the same classification of items in the different data fields even when used by multiple individuals for multiple projects. This can be accomplished by using pull-down menus with appropriate standardized field classification and definitions for terms used in the Form. It was noted while reviewing the first-aid data set that a standard set of definitions was necessary for terms describing various injuries and illnesses.
7. The database classification fields should provide a standard set of categories to select from that are a common part of the industry's vocabulary, highly descriptive in nature and useful for sorting and tracking safety issues that can lead to the development of corrective action measures and improved safety programs that work to reduce construction incidence rates.
8. The database classification fields should also have another category which would provide space for a description in order to allow one to account for an unusual incident.
9. The database should allow for input and tracking of as much data as possible. It should also allow for the input of data that may be required at a later date for multiple project analysis and evaluation. These data might also be useful in the event of a legal issue that arises due to an injury or illness, the data added in the Form such as safety training details, cost data etc.

10. The results of the data entered in the Form can be used in:

- The preparation of various reports like OSHA/BLS Form 300, 300A and 301.
- The creation of accident investigation reports.
- The development of case status reports on a daily or periodic basis.
- The analysis, evaluation and continuous improvement of safety programs.

Proposed Classification System for Injuries and Illnesses

The overall classification system followed for developing the proposed Injury & Illness Database/Form is presented in Fig.2.

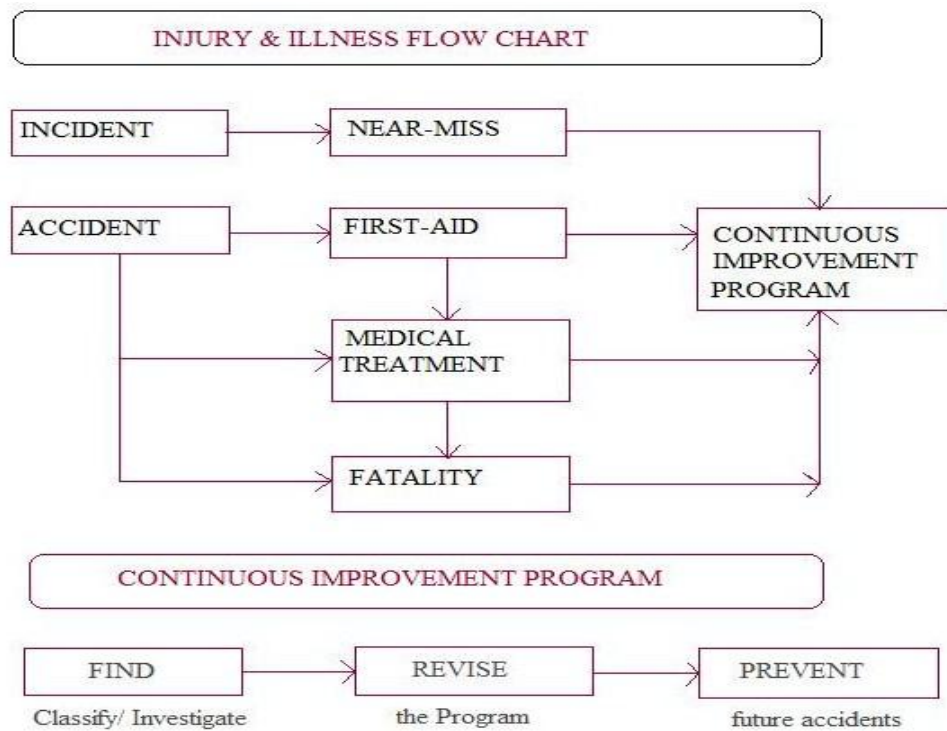


Fig.2 Flow Chart for Injury & Illness and for the Continuous Improvement Program.

Hazard Assessment and Mitigation can be done for injuries and illnesses by understanding the various types of incidents and accidents that occur at a construction site. The majority of injuries and illnesses result from any of the following five categories namely Near-miss, First-aid, Non-work related injury, Medical treatment and Fatality which are categorized under recordable and non-recordable injuries and illnesses. They can be described as follows:

- Non-Recordable Injury

(1) Near-miss: This indicates an incident on the job site that could have caused an injury but just stopped short of causing harm to any individual. Since no injury has occurred OSHA considers this non-recordable.

(2) First-aid: This type of injury is usually minor in nature, involves some basic First-aid measures to be taken and sometimes needs to be observed by a physician. A first-aid injury very rarely requires treatment. These injuries are not associated with days away from work or job transfer and so are not considered to be recordable by OSHA.

