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ABSTRACT

THE EFFECTIVENESS OF SAFETY TRAINING

by
Mayeana Kamara

The objective of this thesis is to evaluate the effectiveness of safety training modalities which are specifically designed for the non unionized workers in the construction industry. The main hypothesis is to determine whether multimodal and extended training improves the effectiveness of the learning aspects and safety consciousness among the trainees. The study conducted a literature survey on the factors that affects safety outcomes in construction industry, especially for the non unionized workers. The study developed a survey instrument to evaluate effectiveness of safety training. This study intended to prove that a video training is not enough and that hands on demonstration will improve the thinking and behavior of construction works.

Session one included a video training session lasting 28 minutes, session two included a video and a demonstrator and session three consisted of a demonstration and a power point presentation. The behavioral question proved to have a statistical difference ($p<0.05$) from session 1 to session 2 and showed not much of a change with session 3. This proved that using safety videos is not the only mechanism need to train a worker. Live lecture and demonstration makes a difference but also to keep in mind that too much information or tedious training like PowerPoint can lose the interest of the worker and as a result there will be no significant change.

EFFECTIVENESS OF SAFETY TRAINING

by
Mayeana Kamara

A Thesis
Submitted to the Faculty of
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in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Occupational Safety and Health Engineering

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APPROVAL PAGE

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I dedicate this paper to my son Fode Mohamed Sheriff.

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To my first son, Fode Mohamed Sheriff, I was pregnant with you when I started this journey and I ended with you when I finished. I will do it all over again just for you.

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CHAPTER 1

INTRODUCTION

As stated by Spellman et.al (Spellman & Whiting, 2005), occupational hazards such as lead poisoning first came to recognition in the early fourth century BC. Life expectancy in the United States was greatly dependent on the type of occupation held. Massachusetts was the first to recognize the need for health and safety standards. These standards included inspection of factories, public buildings, machine guards, air quality and fire escapes. Businesses at that time were unsupportive and did not want to be burdened by government regulations and perceived excess cost.

Groups such as the United Mine Workers and the American Public Health Association pushed for shorter hours, increased pay and improvement of safety conditions. The father of safety theory H.W. Heinrich (2005) published the most influential early books on industrial safety in 1931. According to Heinrich, accidents result from the social environment and unsafe conditions or acts. As with anything in society, big disasters catch the attention of the public and laws are established. Before 1970, the federal government had no responsibility for the prevention of occupational injuries, and it was up to the states to do it. After the 1970, the Occupational Safety and Health Act (OSH ACT) stepped in, with a mandate to monitor and maintain comprehensive safety standards in private business enterprises by a federal agency (Spellman & Whiting, 2005). With the involvement of the Federal Government through the OSH Act, considerable improvements in safety standards have been achieved

(Figure 1.1). According to the Bureau of Labor Statistics, a total of 5,071 fatal work injuries were recorded in the United States in 2008 (BLS, 2010).

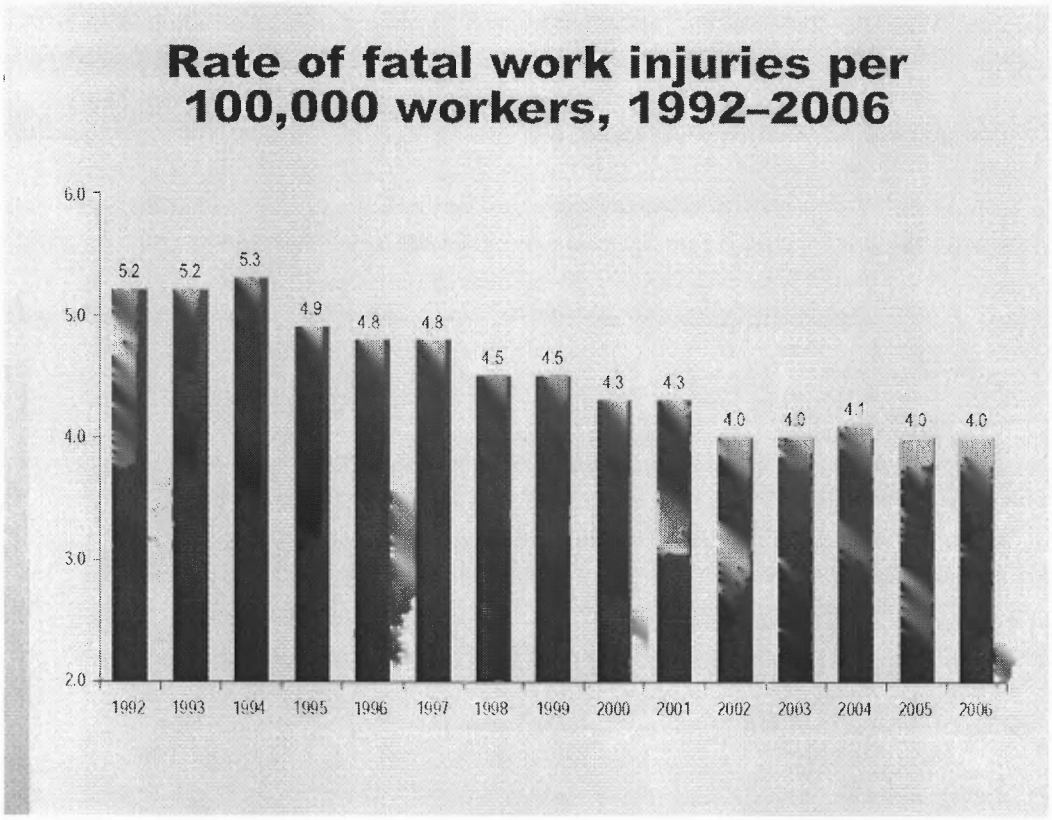


Figure 1.1 Steady reduction of fatality rates in private industry from 1992-2006 (Source www.bls.gov 2010)

Workers in the construction industry in general, are exposed to many hazardous situations. According to BLS statistics for 2006, construction sector recorded 1,239 fatalities, which was the highest among all industry sectors (Figure 1.2). In 2007, 135,350 injuries and illnesses occurred among construction worker (NIOSH, 2010).

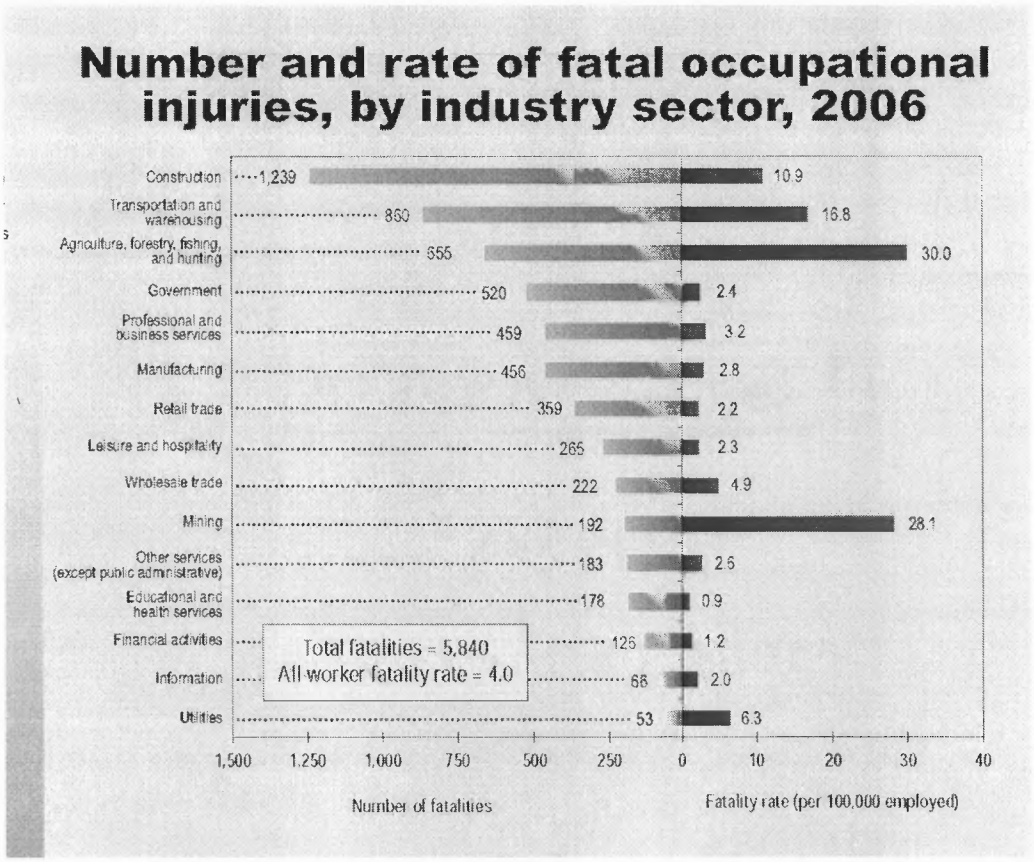


Figure 1.2 Number and rate of fatal workplace injuries among different industry groups (Source www.bls.gov 2010)

The US Department of Labor (DOL) lists falls as one of the leading causes of traumatic occupational death, accounting for eight percent of all occupational fatalities from trauma (OSHA.gov).The injury rates show that there is a big problem with fall protection and there is a serious need to find ways to prevent falls and improve existing work practices (Hsiao and Simeonov, 2001). The statistics published by BLS (2010) regarding the manner in which the workplace fatalities occurred showed 14% and 17% of all fatalities (N=5,840) in 2006 occurred by falls and contact with objects and equipment, respectively (Figure 1.3). According to Hsiao and Simeonov (2001), work-related falls are the most crucial and biggest problem in the construction industry. According to Spellman and

Whiting (2005), falls caused 600 or 10 percent of workplace deaths in 1994. Clearly there is a major problem in the field of construction safety. The question is what can be done?

We have union construction workers and non-union construction workers. Union workers usually receive training in a specific trade for 3-4 years while non union workers, who make up 80 percent of the construction work force, do not get the same kind of training. If they do get training, it is given in large groups. Non union subcontractors do not believe in investing money for their workers to be properly trained and this is one of the reasons why falls are the number one cause of fatalities in the construction industry (Goldenhar et al., 2001).