(3) Non-work related: The cause of this injury or illness is not work related and so will not be recorded.

- Recordable Injury

(4) Medical Treatment: This type of injury is caused by an accident on a job site requiring the injured individual to seek medical treatment from a medical facility and may require hospitalization. It is usually associated with days

away from work, restricted work activity or a job transfer. This injury is an OSHA recordable injury.

(5) Fatality: This refers to the death of a worker due to a work related activity.

All work related fatalities and loss of consciousness are recordable by OSHA standards.

As noted in the flowchart in Fig.2, an analysis of near-misses can also be used to develop a “Continuous Improvement Program” along with the other types of injuries with the aim of preventing future accidents. Again, the Pareto principle applies here and the odds are that numerous similar near-misses and first-aid injuries will result in an accident. The Continuous Improvement Program can also be prompted and modified by medical treatment cases and fatalities. The program works by implementing changes in the Form and revising it periodically to get a good database which helps in studying the common accident prone areas. The constant use of this program will help in avoiding future accidents thereby reducing the injury and fatality rate.

Database Information Fields for the Proposed Injury & Illness Database/Form

The proposed Injury & Illness Database/Form was created by using Microsoft Access because it is an efficient software which can be used to create different features in Databases and Forms and also has good search options in terms of using Queries to find information. Visual Basic coding was used to provide certain options in the Form which are not available in MS Access.

The information fields of the database are numbered below and the classification categories are listed as bullet items:

Record Details

1. Record number: (*Automatic numbering system*)
2. Status of Report: (*Pull down menu*). It is important to note that the record status can be left open as the case progresses and more information becomes available.
 - Open: This option is selected until the injured employee returns to work or when the investigation is complete.
 - Closed: This option is selected when the employee returns to work and when the investigation is complete.

Establishment Details (*Query 1*)

3. Name of Company: (*provide data*). This field can become a macro (permanent data) after it's entered once or it can be changed to track sub-contractors.
4. SIC No: (*pull down menu*)
 - Major Group 15 - Building Construction General Contractors And Operative Builders
 - Major Group 16 - Heavy Construction Other Than Building Construction Contractors
 - Major Group 17 - Construction Special Trade Contractors.
5. Type of Industry: (*provide data*). Ex: Industrial, Commercial, Civil etc.
6. Street Address of Company: (*provide data*)
7. City: (*provide data*)

8. State: *(provide data)*

9. Zip code: *(provide data)*

Details of Injured Employee (Query 2)

10. Direct Employer: *(pull down menu)*

- General Contractor
- Subcontractor
- Sub-subcontractor

11. Employer Information (if different from above): *(provide data)*

12. Injured Employee ID Number: *(provide data)*. This field can become a pull down menu once the company adds its employee information to the database.

13. Date Employee was Hired: *(Calendar pull down menu)*

14. Name of Injured Employee: *(provide data)*

15. Discipline of Work Involved in the Injury: *(pull down menu)*

- Concrete
- Earthwork
- Electrical
- Equipment
- Demolition
- Glazing
- Maintenance
- Mechanical
- Masonry

- Piping
- Scaffolding
- Structural + Misc. Steel
- Woodwork
- Other

16. Classification of Injuries and Illnesses: (*pull down menu*)

- Non-Recordable Injury:
 - (1) Near miss
 - (2) First aid
 - (3) Non-work related
- Recordable Injury:
 - (4) Medical treatment
 - (5) Fatality

17. Date of Injury: (*Calendar pull down menu*)

18. Time Employee began work: (*provide data*)

19. Time of Injury Occurrence: (*provide data*)

20. Location where Injury took place: (*provide data*). This field will contain the site location where the accident took place as well as references to photographs.

21. Name of Supervisor and/or Foreman: (*provide data*). This field is needed in the Form to know who was in charge of the employee at the time of injury to facilitate further investigation.

22. Title/Position of Injured Employee: *(pull down menu)*

- Management/Staff
- Superintendent/Foreman
- Carpenter
- Concrete
- Electrician
- Iron worker
- Laborer/Helper
- Maintenance
- Mason
- Millwright
- Operator
- Painter
- Pipe fitter
- Welder
- Other

23. Gender of Employee: *(pull down menu)*

- Male
- Female

24. Age of Employee: *(pull down menu)*

- 18-25
- 25-30

- 30-35
- 35-40
- 40-45
- 45-50
- 50-55
- 55-60
- 60 & Above

25. Street Address of Employee: *(provide data)*

26. City: *(provide data)*

27. State: *(provide data)*

28. Zip code: *(provide data)*

Emergency Measures and Treatment Details (Query 3)

29. Was first-aid administered on site?: *(check box)*

- Yes
- No

30. First-aid Details: *(provide data)*

31. Location where First-aid/Medical Treatment was given (if different from Injury location): *(provide data)*

32. Was the injured person taken to hospital?: *(check box)*

- Yes
- No

33. Name and Address of Hospital: *(provide data)*

34. Name and Address of Physician: (*provide data*)

35. Did the employee stay in the hospital?: (*check box*)

- Yes
- No

36. Period of Hospitalization: (*pull down menu*)

- Overnight
- 1-2 days
- 3-7 days
- 1-2 weeks
- 3 -4 weeks
- 1 month
- 2 months & more

37. Description of Medical Treatment / Final Diagnosis (if changed during a period of time, specify date of change): (*provide data*)

Injury Details (Query 4)

38. Time lost: (*pull down menu*)

- None
- Days away from work
- Job transfer or restriction
- Other Recordable Cases

39. Date Employee Returned to Work: (*Calendar pull down menu*)

40. Number of Lost Work Days: (*provide data*)

41. What the employee was doing before injury took place: (*provide data*). This field will give the safety manager an indication of what action could have triggered the accident and thus understand the root cause for the injury.

42. Mechanism of Injury: (*pull down menu*). This field lists out the most common mechanisms or causes for injuries.

- Caught in, on or between Object/ Equip
- Exposure to Harmful Substance (Chemicals/Loud Sound)
- Fall from elevation
- Fires and Explosions
- Injection (Object/ Insect)
- Over exertion
- Slip/Trip/Fall By Equip/Object
- Overextension/ Bodily motion
- Strike Against/By Equip/Object
- Ambient Temperature related injury (Heat/Cold)
- Multiple Injuries (Explain)
- Other(Explain)

43. Body part injured: (*pull down menu*). The field lists parts of the body that are most prone to injuries.

- Head
- Eye
- Face

- Neck
- Skin
- Shoulder
- Back
- Hand
- Arm
- Torso
- Leg
- Foot
- Multiple Parts (Explain)
- Other (Explain)

44. Type of injury/Illness & Definitions: (*pull down menu*). This field will help in categorizing the types of injuries and illnesses most common on a job site. The ‘?’ command button can be used when a person using the Form is unsure of the category definition. The definition for that term will be retrieved when the ‘?’ button is used. The definitions used for the categories are provided in the I & I Form.

- Allergic reaction/ Irritation(eye/skin)
- Burn : Thermal
- Burn: Chemical
- Burn: Electric
- Death

- Dislocation
- Fracture
- Hearing Injury
- Heat Exhaustion
- Hypothermia
- Infection
- Insect bite/ Sting
- Non work related Injury/Illness
- Poisoning
- Respiratory Illness
- Strain/ Sprain
- Open Wound (OW):
 - (a) OW: Abrasion (Scrape)
 - (b) OW: Laceration/ Incision
 - (c) OW: Punctures
 - (d) OW: Avulsion
- Closed Wound (CW):
 - (a) CW: Contusions/ Hematomas/ Bruise
 - (b) CW: Crushing
- Multiple Traumatic Injuries
- Other (Explain)

45. How did the Injury take place? : (*provide data*). This field will provide a detailed description of the scene of the accident and will help in compiling the accident investigation report.

46. Number of times this employee has been injured before? : (*pull down menu*). The response to this field can be used to enhance employee training and determine its effectiveness.

- 1
- 2
- 3
- 4
- 5 & more

Safety Regulations (*Query 5*)

47. Was appropriate safety equipment worn by the employee?: (*pull down menu*)

- Yes
- No
- Partial

48. Was the activity being performed in compliance with safety regulations? : (*provide data*). This field will contain details of the safety regulations followed for the activity that caused the injury. This will help to pin point what was done wrong in preparation for the job. This will also contain information about safety training.

49. Was the employee given safety training earlier? : (*check box*)

- Yes
- No

50. If yes, when was the last training date? : (*Calendar pull down menu*). This date will be used as a reference to check if the employee had been trained recently or long ago for the safety procedures needed for the activity that caused his injury.