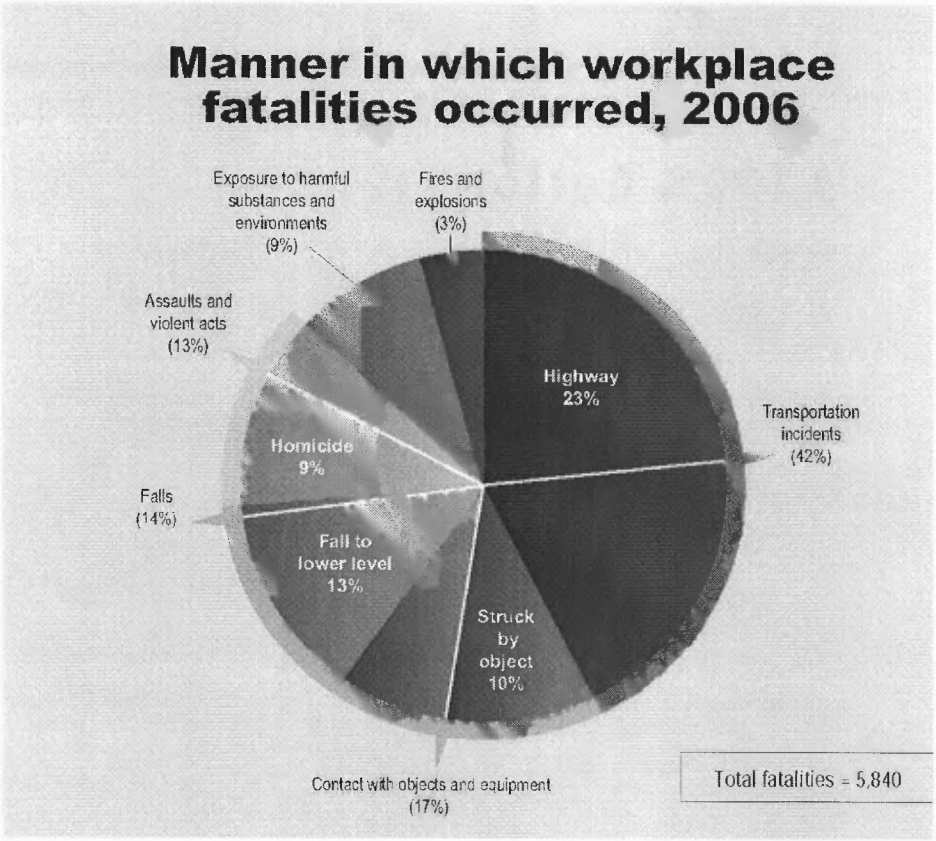


Figure 1.3 Manner in which workplace fatalities occurred in 2006 (source bls.gov 2010)

1.1 Objective of the Study

The objective of this thesis is to evaluate the effectiveness of safety training modalities which are specifically designed for the non unionized workers in the construction industry. The main hypothesis is to determine whether multimodal and extended training improves the effectiveness of the learning aspects and safety consciousness among the trainees. To achieve the above objective, the following steps have been performed, which would be detailed in the subsequent chapters of this thesis:

(1) Conduct a literature survey to determine the inter-relationship among safety culture, organizational safety climate, on worker behavior, attitude, and training effectiveness.

(2) Gather technical information regarding fall protection and training, since this is one of the major hazards in the construction sector.

(3) Develop realistic safety training sessions, especially towards fall protection, with progressively increased multimodal safety training programs to improve the effectiveness of the training.

(4) Develop a comprehensive survey instrument to measure the safety training effectiveness in terms of improvement in safety attitude and learning technical information.

(5) Conduct a laboratory test and analyze the test results to verify the study hypothesis, whether intensive and multimodal training improves safety attitude and learning, especially in fall protection.

CHAPTER 2

LITERATURE REVIEW

Construction has the highest accident rates of any industry and the leading cause of death is falls. To understand the subject matter, a literature survey has been conducted and is presented under the following three sections (1) the safety climate, culture, behavior, training and education of workers, (2) fall protection systems, and (3) recent laboratory based studies related to safety training in different types of industries.

2.1 Safety Culture and Safety Climate

The terms safety climate and safety culture are very similar in definition. Safety climate is the shared perceptions and belief between managers and workers towards safety (Cooper & Philips, 1994). Management's commitment is a central element of the safety climate (Zohar, 1980). Safety Culture on the other hand, is the ability to manage safety from the top of the ranks to the bottom workers (Mohamed, 2004). According to Choudhry and Fang (2009), a positive safety climate/culture is required for improving safety performance on construction projects. Choudhry and Fang performed a safety climate survey to ensure accountability of management leadership and support for safety. The results from their survey showed the importance of management and employee involvement and inappropriate safety procedures and work practices on construction projects. Safety climate and culture are very important aspects of construction safety. Safety culture establishes the environment and safety climate enforces it from all levels.

Behavior and attitudes from management to workers is the key to have an effective safety program and culture. Changing a person's perception or attitude is the

hardest thing to do, but if construction companies can depart radically from their old way of doing things, the results will be positive (Nadler and Tushman, 1989; 1990). Major change is impossible unless upper management actively participates and demonstrates the importance of change (Freda and Gatlin-Watts, 1999). Behavior and attitudes work together and in order for change to happen management and workers need to be willing to change their behaviors and attitudes towards construction safety.

Training and education are two vital topics in general construction safety. Training can be broken up into three parts: Induction training, refresher training and ongoing training. Induction training is specifically for new workers ready to join a construction site and this type of training is aimed to improve basic safety awareness. Refresher training is for workers that have been at the same position for many years. They are more likely to perform bad habits or simply forget the basics of construction safety. Ongoing training addresses the needs of salaried workers that need to be retrained on new techniques and for new workers to be trained from scratch (Rowlinson, Steven, 2004). There are two groups in the construction industry: union workers and non-union workers. Union workers are paid more than nonunion workers and they also have better benefits (BLS, 2010). Union workers receive a more intense 3-4 year trade specific training and most non union workers receive little to none (Goldenhar et.al, 2001). The reason why non union workers receive little to no training is because; employers place less focus on training and choose not to spend the money. (Korman, 1997; The Business Roundtable, 1996). Educational status is a very important topic that works together with effective training. According to the study Gyekye and Salminen conducted, understanding the impact of education on perceptions of workplace safety would benefit

management's decisions regarding workers' adaptability, general work effectiveness, and accident frequency, implementation of safety management policies and handling of education-related accident characteristics. Gyekye and Salminen conducted a study on 320 Ghanaian industrial workers. Each worker had a different level of education and they all participated in a questionnaire used to assess safety on the work site. Their results showed that the lower educated workers were involved in more accidents, had greater risk of displaying inappropriate and inaccurate safety behaviors and lower educated workers had no room for advancement to safer working positions because of their lack of education. As a result, the lower educated workers had a lower job satisfaction rating and did not appreciate the importance of safety training in their current positions (Gyekye and Salminen, 2009).

The six topics covered in this section are key components that contribute to the effectiveness of safety training in general construction. The Culture and climate of a construction site will determine the type of atmosphere in which safety is taken seriously and respected while behavior and attitude will determine how managers and workers look at safety. However, there are many different trades and areas in construction safety that are too much to tackle. This thesis will focus on construction safety but specifically fall protection. The next section will discuss the importance of fall protection training, equipment inspection and the methods to prevent falls from elevated surfaces.

2.2 Fall Protection in Construction Safety

Fall protection means eliminating or effectively controlling fall hazards (Ellis, 2004)

Before we can really understand fall protection there are some terms to know. Access: The protected means of reaching the overhead work zone by climbing ladders or stairs or using aerial lifts or scaffolds; Guardrail system: means a barrier erected to prevent employees from falling to lower levels(OSHA 29 CFR 1926); Fall Hazards: zones where a sudden drop or structural collapse is reasonably possibly as a result of a misstep, tripping, slipping or some other design flaw or human frailty; Lanyard: a flexible rope, wire rope or strap with connectors on each end used to connect the body harness to a deceleration device, lifeline or anchorage(OSHA 29 CFR 1926); Lifeline: a flexible line for connection to an anchorage at one end to hang vertically or horizontally and serves as a means of connecting components of a personal fall arrest system (OSHA 29 CFR 1926); Anchorage: a secure point of attachment for lifelines, lanyards or deceleration devices (OSHA 29 CFR 1926); Toe board: a low protective barrier that will prevent objects from falling over (OSHA 29 CFR 1926); Warning Line system: a barrier on a roof used to warn employees as they approach an unprotected side or edge and it is used to designate an area where work may not take place without the use of a guardrail or safety net (OSHA 29 CFR 1926); Personal fall arrest system: a system incorporating a full body harness with features for the application of a frontal D-ring for climbing and a back D-ring for fall arrest used with a connecting device such as a lanyard or self-retracting lanyard/lifeline or rope grab, and attached to an approved fixed anchor point or a cable or a rail system by means of a snap hook or other connector (Ellis, 2004).

Areas of fall protection concern are unprotected sides and edges, stability of walking/working surfaces and protection from falling objects. Unprotected sides and edges include: leading edges, hoist areas, holes, reinforcing steel, ramps, excavation, and

overhand bricklaying. With an unprotected side or edge an employee should be protected at 6 feet or more above a lower level.

Fall protection is accomplished by guardrail system, covers, safety net system, positioning device system, warning line system, controlled access zones, safety monitoring systems, toe boards, personal fall arrest system and a fall protection plan. Most of the rules and regulations are similar for most of the different fall protection systems mentioned above. The following paragraph will discuss a few of the important fall protection systems.

A Guardrail System should be capable of withstanding at least 200 pounds applied within 2 inches of the top edge in any outward or downward direction. The top rail should be 42 inches plus or minus 3 inches and it can exceed 45 inch in height. Safety net systems should be installed in the walking/working area zone. A safety net should withstand the drop of a 400 pound bag of sand. The nets should be inspected at least once a week for wear and damages. Personal fall arrest system consists of connectors, Dee-rings and snap hooks, lifelines and lanyards. Connectors are made of steel with a smooth finish. Dee-rings and snap hooks should have a minimum tensile strength of 5,000 pounds and a minimum tensile load of 3,600 pounds. The lifeline free fall distance limit is 2 feet and the line should be made from synthetic fibers. Lanyards have a maximum breaking strength of 5,000 pounds. Positioning device system cannot fall more than 2 feet in distance and they should be capable of withstanding 3,000 pounds. Figure 2.1 illustrates typical construction industry fall protection equipment.