51. Were there any witnesses? : (*check box*). Documenting the names and details of witnesses to the accident will help provide more details about the accident).

- Yes
- No

52. If yes, Provide Witness Names, Addresses and Statements: (*provide data*)

Loss Incurred Due to an Accident (*Query 6*)

The next set of fields will provide comprehensive information regarding the losses incurred by the company for a particular injury on site in terms of money and time.

53. Was any company property damaged?: (*check box*)

- Yes
- No

54. Cost of the Property: (*provide data*)

55. Number of Days Lost before Work could be Resumed: (*provide data*)

56. Cost of Medical Treatment (in \$): (*provide data*)

57. Employee Insurance Coverage (in \$):(provide data)

58. Total Loss (in \$):(provide data)

General Information

59. Name of Person Completing the Investigation: (*provide data*)

60. Title of Person: (*provide data*)

61. Phone Number: (*provide data*)

Definitions Provided for Item #44 in the Form

A list of definitions provided in item #44 describing the various ‘Types of Injury/Illness’ listed in the Form is as follows (Thygerson and Gulli, 2005):

Wounds

1. Open Wound (OW) - is a type of injury in which the skin is torn, cut or punctured. Types of open wounds are as follows:
 - Abrasion- superficial wound in which the topmost layer of the skin (the epidermis) is scraped off.
 - Laceration – Cut skin with jagged, irregular edges.
 - Incision - Cut skin with smooth edges.
 - Punctures- Deep narrow wounds in the skin & underlying organs.
 - Avulsion- Piece of skin that is torn loose and is either hanging from the body or completely removed.
2. Closed Wound (CW) – is a type of injury where blunt force trauma causes a contusion. Types of closed wounds are as follows:
 - Contusions- Bruises caused by blunt force trauma that the damages tissue under the skin.

- Hematomas- caused by damage to a blood vessel that in turn causes blood to collect under the skin
- Crushing injuries- caused by a great or extreme amount of force applied over a long period of time.

Burns

The types of Burns are as follows:

3. Thermal Burn- Contact with fire, hot objects, flammable vapor, steam or hot liquid;
4. Chemical Burns- Certain chemical agents cause tissue damage and death on contact with the skin; and
5. Electric Burns- Contact with electric current (injury severity depends on the type of current, the voltage, the area of the body exposed & the duration of contact).

Musculoskeletal Injuries

The types of musculoskeletal injuries are as follows:

6. Sprain - Injury to ligaments that is caused by being stretched beyond their normal capacity and possibly torn;
7. Strain - Injury to a muscle or tendon in which the muscle fibers tear as a result of overstretching; and
8. Dislocation - Joint dislocation occurs when bones in a joint become displaced or misaligned. It is often caused by a sudden impact to the joint.

CHAPTER V

SURVEY: TESTING THE FORM

In order to test the validity of the Injury & Illness Database/Form and to capture the required data accurately, three sample accident scenarios were developed by referring to BLS injury reports, OSHA Injury reports and accident reports from the industrial data used earlier to create the proposed Form. The three scenarios represent different types of injuries namely, first-aid, medical treatment and fatality respectively.

The I & I Form, the three scenarios and the thesis proposal were sent for the IRB approval process. The survey was assessed and returned as being exempt from the IRB process.

The three scenarios were used by 30 construction science graduate students to complete the proposed I & I Form for the survey. Of the 30 students, 20 students completed the Form for the medical treatment injury scenario, 5 completed the Form for the first-aid injury scenario and 5 completed the Form for the fatality scenario in the Form. Each participant received a brief description of the objective of the Form and Survey. They were also timed to determine how long it took to complete the Form. At the end of the survey they were asked two questions namely:

- What was the level of difficulty encountered in completing the form with a rating from 0 to 5, 0 being the least difficult?
- Do you have any suggestions to improve the Form?

In addition to the 30 construction science student, one individual from a non-construction related field was asked to complete the Form for 10 accident scenarios.

The Three Sample Accident Scenarios

Below are the three accident scenarios used by the 30 construction science students to complete the I & I Form for the Survey.

1. At a GC, Harrison and Co (Add: 290 Fisher St, Block #37, Cleveland, OH-01234) worksite on 30th October 2009 at 10:30am, Mr. Tony Stinson, a 33 yr old scaffold maker working on a 3 storey apartment building (Employee ID: 1098, 511 Check St, Normandy Apartments # 26, Cleveland, OH-01234), had a fracture on his right leg because he fell from a scaffolding at the 2nd floor level (outside the building) also causing the scaffolding to crash down as he tripped and fell. He was sent to St. Joseph's Medical Centre at 96 Garrod St, Block #34, Cleveland, OH-01234 where he had a minor surgery (no stay in the hospital) to correct the fracture and had a cast on his right leg. He was asked to return in 2 month's time for check up and to remove the cast. He later came back to work on 10th January 2010. His surgery had cost \$5000 including other medical bills. It was fully covered by employee insurance. He had not been given training regarding scaffolding work techniques and the supervisor Mr. Joseph Cullen hadn't inspected the scaffolding prior to it being used after a rainy day causing it to fail. The scaffolding had to be rebuilt at a cost of \$900 and the construction work started again only after 3 days.

2. Mr. Jacob Fowler (Employee ID: 2109, Add: 63 Rattler St, Apt #18, Detroit, MI-90123), a 48 yr old foreman who worked with Palladio Construction (Add: 51 Poison St, Block# 07, Detroit, MI- 90123) who were subcontractors that did painting jobs. He fell on debris lying on the floor while painting the living room of a residence, causing an abrasion to his right shin and left hand. His hand had fallen on top of a nail. The injury was caused due to improper Housekeeping which was the responsibility of Mr. Anthony Gonzalves to supervise. The wound was cleansed and bandaged after applying antibiotic cream. He was asked to get a tetanus shot to avoid any infection. He returned to work the next day after a visit to the doctor to change the bandage. The injury took place on 28th September 2009 at 11:15am.
3. On 3rd Jan 2010 at 11:00am, Joe Cullen (Employee ID:0987, Add: 72 Bank St, Apt#31, Bryan, TX-12345), a 62yr old Male Laborer, working with a Demolition contractor(Democon Inc- 601 cross street, Block # 501, Bryan, TX-12345) was engaged in the removal of an existing stairway and fell through the stairway floor opening. He fell 32 feet because his safety equipment was faulty and died on the spot. He had been employed in the company for the past 2 months without safety training. He had been injured on site twice earlier and his last training was given on 15th Dec 2008. The work place had been inspected earlier by supervisor Mr. John Malkovich and he found that the harness had been faulty.

A screenshot taken from MS Access of the proposed Injury & Illness Database/Form is presented in Fig.3. This figure shows how the various data fields have been incorporated and arranged in the Database/Form.

The screenshot displays a Microsoft Access form titled "First Aid Data Form" with the main heading "INJURY/ILLNESS RECORDING FORM". The form is organized into two columns and includes the following fields:

- Date:** [Text Box]
- Time:** [Text Box]
- 1) Record No:** [Text Box]
- 2) Status:** [Dropdown Menu]
- 3) Name of Company:** [Text Box]
- 4) SIC No:** [Dropdown Menu]
- 5) Type Of Industry:** [Text Box]
- 6) Street Address of Company:** [Text Box]
- 7) City:** [Text Box]
- 8) State:** [Dropdown Menu]
- 9) Zipcode:** [Text Box]
- 10) Injured Employee ID No:** [Text Box]
- 11) Date Emp was Hired:** [Text Box]
- 12) Name of Injured Emp:** [Text Box]
- 13) Discipline of Work involved in the Injury:** [Dropdown Menu]
- 14) Classify the Injury/Illness:** [Dropdown Menu]
- 15) Date of Injury:** [Text Box]
- 16) Time Emp began work:** [Text Box]
- 17) Time of Injury :** [Text Box]
- 18) Location where Injury took place:** [Text Box]
- 19) Name of Supervisor on site:** [Text Box]
- 20) Title/Position of Emp:** [Dropdown Menu]
- 21) Gender of Emp:** [Text Box with options: Male, Female]
- 39) Time Lost:** [Dropdown Menu]
- 40) Place of Injury:** [Text Box with options: Indoor, Outdoor]
- 41) What was Emp doing before Injury took place:** [Text Box]
- 42) Mechanism of Injury:** [Dropdown Menu]
- 43) Body Part Injured:** [Dropdown Menu]
- 44) Type of Injury/Illness:** [Dropdown Menu with a help icon (?)]
- 45) How did the injury take place:** [Text Box]
- 46) No of times Employee was Injured before:** [Dropdown Menu]
- 47) Was Employee wearing Appropriate Safety Equipment:** [Text Box with options: Yes, No, Partial]
- 48) Was the Activity being performed in compliance (details):** [Text Box]
- 49) Was the Emp given Safety Training:** [Checkbox]
- 50) Date of Last Training:** [Text Box]
- 51) Were there any Witnesses:** [Checkbox]

Fig.3 Proposed Injury & Illness Database/Form.