Figure 2.1 Fall Protection Equipment includes hard hat, safety glasses, hearing protection and a full body harness

Warning line systems can be of the following: ropes, wires or chains. They should be erected no less than 6 feet from the roof edge when mechanical equipment is being used or not. Controlled access zones are used where there are leading edges and operations are being performed within the controlled access zone. Employees involved in overhand bricklaying are permitted within the control access zone (OSHA 29 CFR 1926).

All of the different rules and regulations mentioned above are as per OSHA standards for construction safety, but once a worker is trained on how to use these different fall protection methods, fall hazards can still occur. Some of the most common hazards with fall protection are: harnesses with leg strap undone, lanyards not attached to the structure, lanyards attached improperly to an anchorage or each other, incompatible equipment, damaged snap hooks and much more (Ellis, 2004). About 80 percent of construction site fatalities in the United States are from falls (Ellis, 2004). The average cost for worker's compensation is $400,000 (Ellis, 2004). The deaths and dollar amounts associated with falls should make safety managers control or possibly eliminate this hazard.

Advanced planning for hazards should be conducted before construction work begins. This highlights vague safety concepts and permits hazard awareness and analysis that can suggest defensive measures (Ellis, 2004). Figure 2.1 shows the five steps needed in preparation of fall hazard mitigation.

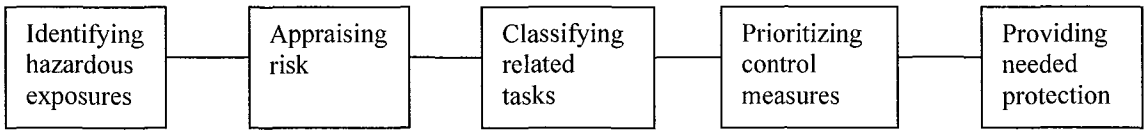


Figure 2.2 Analyzing a fall hazard (Ellis, 2004)

Once the protection needed has been provided, workers need to be properly trained by a competent person on how to use safety equipment. Workers should be able to recognize site specific fall hazards, shown the adequate fall protection controls, and assemble the systems (Ellis, 2004). The worker must also be able to erect, maintain, disassemble and inspect the fall protection system (OSHA 29 CFR 1926).

In order for workers to be trained properly, they must have the proper attitude and mindset to follow safety procedures. Safety training can be effective when only the workers' behavior, educational status, safety climate/culture and attitude are geared towards the importance of safety. The purpose of the experiment in Chapter 3 is to prove how workers' behavior and intensity of safety training can reduce injuries. The literature review of the next section explores these topics in further detail and shows why the behavior, attitude and educational status affect the effectiveness of safety training.

2.3 Recent Studies Related to Safety Training Effectiveness

Behavior is a crucial aspect in construction safety. A construction worker can choose to work in a safe or an unsafe manner. So, the question is, why do workers engage in unsafe behavior at work sites?

Choudhry and Fang (2008) researched the behavior focus and found that workers are involved in unsafe behavior because of lack of safety awareness, putting on a tough image, work pressure, co-workers' attitudes, organizational, economic and psychological factors. Their study suggested recommendations for improving site safety by listening to the viewpoints of the subcontractor's workers. The reason behind this is because the subcontractors deal with different situations that judge their action on how best to work safely on a construction project. The objective is broken down into three parts: workers viewpoint, unsafe behaviors and safety behavior. Choudhry and Fang's goal is to understand the workers viewpoint as to why accidents happen and this was accomplished by performing in-depth interviews with workers. Gaining understanding of why construction workers engage in unsafe work behavior and identifying factors that influence their safety behavior was part of their study.

There are three root causes of accidents that occur on construction sites. According to Abdelhamid and Everett (2000) the roots are failure to identify unsafe conditions that already exist, proceeding of work activity with preexisting unsafe condition, and the decision to act unsafely regardless of initial unsafe work conditions.

The experiment in Choudhry and Fang's literature required both authors to reside for two months in Hong Kong to observe communication from top management to frontline workers of subcontractors. An initial interview was conducted with Chinese and non-Chinese workers who have been previously injured on the job. Chang and Fang developed a quantitative questionnaire to further explore the objective's three main parts. There were four safety managers that assisted Choudhry and Fang with the interviews. To keep the interview unbiased, the employees were not interviewed by their own direct manager. The interviews took about 45 min to 1 hr and 15 min. All interviews were recorded, transcribed into English and kept confidential. The employee's age, gender and educational status were recorded for each participant.

Employees were required to explain events when they performed work in an unsafe manner. When an accident occurred, it was labeled as inadequate supervision, inadequate training and planning. Unsafe behaviors were evident in daily practices and participants provided insights towards the type of work environment that encouraged and supported unsafe behaviors. The interviews revealed that nothing is possible without management support. Operators also mentioned that in order to achieve higher productivity, they performed unsafe behaviors for productivity bonuses. These unsafe behaviors resulted in taking shortcuts to get the job done much quicker even though

employees were aware of the risk involved in their work. Job security and education were two factors that also influenced unsafe behaviors.

Based on this study, the key factor to discuss is how to improve unsafe behavior on a construction site. The workers views on safety should be considered with high regard and management should be responsible for each unsafe condition performed by an employee. Revision and through review of safety procedures should be made and the workers should be properly trained (Choudhry and Fang, 2008).

Chang and Liao (2009) examined the (KAB) knowledge, attitude, and behavior effect of aviation safety education on passenger cabin safety awareness. The purpose of passenger education is to reduce stress and panic in the event of an emergency (2009). Findings in this paper showed that an increase in cabin safety knowledge positively affected airline passenger behavior, knowledge-behavior and attitude-behavior. Aviation Safety education consists of ground staff and cabin crew. The rules and regulations are generally given before takeoff and during the flight. Ground staff informs the passengers of prohibited goods in carry-on baggage and the cabin crew familiarizes passengers about the use of their seat belts, emergency exits, life jackets and oxygen mask (2009).Chang and Liao formulated six hypotheses to target cabin safety knowledge. Figure 2.3 shows these six hypotheses.

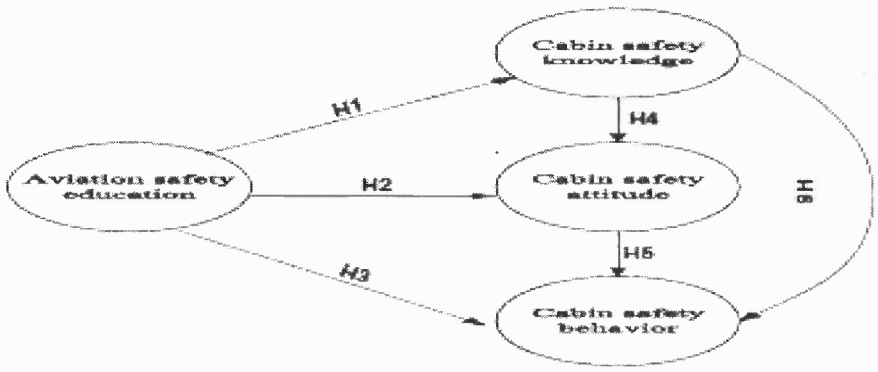


Fig. 1. The conceptual model of the study.

Figure 2.3 The conceptual model of the Chang and Liao (2009) study

The method used to test Chang and Liao's (2009) hypothesis was Likert-scaled questionnaire. Chang and Liao used this method in their questionnaire to determine what passengers knew about cabin safety. The questions asked in this study are; what do passengers know about cabin safety and the types of goods that are permitted and prohibited in carry-on baggage? Do they know the responsibility of exit row seat passengers and do they know how to use the oxygen mask or life jackets? (2009). Based on these questions, Chang and Liao created a 39 item questionnaire which was revised with five aviation safety experts and finally used at a Taiwan airport. The questionnaire had five parts: airline passenger perception of aviation safety education, airline passenger understanding of cabin safety information, airline passenger cabin safety behavior and demographic data of the participants. The data was collected, and analyzed in three stages: exploratory factor analysis, confirmatory factor analysis and structural equation modeling. Based on the three factors, the findings showed that emergency equipment, situational awareness and response, regulations necessary to know and aviation safety

education channels are the essential factors contributing to aviation safety education. The authors' hypothesis was supported based on the experiments because the indication that aviation safety education was positively affected by airline passenger cabin knowledge, attitude and behavior was true. Indeed, behavior and attitude are two contributing factors in safety.

Olson based a current study on collective behavior on the use of personal protective equipment. The first priority to completely remove a hazard from a job site is through engineering or job control methods (Olson et al., 2009). The last priority is the enforcement of PPE and training. The current paper evaluated the behavior of social models and evaluated safety behavior within work groups. Olson hypothesis asserts that new hires are more likely to use PPE if there is a collective proportional use among their peers. Work groups function as a powerful modeling network for individuals (Bandura, 1997). Peers provide a primary source of social support and solidarity in the workplace (Olson et al., 2009). New hires tend to fit within group norms. They copy the attitude and behaviors of other workers especially if it is their first placement (Barrett and Randle, 2008).

Participants for Olson's experiment were recruited from a university with a teaching hospital and the general public. The advertisement for the study was "Baggage Screening Experiment". The experiment was conducted in a laboratory room that included a laptop and a pair of yellow over-ear sound mufflers. White noise was played in the background at 70 decibels. The work groups were broken up into four conditions: (0) zero of three models wearing PPE, (1) one of three models wearing PPE, (2) two of three models wearing PPE and (3) three of three social models wearing PPE (Olson et al.,

2009). Participants were shown a 2-minute training video while three confederates were seated side by side at a long table. Each participant had a laptop and a pair of over-ear sound mufflers. After the video, participates put on the mufflers and started the task as instructed. Participants were then escorted to the testing room and worked for 40 min at the simulated baggage screening task. The number of time intervals each participant wore PPE was the primary dependent variable.

The author's prediction that PPE use would increase as the number of safety models increased was supported with a moderate positive correlation between the observed number of models wearing PPE and the subsequent number of intervals of PPE use within the entire sample (Olson et al., 2009). The findings of this study represented the collective behavior of a work group and proved that positive social models in a group produce moderate-to-large effects on safety behavior.

Understanding the impact of educational and safety climate on a construction site will reveal the importance of safety and the changes that need to occur. Seth and Simo performed a practical study that measured the relationship between educational attainment and safety perception, job satisfaction, compliance with safety management policies and accident frequency.