22) Age of Emp:	<input type="text"/>	52) Witness name and statement:	<input type="text"/>
23) Street Address of Emp:	<input type="text"/>	53) Was Property Damaged:	<input checked="" type="checkbox"/>
24) City:	<input type="text"/>	54) Cost of Property in \$:	<input type="text"/>
25) State:	<input type="text"/>	55) No of days lost before the work could be resumed:	<input type="text"/>
26) Zipcode:	<input type="text"/>	56) Cost of Medical Treatment in \$:	<input type="text"/>
27) Was First Aid Given on Site	<input checked="" type="checkbox"/>	57) Emp Insurance Coverage in \$:	<input type="text"/>
28) First Aid Details:	<input type="text"/>	58) Total Loss in \$:	<input type="text"/>
29) Location where First-Aid/Treatment was given (if different):	<input type="text"/>		
30) Was the Injured Emp taken to the Hospital:	<input checked="" type="checkbox"/>	Form Completed By: <input type="text"/>	
31) Name and Address of Hospital:	<input type="text"/>	Title:	<input type="text"/>
32) Name and Details of Physician:	<input type="text"/>	Phone:	<input type="text"/>
33) Was Emp Treated in the Emergency Room	<input checked="" type="checkbox"/>	<input type="button" value="Submit"/> <input type="button" value="Find Record"/> <input type="button" value="Close Form"/> <input type="button" value="Add New Record"/>	
34) Did the Emp Stay in the Hospital:	<input checked="" type="checkbox"/>		
35) Period of Stay in the Hospital:	<input type="text"/>		
36) Final Diagnosis/Medical Treatment (if changed, specify date of change):	<input type="text"/>		
37) Date Emp returned to work:	<input type="text"/>		
38) Treatment Details on Return(if any):	<input type="text"/>		

Record: 17 of 17 No Filter Search

Fig.3 (Continued).

Result of the Survey

Level of Difficulty

The responses given by the 30 students with respect to the level of difficulty they experienced while completing the Form are presented in Table 1.

- Five of the students felt that the survey had a difficulty level of '0' because they were aware of all the terms used in the form and found it easy to complete the Form.
- Twenty students found the form to have a difficulty level of '1', as they explained that even though certain terms were new to them; the Form was self-explanatory making it easier to complete.
- The remaining five students felt the survey had a difficulty level of '2' because they found the Database/Form to be lengthy.

Table 1 Level of difficulty faced in completing the Form

No of Participants	Level of Difficulty
5	0
20	1
5	2

Time Taken to Complete the Form

- On an average the participants took between 10-15 minutes to complete the Form. A majority of them took 12 minutes to complete it.

Respondent's Suggestions for Improvement

- A few students gave suggestions to revise the wordings of the questions asked to provide a better understanding of the questions. The wording revisions made were very minor.

Result of the Non-construction Field Related Respondent

The first time, the individual took 30 minutes to fill the form as he was not familiar with the terms used in the form since he was not a part of the construction industry. However, by the time he was completing the 10th accident scenario in the Form he was able to complete it in 15 minutes. Thus, it is evident that the database format is easy to use even for a “construction novice”.

Once a firm adopts the use of the proposed Database/Form, many of the fields can be set with default answers such as company name and other repetitive responses. Also more fields can have pull down menus to choose from such as for employee details and project details when the Form is being completed for a particular project. This will reduce the time taken to complete the form by another 15-20%.

CHAPTER VI

CONCLUSION

A proposed Injury and Illness Database/Form was developed using Microsoft Access. It was then tested by 30 construction science students to determine if it was sufficiently self-explanatory in such a way that the respondents would record the data from the three sample accident scenarios in the same manner as each other and they did.

First-aid injuries cause delays in terms of work time, poor productivity and workmanship which in turn cause a loss to the company. Therefore, when calculated on an annual basis, the total cost of first-aid cases could translate to large losses for the company. The proposed database is an improvement over the present system where only recordable injuries are considered. The proposed I & I Form allows for the documentation of injuries, illnesses and fatalities that are either recordable (medical treatment, loss of consciousness or fatality) or non-recordable (first-aid treatment or near-miss). This expands the size of the database making it more useful for the development of safety improvement activities aimed at preventing additional injuries, illnesses and fatalities.