Safety climate is a technical term that can also mean safety perception, value, norms, beliefs, practices, and principle. For the past 30 years, the critical importance of safety climate in the work environment and how it differs from work groups, companies and institutions has been closely examined (Gyekye and Salminen, 2009). Most of these studies have revealed that workers differ in their attitudes to safety issues and in their perceptions of workplace hazards (Gyekye and Salminen, 2009). There has been lack of

research to support the relationship between workers' educational attainment and safety perception. This study compared safety perception with four levels of educational attainment (basic, secondary, professional/vocational, and university education). Education level was also examined with job satisfaction, compliance with safety management policies, and accident frequency (Gyekye and Salminen, 2009). Education is a learning process through which people acquire knowledge, information, cognitive capacities and the transfer of norms, values and modes of behavior. A higher level of education will promote strategic thinking, develop workers' perspectives, store and rightly use information. Going by this reasoning, peoples' levels of education would be positively correlated with their safety and preventive behaviors, and inversely related to their accident involvement rate (Gyekye and Salminen, 2009). Accident frequency and job satisfaction have yet remained limited and equivocal. The study consisted of 320 male and females Ghanaian industrial workers. The group was broken up by their sex, age, work experience level and educational level. A structured questionnaire was first presented in English but due to the fact that some of the workers had problems understanding English, it was translated to the local dialect. Correspondents answered on a five-point response formant 1(=not at all) to 5(=very much). The result revealed that the higher the education, the more experience the worker had. Also, higher-educated subjects evaluated work safety more than lower educated counterparts (Gyekye and Salminen, 2009). The main findings of this study revealed a relationship between workers with high education level, safety perception and job satisfaction. The results showed a negative relationship with educational level and accident frequency. It is perceptible that the higher the educational background, the lower the risk exposure was (Gyekye and

Salminen, 2009). Low- educated workers were at greater risk of displaying inappropriate and inaccurate safety behaviors. Low-educated workers accept hazardous tasks and work under stressful conditions such as: job and income insecurity, low earnings and lack of job variety. Higher-educated workers do not have the same conflicting demands (Gyekye and Salminen, 2009). The high accident rates indicated that special training for lower-educated workers is needed along with an integrated approach of education and engineering controls to best protect them from injuries. Effective safety education programs in conjunction with the appropriate leadership role can induce positive safety behaviors (Zohar, 2002).

Safety Climate offers workers with the knowledge of attitudes and perceptions that can help achieve better safety performance. Choudhry, Fang and Lingard performed an experiment to determine the safety climate that would enhance safety culture and positively impact perceived safety performance on construction projects (Choudhry, Fang and Lingard, 2009). The concept of "safety culture" (Choudhry et al., 2007a) is highly valued within the company and management believes that a positive safety climate is required for improving safety performance on its construction projects. The main objective of this study was to suggest recommendations for improving site safety. A site safety climate survey was performed to ensure the accountability of management in demonstrating their leadership and support for safety (Choudhry, Fang and Lingard, 2009).

Safety Climate refers to perceptions of policies, procedures, and practices relating to safety in the work place (Zohar, 1980). Flin et al. (2000) defined safety climate as the shared perceptions about safety values, norms, beliefs, practices and procedure. For the

most part, safety climate highlights the perceptions held by employees regarding the significance of safety in their jobsite (Choudhry et al., 2007b). Safety Climate consist or eight dimensions: successful safety training; management commitment to safety; status of safety officer; status of safety committee; level of risk at workplace; effects of safe conduct on promotion; effects of safe conduct on social status; and effects of required work place on safety (Zohar, 1980).

Choudhry, Fang and Lingard collected data on 22 construction projects in Hong Kong. Twenty four questions came from the 71 item questionnaire form the Health and Safety climate survey tool. Seven additional items where included to make the questionnaire suitable for the safety managers in Hong Kong (Choudhry, Fang and Lingard, 2009). The questionnaire was examined for content validity, structure validity and offensiveness of the language. The questionnaire was presented in English and Chinese and consisted of 42 states about safety issues. About 1,500 questionnaires where passed out and 1,294 were collected. The respondents returned their questionnaire in a sealed box and everything was kept anonymously. Factor Analysis was used to identify the underlying cluster of factors which affected the safety climate (Choudhry, Fang and Lingard, 2009). This technique revealed two dimensions: management commitment and employee involvement and inappropriate safety procedure and work practices. Interviews were also conducted which revealed that management commitment was highly important. The following literature review presented different case studies that focused on behavior, educational status, safety climate/culture and attitude. They explored in detail why construction workers engage in unsafe behaviors, educational status in correlation with injury rates and how social modeling can help influence new incoming workers to

perform their task safely. This chapter explored the factors that contribute to the effectiveness of safety training along with hands on training experiments performed in each literature. For example, under the behavior and attitude literatures, Choudhry and Fang performed an experiment that proved that workers with positive behavior and attitudes performed better than others. Yu and Meng proved that safety training in aviation safety is positively affected by attitude and behavior. Gyekye and Salminen proved that with more education and positive safety climate, the more effective the safety training is. Chapter 3 will describe an experiment that will show a video, demonstration and power point to train for safety. The literature review is related to this study because the experiment shows the different intensity levels of training intended to prove the point.

CHAPTER 3

EXPERIMENTAL METHOD

The experimental part of this study was designed to evaluate the effectiveness of progressively more intensive safety training on construction sites with a focus on fall protection training. The intent of the experiment was to test if progressively increasing the intensity of safety training would improve the trainees' learning and safety attitude. For the purpose of this experimental study, three levels of safety training were developed.

The first level of training included a video training session lasting 28 minutes. The contents of the video encompassed training on safety policy and safety philosophy of a construction company, as well as general guidelines on safety related hazards and standard procedures for safe work practices. Specific safety areas addressed were fire, confined space, fall protection, electrical safety, and personal protective equipment. This video was professionally developed and used by a major construction firm in New Jersey to provide training to construction workers.

In the second level of training, in addition to this video demonstration, a safety trainer reinforced the importance of safety in construction and provided a hands-on demonstration of the personal fall protection system. The demonstration was performed by Mr. Robert Weissman who is a certified safety professional and works for the NJ Turnpike Authority. Mr. Weissman focused on fall protection and proper training for fall protection. A full body harness was brought in along with a hard hat, safety glasses and proper construction clothing.

The third level of training constituted the training of level two and an additional half an hour power point presentation. The power point presentation was designed to review the important safety training aspects shown in the video tape and additionally, it stressed the technical aspects of the personal fall protection system. The power point presentation is included at the end of the appendix.

Each of the sessions was conducted in the Murry Center conference room at NJIT in three separate days. Session one, two and three lasted 60 minutes, 1 hour and 20 minutes and 1 hour and 40 minutes, respectively. Flyers were posted in the campus center, dorm rooms and administration buildings to attract participants to take part in the experimental sessions. Facebook was also used to attract participants. The participants were required to be 18 years or older, with no prior construction training and English speaking persons. No prior construction training was required to emulate non-unionized contractor laborers, who typically may not have any prior construction experience. Each participant was paid $10 for participation. Each participant attended only one training session, and participants were randomly assigned to a training sessions. Originally 10 participants were planned for each session, but due to scheduling problem, the third session was conducted with seven participants. The Institutional Review Board (IRB) clearance was obtained prior to the experimental study. The IRB application and three consent forms are included in Appendix A. Participants signed the informed consent form prior to taking part in the experimental session.

A detailed questionnaire survey was designed to assess the effectiveness of the training sessions. The questionnaire (See Appendix B) contained two parts. The first part included 23 construction related safety questions. The questionnaire included five

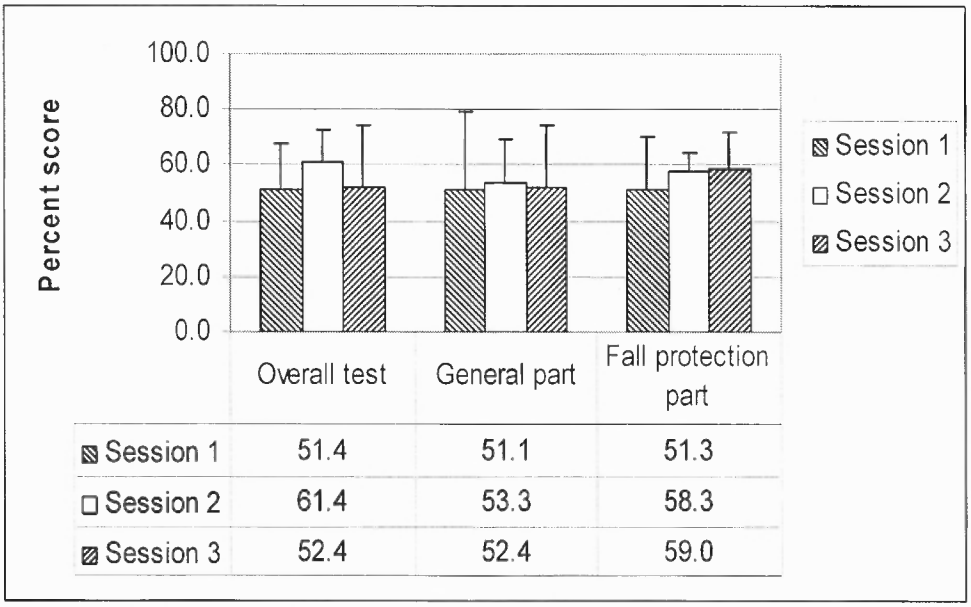
important construction related fall protection topics, namely, personal protective equipment, confined spaces, scaffolding, ladder and personal fall protection. The questions were a mix of true/false, multiple choice and short answers type. Additionally, part 2 of the questionnaire contained 14 safety behavior and attitude questions to elicit the subjective perception of the participants about the effectiveness of the training session. Participants provided their rating in a numerical scale of 1-5, 1 being mot favorable and 5 being most unfavorable.

At the end of each session, each participant was allowed 25 minutes to fill out the survey questionnaire. The survey responses were later analyzed to determine the effectiveness of the safety training sessions. Chapter 4 would discuss the results in detail.

CHAPTER 4

RESULTS AND ANALYSES

Session 1, 2 and 3 tests were graded and separated by sessions. Microsoft Excel was used to separate each session, subject and test responses. For the first part of the test, that contained 23 questions, correct answers were scored with 1 and incorrect answer with a 0. The raw scores obtained by the participants are provided in Appendix C of the 23 questions in part 1, the first 14 questions were related to general construction safety, and the remaining nine questions were specific to fall protection. The grades obtained in these two sections were also summarized separately. The average and standard deviation of the test scores, in terms of overall score, score in the general safety part and in the fall protection part are shown in Figure 4.1.



	Overall test	General part	Fall protection part
Session 1	51.4	51.1	51.3
Session 2	61.4	53.3	58.3
Session 3	52.4	52.4	59.0

Figure 4.1 Test scores obtained in three experimental sessions

The test session 2 obtained the highest average scores in the first two categories. The test session 3 registered the highest score in the fall protection category. However, a subsequent statistical test was performed using MINITAB 15® statistical software, which indicated no statistically significant difference in the mean scores between the three sessions. Details of the statistical test are provided in Appendix D.

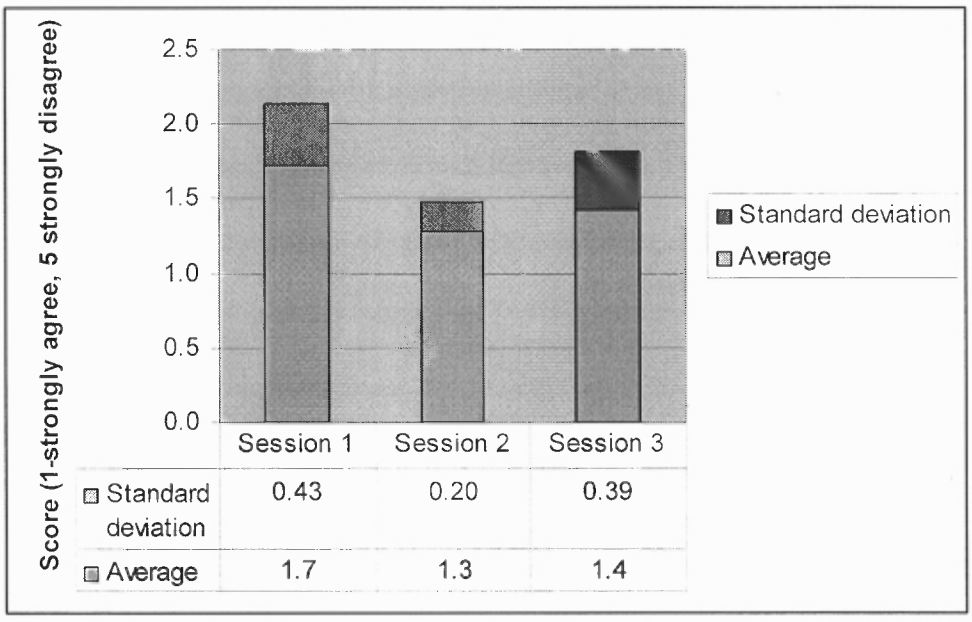


Figure 4.2 Perception of the effectiveness of safety training

Part 2 of the test questions included 14 questions eliciting participant perception regarding the effectiveness of the training session. Each was graded on a scale from 1-5, 1 indicating strong agreement and 5 indicating strong disagreement. The averages and standard deviations of the scores for the three sessions are provided in Figure 4.2. The overall average score varied between 1.3 to 1.7, which indicated that participants rather strongly agreed on the value and effectiveness of the training sessions. Session 2 of the training, which included video and a hands on demonstration received the most favorable

response from the participants. Statistical test showed that the mean score for session two was significantly better than the mean test score of session 1 (p=0.029).

4.1 Discussion

The first comparison done is the difference between session 1 (Video Only), session 2 (Video and Demonstration) and session 3 (Power point and Demonstration). Originally session 3 was to consist of the safety video, demonstration and power point but due to technical difficulties, the video could not be played for that day. The average test scores for session 1, 2 and 3 were 51, 61, and 52, respectively. According to the results, session 2 did much better than session 1 but session 3 did not have a additional positive contribution..

There were 14 behavioral attitude questions. The behavioral questions are attached to the 23 survey questions and were administrated at the end of each session. The questions were coded according to how important or not important they were to the participant. Question 1= strongly agree, excellent or very important, question 2 = agree, good or important, question 3 = somewhat agree, satisfactory or somewhat important, question 4 = somewhat disagree, fair or not that important and question 5 = strongly disagree, poor or not important. A detailed analysis showed an overall view of how many participants strongly agreed or disagreed for each session and it showed that four out of the 14 behavioral questions had the most votes for strongly agreeing. Also, the four most popular questions all focused on fall protection safety.

The 23 survey questions were broken into general safety questions (GSQ), fall protection questions (FPQ) and behavioral questions (BQ). Figures 4.1 and 4.2 show the average scores for each training session. The average for each are GSQ = 51.1, FPQ =

51.3 and BQ = 1.71 for session 1. For session 2 GSQ = 53.3, FPQ = 58.3 and BQ = 1.3 and for session 3 GSQ = 52.4, FPQ = 59.0 and BQ = 1.4. The averages show that the GSQ went up between session 1 & 2 and the averages for the FPQ increased going from session 1 to 2 and 3. A similar pattern is seen in BQ scores, where the scores improved between sessions 1 and 2 and between sessions 1 and 3. The average scores supports the study hypothesis that increased and multimodal training would provide improved learning and safety attitudes.

The score for the BQ was compared for each session in Minitab and the results were statistically significant. This indicates that the behavioral question had a statistically significant difference between sessions 1 and 2 and it proves that the overall behavior and attitude of the people that watched the video and saw the demonstration changed more favorable toward safety than the group that watched the video only. The study results also proved that a demonstration and a power point are redundant and it made no significant difference in training.

CHAPTER 5

CONCLUSION

The overall objective of this thesis was to evaluate the effectiveness of safety training for construction sites, and specifically for fall protection. The study conducted a literature survey on the factors that affects safety outcomes in the construction industry, especially for the non unionized workers. It delineates the technicalities of fall protection and the need for training. The study developed a survey instrument to evaluate the effectiveness of safety training. This study intended to prove that a video training is not enough and that a hands-on demonstration will improve the safety behavior and behavior of construction works.

Although there was not a statistical significant difference in the general safety question and the fall protection question for increasingly intensive training sessions, it still showed that a change occurred in the positive direction. With the behavioral and attitude type questions, the majority chose to strongly agree with the fall protection questions, which justifies why fall protection is so important. The behavioral question proved to have a statistical difference ($p<0.05$) from session 1 to session 2 and showed not much of a change with session 3. This proved that using safety videos is not the only mechanism needed to train a worker. A live lecture and demonstration makes a difference, but one should also keep in mind that too much information or tedious training like power points can lose the interest of the worker and as a result there will be no significant change.

Other factors that affected the results of my experiment were, participants arriving late, not enough people for each session especially session 3, video malfunction, and performing a test during the week of final examinations. With more than 10 people participating in the experiment, there could have been a statistical significant difference among the three sessions. Some of the feedbacks from each session were: "the video was boring and too long", "I remembered the little rules and how tying off is very important", "good demonstration, I learned a lot more from the demonstration" and "the video gave no real life example but the demonstration was more realistic".

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPLICATION AND THREE IRB

CONSENT FORMS

Date 4-20-10

HUMAN SUBJECT RESEARCH REVIEW FORM
NEW JERSEY INSTITUTE OF TECHNOLOGY
INSTITUTIONAL REVIEW BOARD APPLICATION
Revised September 19, 2007

Name of Principal Investigator(s) Mayeana Kamara

Faculty members and/or staff must be principal investigators. Students can serve as co-principal investigators under *faculty/staff supervision for expedited projects.*

NJIT Address: Graduate Student, MIE, NJIT, Newark NJ 07102

Department: Mechanical & Industrial Engineering

E-mail Address: Mnk3@njit.edu

NJIT Affiliation of Principal Investigators (Check all that apply):

☐ Faculty ☒ Student ☐ Other - Describe: _____

*Note students and doctoral candidates applying for IRB approval must submit written documentation from their faculty advisors (via e-mail) stating that research is being conducted under their supervision.

Project Title: Effectiveness of Safety Training

This project will be conducted:

☒ On Campus ☐ Off Campus: Location: GITC Building ☐ Both

Is this research funded by outside source(s)? ☐ Yes ☒ No

If yes, indicate name(s) and type of funding source(s):

Name of Funding Source(s): _____

Type:

- ☐ Government (County, State or Federal)
- ☐ Foundation
- ☐ Corporation
- ☐ Other _____

Anticipated Starting Date of Project: 4-26-10

Anticipated Closing Date of Project: 4-26-10

Number of Subjects: 30

NOTE: All principal investigators, faculty, and students who will be interfacing with human subjects in this study must complete an online training course in the protection of human subjects. This course can be accessed by going to the US Department of Health and Human Services' Office for Human Research Protection website (http://www.hhs.gov/ohrp/) and clicking on "Education." At the bottom of this page, you will see the tutorial for the training module for assurances. All certificates indicating course completion must be submitted with this application.

To Principal Investigator: In addition to the questions below, please furnish copies of any questionnaires interview formats, testing instruments or other documents necessary to carry out the research. Any advertising materials used to recruit subjects must also be submitted.

The completed forms should be sent to:

Dawn Hall Apgar, PhD
dawn.apgar@njit.edu
Chair, IRB
DD Planning Institute – CABSR
Campbell 330
New Jersey Institute of Technology
University Heights
Newark, NJ 07102-1982

1. Project Title: The Effectiveness of Safety Training

2. List the names and status (faculty, student, etc.) of the persons conducting the research:

   a. Principal Investigator(s): Mayeana Kamara

   b. Other Members of Research Team: Robert Weissman

   c. NJIT Faculty Advisor(s) if Student Project: Dr. Arijit Sengupta

3. Describe the objectives, methods and procedures of the research project. This summary will used to describe your project to the IRB. Use up to 2 pages, if necessary. You may also attach a copy of an abstract or full research proposal describing this work.

The objective of this dissertation is to evaluate the effectiveness of safety training specifically construction safety. Construction has the highest rate of accidents in any industry and the leading

cause of death is falls. The experimental part of this study will focus on construction training and its effectiveness.

Materials used for this experiment are: #2 pencils, TV and DVD player, chairs and tables and a video recorder. Before each session the consent form will be read out loud as well as the step by step directions. The experiment will be broken up into three sessions.