The proposed database exhibits not only ease of use but also the sorting ability to provide a firm with daily or periodic status reports as well as reports meeting the requirements of OSHA Forms 300, 300A and 301. One can also use the database as a storage vessel and reference the location of additional information such as photographs, outside statements, drawings, specifications, training records and witness details.

In addition, the database allows one to sort using a hierarchy of multiple standard fields and more importantly standardized categories within each field. This allows one to sort data more easily to the common injury type, cause of injury and a host of other variables. The more frequently a variable is cited, the more potential for the variable to be associated with an accident in the future. Thus, theoretically a large number of common first-aid cases will eventually become a medical treatment injury. By analyzing the collected data, more savings can be made by companies if hazards are discovered earlier and safety procedures are altered to avoid common injuries. This will also help in manipulating the factors and the working style needed to reduce injuries. This allows the firm to be proactive and develop a prevention program in advance.

Summarizing the advantages in using the proposed Injury & Illness

Database/Form such as:

1. The same Database/Form can now be used irrespective of the type of project as the fields have been designed in such a way to suit all.
2. The database uses a classification system such that even when used by different individuals for various projects, the categories will yield same answers. This was made easier by using a standard set of definitions for describing various injuries and illnesses.
3. The database classification fields have standard categories that are very descriptive and commonly used in the industry thereby making it more user-friendly.

4. The database allows for tracking of data that could be useful in analyzing specific injury data or in legal issues that arises due to an injury or illness.
5. Various reports can be prepared from the database results like OSHA Forms and accident investigation reports.

Further research can be done on this topic by sending it out for testing to various industries. From their response, changes can be made to the form to further suit their needs. The proposed Injury & Illness Database/Form can also be sent to OSHA for approval and can later be used as a substitute for the current forms as this form encompasses various kinds of data all in one. Thus, the report generated with the help of this form will give safety managers a good indication as to the location of their danger areas. Further, the adoption of the Form by OSHA would allow the nation to collect data in a similar format which would provide a wealth of information for researchers and developers of safety programs.

This database can have a number of users such as construction related companies, physical labor oriented industries, insurance organizations involved in worker compensation, safety equipment retailers, researchers studying safety related topics and industrial hygienists.

REFERENCES

- BLS (2007, 2008), *Injury Statistics for 2007 and 2008*, Bureau of Labor Statistics, available at <http://www.bls.gov> (accessed 1 March 2010).
- Byung, Y. J., (1998) Occupational deaths and injuries in the construction industry. *Applied Ergonomics*, **29** (5), 355-60.
- Lipscomb, H. J., Glazner, J.E., Bondy, J., Guarini, K. and Lezotte, D. (2006) Injuries from slips and trips in construction. *Applied Ergonomics*, **37** (3), 267-74.
- MDLI (2007), *The Survey of Occupational Injuries and Illnesses*, Minnesota Department of Labor Industry, available at <http://www.dli.mn.gov/main.asp> (accessed 15 May 2009).
- OSHA (1970), *OSHA Recordkeeping Handbook*, Occupational Safety and Health Administration, available at <http://www.osha.gov/> (accessed 1 March 2010).
- Thygerson, A. and Gulli, B., (2005) *First Aid, CPR and AED*, Jones and Bartlett Publishers, Sudbury, Massachusetts.
- Wikipedia Dictionary (2001), *Definitions*, available at <http://en.wikipedia.org/wiki/Dictionary> (accessed 20 February 2010).
- Zwerling, C., Miller, E. R., Lynch, C. F. and Torner, J. (1996) Injuries among construction workers in rural Iowa: Emergency department surveillance. *Journal of Occupational & Environmental Medicine*, **38** (7), 698-704.

APPENDIX A
DEFINITIONS

1. Lost workday injury rate, OSHA recordable injury rate, and first aid injury rate -
The number of lost workday injuries per 200,000 worker hours (or per 100 workers working in a full year).
2. Incidence rates - It denotes the number of injuries and/or illnesses per 100 full-time workers. However, in some tables, the rate denotes the number of injuries and/or illnesses per 10,000 full-time workers.
3. Fatality rate - Fatalities per 100,000 workers.
4. Nonfatal occupational injuries – They are defined as involving one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job or medical treatment (other than first aid).
5. Occupational injury – It is defined as an injury, such as a cut, fracture, sprain, strain, amputation, etc, that results from a work event or from a single instantaneous exposure in the work environment.
6. Musculoskeletal Injuries - refers to damage of muscular or skeletal systems, which is usually due to a strenuous activity.

APPENDIX B

VISUAL BASIC CODING

Visual Basic Codes Used to Make Changes in the Injury & Illness Database/Form

1. To create a new textbox for the “Others” option in the Type of Inj/Ill category, the following steps were executed:

- First create a new field called “Other_Inj” in the Design view of the First Aid data table and set the data type as “memo”.
- Next add the textbox in the design view of the form from the ‘add existing fields’ option.
- Now open the VB coding page for “Typ_Of_Inj_Ill_” and open it for the ‘change’ option in the actions category and type the following code under

“Private Sub Typ_Of_Inj_Ill_Change()”:

(a) If Typ_Of_Inj_Ill.Text = "Other" Then

(b) Other_Inj.Visible = True

(c) Other_Inj.SetFocus

(d) End If

(e) End Sub

- Next open the Form load property in the VB coding software and type the following code under – “Private Sub Form_Load()”:

➤ Other_Inj.Visible = False

- This will ensure that when the form opens, the “Other_Inj” box will not be visible till the “Others” option has been selected.
- The steps above was followed for creating “Other” text boxes for other categories like Discipline of work involved in injury, Title/Position of Employee, Mechanism of Injury and Body Part Injured.

2. To create a help- ‘?’ command Button for definitions and a box with the definitions in it, the following steps were performed:

- Create a new table with 2 fields- ID (number, remove the primary key option on it) and Definition (memo).
- Open the design view of the form and add a command button (name it – ‘?’) as well as the ID and definition text boxes.
- Add these commands under “Private Sub Form_Load()” to the form load property in the VB page so that they don’t appear when the form is opened initially.

(a) ID.Visible = False

(b) Definition.Visible = False

- The '?' button in this case is called 'command247' in the properties page, so open the VB coding for that for 'click' option, then type the following under "Private Sub Command247_Click()":
 - (a) Mech_Of_Inj.SetFocus
 - (b) If Mech_Of_Inj.Text = "Open Wound:" Then
 - (c) Definition.Visible = True
 - (d) Definition.SetFocus
 - (e) Definition.Text = "Open Wound- is a type of injury in which the skin is torn, cut or punctured."
 - (f) Exit Sub
 - (g) End If
- Add this command in the definition- lost focus option- "Private Sub Definition_LostFocus()", so that when the tab moves to the body part category after definition.
 - (a) Body_Part_Inj.SetFocus
 - (b) End Sub
- Also add this in the got focus tab- "Private Sub Body_Part_Inj_GotFocus()"
 - (a) Definition.Visible = False

(b) End Sub

- The steps above were followed to create definitions for Closed Wound, Abrasion, Laceration/Incision, Punctures, Avulsion, Contusions/Hematoma/Bruise, Crushing Injury, Thermal Burn, Chemical Burn, Electric Burn, Sprain/Strain and Dislocation.

3. To create a total amount in \$ using a formula, the steps shown below were followed:

- Add this formula in the VB column of total loss – “Private Sub Total_Loss_in__GotFocus()”:

(a) $\text{Total_Loss_in_Value} = \text{Cost_Prop.Value} + \text{Cost_MT.Value}$

(b) End Sub

- To move the focus(tab) to ‘Total loss’ after ‘Employee Insurance’ , type the following command under – “Private Sub Emp_Ins_Cover_LostFocus()”:

(a) $\text{Total_Loss_in_SetFocus}$

(b) End Sub

APPENDIX C
NEW FORM AND SURVEY

The attached CD contains the proposed Injury & Illness Database/Form, the survey filled out by the 30 Graduate students as well as the injury data collected and studied from an industry as a part of the literature review.

VITA

Name: Bhavana Sudhakaran

Address: 3137 TAMU, Langford Building A, Room 422, Department of
Construction Science, College of Architecture, Texas A & M
University, College Station, Texas 77843-3137

Email Address: bhav_3005@hotmail.com

Education: B.Arch., Hindustan College of Engineering, Chennai, TN, India, 2008
M.S., Construction Management, Texas A&M University, College
Station, Texas, 2010.