Each volunteer will be screened based on their knowledge and work experience in the construction field before each session. The first session will consist of a 28 minute video that will viewed by 10 volunteers. This video has been obtained from a large construction firm (Turner Construction) which uses this video as a training material. The conductor of this session will be I and the process will be video recorded to be later reviewed. The session will start off with an introduction of the project and an explanation of what will be conducted that day. Volunteers will be handed a consent form explaining the reason for the study and their payment arrangements for the participation. The participants will be urged to pay close attention to the video, and will be informed that this experiment is not a certification class for fall protection. Anything outside this experiment pertaining to fall protection performed on their own time will be at their own risk. The conductor will then insert the DVD and play it through the end. The volunteers will be handed a #2 pencil and a question survey sheet. Volunteers will be informed that they have 25 minutes to complete the test. The surveys will be collected at the end of 25 minutes the participants will be thanked for their participation and payment will be distributed. Session two will consist of a video and a demonstration on topics related to construction. The same steps for session one will be conducted but after the video is over, the demonstrator will begin to speak. The demonstrator will focus on: full body harness equipment, difference between subcontractors training and big company training towards fall protection, Job hazard analysis, and situational events. After the

demonstrator speaks for 20 minutes, participants will be encouraged to ask questions. At the end of the session the same survey will be conducted as described in the previous session.

Session three will consist of a video, demonstration along with a power point presentation. The same steps for session one will be conducted but after the demonstrator, a 20 minutes power point which will be conducted. After the 20 minutes power point, the volunteers will be handed a #2 pencil and a 23 question survey sheet. After 25 minutes have gone by, the surveys will be collected, and payment will be distributed.

The estimated total session times are: session one = 60minutes, session two = I hour and 20 minutes and session three = I hour and 40 min.

4. List name and institutional affiliation of any research assistants, workers student that will be working on this project.

Mayeana Kamara (Conductor) – NJIT Graduate Student
Robert Weissman, CSP (Demonstrator) – NJIT Graduate Student, OSIH Student

5. If research assistants, workers, students will be working on the project describe their qualifications, special training and how they will be supervised.

Robert Weissman (Demonstrator): Robert Weissman (Certified Safety Professional) Safety director for the New Jersey Turnpike Authority. He has extensive training in fall protection and is a qualified competent fall protection trainer.

6. What is the age of the subjects and how will they be recruited?

The age range is 18 and above and they will be recruited by posting flyers around campus and using social networks such as face book and twitter.

7. Attendant risks: Indicate any physical. Psychological, social or privacy risk or pain, which may be incurred by human subjects, or any drugs medical procedures that will be used. (This includes any request for the subjects to reveal any embarrassing, sensitive, or confidential information about themselves or others.) Also, indicate if any deception will be used, and if so, describe it in detail. Include your plans for debriefing.
NONE

8. Evaluate the risks presented in 7.
   a. Is it more that would normally be encountered in daily life? N/A

b. Do your procedures follow established and accepted methods in your field? N/A

9. How will the risk be kept at a minimum? (e.g. describe how the procedures reflect respect for privacy, feeling, and dignity of subject and avoid unwarranted invasion of privacy or disregard anonymity in any way.) Also, if subjects will be asked to reveal any embarrassing, sensitive, or confidential information, how will confidentiality of the data be insured? Also include your pans for debriefing. If subjects will be placed under any physical risk, describe the appropriate medical support procedures.

In any emergency situation call 911

10. Describe the benefits to be derived from this research, both by the subject and by the scientific community (this is especially important if research involves children).

As important as safety is in all industries today, it is still the most overlooked topic. But yet, the numbers speak for themselves, injuries and deaths occur every year. The results of this experiment may show the importance of intense safety training and how to motivate and educate unskilled workers in the construction field. Currently, majority of the companies only provide a short training video to their workers when they are recruited. This research may prove that additional training can improve safety consciousness effectively.

11. Describe the means through which human subjects will be informed of their right to participate, not to participate, or withdraw at any time. Indicate whether subjects will be adequately informed about the procedures of the experiment so that they can make an informed decision on whether or not to participate.

The human subjects will be informed of their rights by signing a consent form. Before each session, the consent form will be read out loud and participates will be notified that this is a volunteer service and they can withdraw at any time. Also the step by step direction will be read out loud.

12. Complete the attached copy of the Consent Form and the Institutional Review Board will make a determination if your subjects will be at risk. This Consent Form must include the following five pieces of information: (1) The purpose of the research, (2) the procedures involved in the work, (3) the potential risk of participating, (4) the benefits of the research, (5) that the subjects are free to withdraw from the research at any time with no adverse consequences.

13. Furnish copies of questionnaires, interview formats, testing instruments or other documents to carry out the research. If questionnaires are not complete please submit an outline of the questions to be used. You will have to submit the completed questionnaire to the Committee before the research can begin.

14. If the subjects will be minor children, complete Consent Form as prescribed in paragraph 12 for signature by parent or guardian. If the project is approved (regardless of the

Board's determination concerning risk), it will be necessary that a Consent Form be secured for every minor child.

15. Attach copy of permission of facility to conduct the proposed research (if other that NJIT).

NEW JERSEY INSTITUTE OF TECHNOLOGY
323 MARTIN LUTHER KING BLVD.
NEWARK, NJ 07102

CONSENT TO PARTICIPATE IN A RESEARCH STUDY # 1

TITLE OF STUDY:

RESEARCH STUDY:
I,_____, have been asked to participate in a research study under the direction of Dr Arijit Sengupta. Other professional persons who work with them as study staff may assist to act for them.

PURPOSE:
The purpose of this study is to evaluate the effectiveness of safety training specifically concentrating on fall protection. The intent of the experiment is to prove that with extensive and continual training, the basic safety factors of fall protection will be practiced more frequently and less likely to be forgotten on the job site. You qualify as a participant in the project because you are in one of the following groups: Male/female between the age of 18 and above have limited prior or limited knowledge in the construction field.

DURATION:
My participation in this study will last for 60 minutes.

PROCEDURES:
I have been told that, during the course of this study, the following will occur:

Session One: Video and Survey

Materials used for this experiment are: #2 pencils, TV and DVD player, chairs and tables and a video recorder. Before each session the consent form will be read out loud as well as the step by step directions.

The first session will consist of a 28 minute video that will viewed by 10 volunteer participants. I will be the conductor of this session and the process will be video recorded to be later reviewed.

The session will start off with an introduction of the project and an explanation of what will be conducted that day. Volunteers will be handed a consent form explaining the reason for the study and their payment arrangements for their participation. The participants will be urged to pay close attention to the video, and will be informed that this experiment is not a certification class for fall protection. Anything outside this experiment pertaining to fall protection performed on their own time will be at their own risk. The conductor will then insert the DVD and play it through the end. The volunteers will be handed a #2 pencil and a question survey sheet. Volunteers will be informed that they have 25 minutes to complete the test. The surveys will be collected at the end of 25 minutes the participants will be thanked for their participation and payment will be distributed. The total estimated time for this session is 60 minutes.

PARTICIPANTS:
I will be one of about ___30_____ participants in this study.

EXCLUSIONS:
I will inform the researcher if any of the following apply to me:

18 yrs and older
English speaking
No prior work experience or knowledge in construction

CONFIDENTIALITY:
I understand confidential is not the same as anonymous. Confidential means that my name will not be disclosed if there exists a documented linkage between my identity and my responses as recorded in the research records. Every effort will be made to maintain the confidentiality of my study records. If the findings from the study are published, I will not be identified by name. My identity will remain confidential unless disclosure is required by law.

VIDEOTAPING/AUDIOTAPNG: (NEED TO INCLUDE ONLY IF APPLICABLE)
I understand that I will be video during the course of this study. Video tapes will be stored for (one month) after the end of this project (06/30/2010). After that time, the tapes will be erased by recording over my recorded sessions.

The tapes will be stored in a locked office at NJIT and will not be made available to anyone except (Mayeana Kamara) who is involved in this research.

PAYMENT FOR PARTICIPATION:
I have been told that I will receive $___10_____ compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW:
I understand that my participation is voluntary and I may refuse to participate, or may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT:
If I have any questions about my treatment or research procedures, I understand that I should contact the principal investigator at:

Dr. Arijit Sengupta, Room # GITCI 2517, Newark NJ 07102

Sengupta@njit.edu

973-642-7073

If I have any addition questions about my rights as a research subject, I may contact:

Dawn Hall Apgar, PhD, IRB Chair
New Jersey Institute of Technology
323 Martin Luther King Boulevard
Newark, NJ 07102
(973) 642-7616
dawn.apgar@njit.edu

SIGNATURE OF PARTICIPANT

I have read this entire form, or it has been read to me, and I understand it completely. All of my questions regarding this form or this study have been answered to my complete satisfaction. I agree to participate in this research study.

Participant Name _____

Signature _____

Date _____

SIGNATURE OF INVESTIGATOR OR RESPONSIBLE INDIVIDUAL (Only required for consent forms of projects requiring full IRB approval)

To the best of my knowledge, the participant, has _____

understood the entire content of the above consent form, and comprehends the study. The participants and those of his/her parent/legal guardian have been accurately answered to his/her/their complete satisfaction.

Investigator's Name Mayeana Kamara

Signature _____

Date 4-20-10

NEW JERSEY INSTITUTE OF TECHNOLOGY
323 MARTIN LUTHER KING BLVD.
NEWARK, NJ 07102

CONSENT TO PARTICIPATE IN A RESEARCH STUDY #2

TITLE OF STUDY:

RESEARCH STUDY:
I,_____, have been asked to participate in a research study under the direction of Dr Arijit Sengupta. Other professional persons who work with them as study staff may assist to act for them.

PURPOSE:
The purpose of this study is to evaluate the effectiveness of safety training specifically concentrating on fall protection. The intent of the experiment is to prove that with extensive and continual training, the basic safety factors of fall protection will be practiced more frequently and less likely to be forgotten on the job site. You qualify as a participant in the project because you are in one of the following groups: Male/female between the age of 18 and above have limited prior or limited knowledge in the construction field.

DURATION:
My participation in this study will last for 1 hour and 20 minutes.

PROCEDURES:
I have been told that, during the course of this study, the following will occur:

Session Two: Video, Demonstration and Survey

Materials used for this experiment are: #2 pencils, TV and DVD player, chairs and tables and a video recorder. Before each session the consent form will be read out loud as well as the step by step directions.

The second session will consist of a 28 minute video, a 20 minute demonstration by Robert Weissman on fall protection and a 23 question survey. I will be the conductor of this session and the process will be video recorded to be later reviewed. The session will start off with an introduction of the project and an explanation of what will be conducted that day. Volunteers will be handed a consent form explaining the reason for the study and their payment arrangements for their participation. The participants will be urged to pay close attention to the video and demonstration and will be informed that this experiment is not a certification class for fall protection. Anything outside this experiment pertaining to fall protection performed on their own time will be at their own risk. The conductor will then insert the DVD and play it through the end. After the video, the demonstrator will focus on: how to wear your full body harness equipment, personal protective equipment and how to inspect your fall protection equipment. After the demonstrator speaks for 20 minutes, participants will be encouraged to ask questions. The volunteers will be handed a #2 pencil and a question survey sheet. Volunteers will be informed that they have 25 minutes to complete the test. The surveys will be collected at the end of 25 minutes the participants will be thanked for their participation and payment will be distributed. The total estimated time for this session is 1 hour and 20 minutes.

PARTICIPANTS:
I will be one of about ___30_____ participants in this study.

EXCLUSIONS:
I will inform the researcher if any of the following apply to me:

18 yrs and older
English speaking
No prior work experience or knowledge in construction

CONFIDENTIALITY:
I understand confidential is not the same as anonymous. Confidential means that my name will not be disclosed if there exists a documented linkage between my identity and my responses as

recorded in the research records. Every effort will be made to maintain the confidentiality of my study records. If the findings from the study are published, I will not be identified by name. My identity will remain confidential unless disclosure is required by law.

VIDEOTAPING/AUDIOTAPNG: (NEED TO INCLUDE ONLY IF APPLICABLE)
I understand that I will be video during the course of this study. Video tapes will be stored for (one month) after the end of this project (06/30/2010). After that time, the tapes will be erased by recording over my recorded sessions.

The tapes will be stored in a locked office at NJIT and will not be made available to anyone except (Mayeana Kamara) who is involved in this research.

PAYMENT FOR PARTICIPATION:
I have been told that I will receive $___10_____ compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW:
I understand that my participation is voluntary and I may refuse to participate, or may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT:
If I have any questions about my treatment or research procedures, I understand that I should contact the principal investigator at:

Dr. Arijit Sengupta, Room # GITCI 2517, Newark NJ 07102

Sengupta@njit.edu

973-642-7073

If I have any addition questions about my rights as a research subject, I may contact:

Dawn Hall Apgar, PhD, IRB Chair
New Jersey Institute of Technology
323 Martin Luther King Boulevard
Newark, NJ 07102
(973) 642-7616
dawn.apgar@njit.edu

SIGNATURE OF PARTICIPANT

I have read this entire form, or it has been read to me, and I understand it completely. All of my questions regarding this form or this study have been answered to my complete satisfaction. I agree to participate in this research study.

Participant Name _____

Signature _____

Date _____

SIGNATURE OF INVESTIGATOR OR RESPONSIBLE INDIVIDUAL (Only required for consent forms of projects requiring full IRB approval)

To the best of my knowledge, the participant, has _____ understood the entire content of the above consent form, and comprehends the study. The participants and those of his/her parent/legal guardian have been accurately answered to his/her/their complete satisfaction.

Investigator's Name Mayeana Kamara

Signature _____

Date 4-20-10

NEW JERSEY INSTITUTE OF TECHNOLOGY
323 MARTIN LUTHER KING BLVD.
NEWARK, NJ 07102

CONSENT TO PARTICIPATE IN A RESEARCH STUDY # 3

TITLE OF STUDY:

RESEARCH STUDY:
I,_____, have been asked to participate in a research study under the direction of Dr Arijit Sengupta. Other professional persons who work with them as study staff may assist to act for them.

PURPOSE:
The purpose of this study is to evaluate the effectiveness of safety training specifically concentrating on fall protection. The intent of the experiment is to prove that with extensive and continual training, the basic safety factors of fall protection will be practiced more frequently and less likely to be forgotten on the job site. You qualify as a participant in the project because you are in one of the following groups: Male/female between the age of 18 and above have limited prior or limited knowledge in the construction field.

DURATION:

My participation in this study will last for I hour and 40 minutes.

PROCEDURES:
I have been told that, during the course of this study, the following will occur:

Session Three: Video, Demonstration, Power point Presentation and Survey

Materials used for this experiment are: #2 pencils, TV and DVD player, chairs and tables and a video recorder. Before each session the consent form will be read out loud as well as the step by step directions.

The third session will consist of a 28 minute video, a 20 minute demonstration by Robert Weissman on fall protection, 20 minute power point presentation and a 23 question survey. I will be the conductor of this session and the process will be video recorded to be later reviewed. The session will start off with an introduction of the project and an explanation of what will be conducted that day. Volunteers will be handed a consent form explaining the reason for the study and their payment arrangements for their participation. The participants will be urged to pay close attention to the video, demonstration and power point and will be informed that this experiment is not a certification class for fall protection. Anything outside this experiment pertaining to fall protection performed on their own time will be at their own risk. The conductor will then insert the DVD and play it through the end. After the video, the demonstrator will focus on: how to wear your full body harness equipment, personal protective equipment and how to inspect your fall protection equipment. After the demonstrator speaks for 20 minutes, there will be a 20 minute power point presentation on construction safety. The volunteers will be handed a #2 pencil and a question survey sheet. Volunteers will be informed that they have 25 minutes to complete the test. The surveys will be collected at the end of 25 minutes the participants will be thanked for their participation and payment will be distributed. The total estimated time for this session is I hour and 40 minutes.

PARTICIPANTS:
I will be one of about ___30_____ participants in this study.

EXCLUSIONS:
I will inform the researcher if any of the following apply to me:

18 yrs and older
English speaking
No prior work experience or knowledge in construction

CONFIDENTIALITY:
I understand confidential is not the same as anonymous. Confidential means that my name will not be disclosed if there exists a documented linkage between my identity and my responses as recorded in the research records. Every effort will be made to maintain the confidentiality of my study records. If the findings from the study are published, I will not be identified by name. My identity will remain confidential unless disclosure is required by law.

VIDEOTAPING/AUDIOTAPNG: (NEED TO INCLUDE ONLY IF APPLICABLE)
I understand that I will be video during the course of this study. Video tapes will be stored for (one month) after the end of this project (06/30/2010). After that time, the tapes will be erased by recording over my recorded sessions.

The tapes will be stored in a locked office at NJIT and will not be made available to anyone except (Mayeana Kamara) who is involved in this research.

PAYMENT FOR PARTICIPATION:
I have been told that I will receive $___10_____ compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW:
I understand that my participation is voluntary and I may refuse to participate, or may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT:
If I have any questions about my treatment or research procedures, I understand that I should contact the principal investigator at:

Dr. Arijit Sengupta, Room # GITCI 2517, Newark NJ 07102

Sengupta@njit.edu

973-642-7073

If I have any addition questions about my rights as a research subject, I may contact:

Dawn Hall Apgar, PhD, IRB Chair
New Jersey Institute of Technology
323 Martin Luther King Boulevard
Newark, NJ 07102
(973) 642-7616
dawn.apgar@njit.edu

SIGNATURE OF PARTICIPANT

I have read this entire form, or it has been read to me, and I understand it completely. All of my questions regarding this form or this study have been answered to my complete satisfaction. I agree to participate in this research study.

Participant Name _____

Signature _____

Date _____

SIGNATURE OF INVESTIGATOR OR RESPONSIBLE INDIVIDUAL (Only required for consent forms of projects requiring full IRB approval)

To the best of my knowledge, the participant, has _____ understood the entire content of the above consent form, and comprehends the study. The participants and those of his/her parent/legal guardian have been accurately answered to his/her/their complete satisfaction.

Investigator's Name Mayeana Kamara

Signature _____

Date 4-20-10

APPENDIX B

QUESTIONNAIRE SURVEY FORM

PART - I

Personal Protective Equipment

1. Which of the following are PPE?
   a.) Hammer
   b.) Full body harness
   c.) Pocket Knife
   d.) Ladder

2. It is the employee's responsibility to ensure PPE is inspected on a regular basis? True or False

3. When there is a noise level of ---------- decibels ---------- protection should be worn?

4. Mask or Respirator needs the following?
   a.) Medical Clearance and Fitness test
   b.) NIOSH Clearance and Fitness test
   c.) OSHA Clearance and Fitness test
   d.) All the above

II. Confined Space

5. Confined Space requirements are as followed?
   a.) Assigned authorized attendant and proper fall protection
   b.) Rescue team and proper confined space label
   c.) Air monitor and lockout/tag out
   d.) All the above

6. What does confined space mean?

III. Scaffolding

7. Scaffolding requires a mudsill, base plate and fence? True or False

8. Scaffolding should be able to hold ---------- times the maximum intended load applied.

9. Employees working on a single-point or two-point scaffold should be protected by?

a.) personal fall arrest system and guardrail
b.) hard hat and safety glasses
c.) safety net
d.) none of the above

IIII. Ladder

10. Name two different types of ladder?

11. Ladders should meet _____ standard and be Type _____.

12. Above a landing how far should a ladder extend

a.) 5 feet

b.) 6 feet

c.) 2 feet

d.) 3 feet

13. Step ladder should be in an open position; True or False

14. The four steps in ladder safety are?

a.) Make sure the ladder is strong enough to withstand your weight and free of defects

b.) Use the right ladder for the job, Inspect the ladder

c.) Set-up the ladder properly, Follow rules for climbing and using ladders

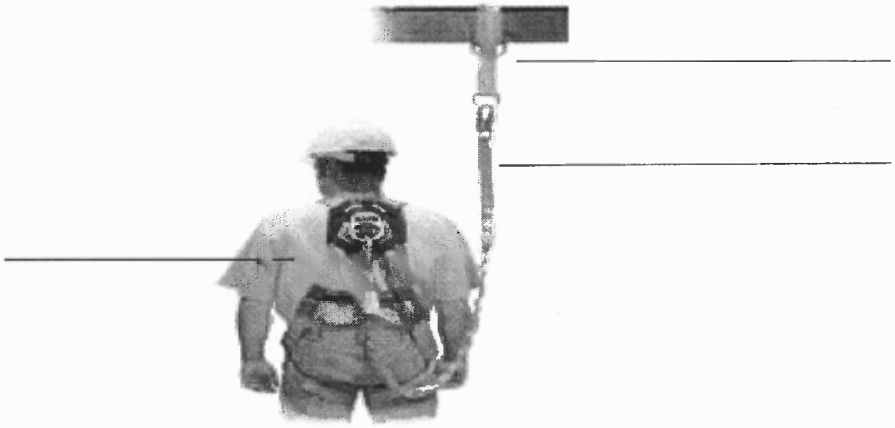
d.)A and C

e.) B and C

f.) All of the above

IV. Fall Protection

15. What is Fall Protection?
16. Please label the parts



17. What is the tie off point?

a.) 9 feet

b.) 3 feet

c.) 6 feet

d.) 12 foot

18. Safety belts are permitted; True or False

19. Cables should be flagged at _____ intervals

20. Anchor points should withstand _____ pounds

PART II

V. Safety, Behavior, and Attitude questions

21. This training improves safety awareness

strongly agree	agree	somewhat agree	somewhat disagree	strongly disagree
1	2	3	4	5

22. One can learn valuable lessons about construction safety from this training

strongly agree	agree	somewhat agree	somewhat disagree	strongly disagree
1	2	3	4	5

23. This training motivates one to follow safety rules during construction work

strongly agree	agree	somewhat agree	somewhat disagree	strongly disagree
1	2	3	4	5

24. This training should have an impact on accident reduction in construction sites

strongly agree	agree	somewhat agree	somewhat disagree	strongly disagree
1	2	3	4	5

25. More detailed safety training should have improved the safety attitude of the workers

strongly agree	agree	somewhat agree	somewhat disagree	strongly disagree
1	2	3	4	5

26. A more hands on training would increase the effectiveness of the training

strongly agree	agree	somewhat agree	somewhat disagree	strongly disagree
1	2	3	4	5

27. The quality of the training is

excellent	good	satisfactory	Fair	Poor
1	2	3	4	5

28. The ability of the training in stimulating interest in safety is

excellent	good	satisfactory	Fair	Poor
1	2	3	4	5

29. The overall value of the training is

excellent	good	satisfactory	Fair	Poor
1	2	3	4	5

30. How important is safety to you?

Very important	Important	Somewhat important	Not that important	Not important
1	2	3	4	5

31. Has this presentation provided a different perspective towards construction safety?

strongly agree	agree	somewhat agree	somewhat disagree	strongly disagree
1	2	3	4	5

32. How Important is wearing your Personal Protective Equipment?

Very important	Important	Somewhat important	Not that important	Not important
1	2	3	4	5

33. How important is it for you to tie off at 6 feet and above

Very important	Important	Somewhat important	Not that important	Not important
1	2	3	4	5

34. How important is it to you to inspect your fall protection equipment than losing your life if you did not?

Very important	Important	Somewhat important	Not that important	Not important
1	2	3	4	5

APPENDIX C

EXCEL SCORES OBTAINED IN TRAINING SESSIONS

Participant	Session	General	Fall protection	test	Behavioral
1	1	50.00	33.33	43.48	2.21
2	1	64.29	22.22	47.83	1.57
3	1	50.00	66.67	56.52	1.64
4	1	57.14	66.67	60.87	1.00
5	1	35.71	55.56	43.48	2.07
6	1	64.29	88.89	73.91	1.57
7	1	14.29	0.00	8.70	2.43
8	1	57.14	33.33	47.83	1.29
9	1	71.43	77.78	73.91	1.64
10	1	50.00	66.67	56.52	1.71
11	2	50.00	55.56	52.17	1.29
12	2	71.43	44.44	60.87	1.00
13	2	57.14	44.44	52.17	1.50
14	2	42.86	66.67	52.17	1.29
15	2	57.14	77.78	65.22	1.29
16	2	57.14	77.78	65.22	1.14
17	2	78.57	33.33	60.87	1.64
18	2	71.43	55.56	65.22	1.36
19	2	71.43	33.33	56.52	1.00
20	2	57.14	44.44	52.17	1.21
21	3	88.89	88.89	82.61	1.29
22	3	44.44	44.44	60.87	2.29
23	3	66.67	66.67	60.87	1.29
24	3	66.67	66.67	65.22	1.36
25	3	33.33	33.33	52.17	1.07
26	3	33.33	33.33	43.48	1.36
27	3	33.33	33.33	47.83	1.29

APPENDIX D

STATISTICAL TESTS

General Linear Model: General, fall protection, versus Session

```
Factor   Type   Levels  Values
Session  fixed       3  1, 2, 3


Analysis of Variance for General, using Adjusted SS for Tests

Source   DF  Seq SS  Adj SS  Adj MS     F      P
Session   2   585.0   585.0   292.5  1.09  0.354
Error    24  6463.8  6463.8   269.3
Total    26  7048.8


S = 16.4112   R-Sq = 8.30%   R-Sq(adj) = 0.66%


Analysis of Variance for fall protection, using Adjusted SS for Tests

Source   DF   Seq SS   Adj SS  Adj MS     F      P
Session   2     24.8     24.8    12.4  0.02  0.976
Error    24  12275.1  12275.1   511.5
Total    26  12300.0


S = 22.6156   R-Sq = 0.20%   R-Sq(adj) = 0.00%


Analysis of Variance for test, using Adjusted SS for Tests

Source   DF  Seq SS  Adj SS  Adj MS     F      P
Session   2   334.5   334.5   167.2  0.90  0.420
Error    24  4455.8  4455.8   185.7
Total    26  4790.3


S = 13.6257   R-Sq = 6.98%   R-Sq(adj) = 0.00%


Analysis of Variance for Behavioral, using Adjusted SS for Tests

Source   DF  Seq SS  Adj SS  Adj MS     F      P
Session   2  1.0094  1.0094  0.5047  4.13  0.029
Error    24  2.9310  2.9310  0.1221
Total    26  3.9404


S = 0.349463   R-Sq = 25.62%   R-Sq(adj) = 19.42%


Tukey 95.0% Simultaneous Confidence Intervals
Response Variable General
```

```
All Pairwise Comparisons among Levels of Session
Session = 1  subtracted from:

Session   Lower   Center  Upper  --------+---------+---------+--------
2         -8.32  10.0000  28.32              (----------*----------)
3        -19.23   0.9524  21.14        (------------*----------)
                                 --------+---------+---------+--------
                                       -16         0        16


Session = 2  subtracted from:

Session   Lower  Center  Upper  --------+---------+---------+--------
3        -29.23  -9.048  11.14  (-----------*------------)
                                 --------+---------+---------+--------
                                       -16         0        16


Tukey Simultaneous Tests
Response Variable General
All Pairwise Comparisons among Levels of Session
Session = 1  subtracted from:

         Difference       SE of            Adjusted
Session    of Means  Difference  T-Value   P-Value
2           10.0000       7.339   1.3625    0.3758
3            0.9524       8.088   0.1178    0.9924


Session = 2  subtracted from:

         Difference       SE of            Adjusted
Session    of Means  Difference  T-Value   P-Value
3           -9.048       8.088   -1.119    0.5122


Tukey 95.0% Simultaneous Confidence Intervals
Response Variable fall protection
All Pairwise Comparisons among Levels of Session
Session = 1  subtracted from:

Session   Lower  Center  Upper  --------+---------+---------+--------
2        -23.02   2.222  27.47      (--------------*---------------)
3        -26.55   1.270  29.09   (-----------------*----------------)
                                 --------+---------+---------+--------
                                       -16         0        16


Session = 2  subtracted from:

Session   Lower   Center  Upper  --------+---------+---------+--------
3        -28.77  -0.9524  26.87  (-----------------*-----------------)
                                 --------+---------+---------+--------
                                       -16         0        16


Tukey Simultaneous Tests
Response Variable fall protection
All Pairwise Comparisons among Levels of Session
Session = 1  subtracted from:

         Difference       SE of            Adjusted
Session    of Means  Difference  T-Value   P-Value
```

```
2             2.222       10.11   0.2197    0.9738
3             1.270       11.15   0.1139    0.9929


Session = 2  subtracted from:

         Difference       SE of             Adjusted
Session    of Means  Difference   T-Value   P-Value
3           -0.9524       11.15  -0.08545    0.9960


Tukey 95.0% Simultaneous Confidence Intervals
Response Variable test
All Pairwise Comparisons among Levels of Session
Session = 1  subtracted from:

Session   Lower  Center  Upper  ---+---------+---------+---------+---
2        -8.254   6.957  22.17       (-----------*-----------)
3        -9.059   7.702  24.46      (-------------*-------------)
                                ---+---------+---------+---------+---
                                 -12         0        12        24


Session = 2  subtracted from:

Session   Lower  Center  Upper  ---+---------+---------+---------+---
3        -16.02  0.7453  17.51  (-------------*-------------)
                                ---+---------+---------+---------+---
                                 -12         0        12        24


Tukey Simultaneous Tests
Response Variable test
All Pairwise Comparisons among Levels of Session
Session = 1  subtracted from:

         Difference       SE of             Adjusted
Session    of Means  Difference  T-Value    P-Value
2             6.957       6.094    1.142     0.4986
3             7.702       6.715    1.147     0.4954


Session = 2  subtracted from:

         Difference       SE of             Adjusted
Session    of Means  Difference  T-Value    P-Value
3            0.7453       6.715   0.1110     0.9932


Tukey 95.0% Simultaneous Confidence Intervals
Response Variable Behavioral
All Pairwise Comparisons among Levels of Session
Session = 1  subtracted from:

Session    Lower   Center     Upper    -+---------+---------+---------+-----
2        -0.8330  -0.4429  -0.05276    (---------*---------)
3        -0.7258  -0.2959   0.13392       (----------*---------)
                                       -+---------+---------+---------+-----
                                     -0.80     -0.40     -0.00      0.40


Session = 2  subtracted from:
```

```
Session    Lower  Center   Upper     -+---------+---------+---------+-----
3        -0.2830  0.1469  0.5768                    (----------*---------)
                                    -+---------+---------+---------+-----
                                  -0.80     -0.40     -0.00      0.40
```

Tukey Simultaneous Tests
Response Variable Behavioral
All Pairwise Comparisons among Levels of Session
Session = 1 subtracted from:

Session	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	-0.4429	0.1563	-2.834	0.0240
3	-0.2959	0.1722	-1.718	0.2190

Session = 2 subtracted from:

Session	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	0.1469	0.1722	0.8531	0.6743

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