THESIS

HOMESAFE: WORK PRACTICES, SITE CHARACTERISTICS, RISK PERCEPTION AND SAFETY CULTURE IN THE RESIDENTIAL CONSTRUCTION INDUSTRY

Submitted by

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WE HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER OUR SUPERVISION BY TASLIM PARAG AHMED ENTITLED HOMESAFE: WORK PRACTICES, SITE CHARACTERISTICS, RISK PERCEPTION AND SAFETY CULTURE IN THE RESIDENTIAL CONSTRUCTION INDUSTRY BE ACCEPTED AS PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE.

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ABSTRACT OF THESIS

HOMESAFE: WORK PRACTICES, SITE CHARACTERISTICS, RISK PERCEPTION AND SAFETY CULTURE IN THE RESIDENTIAL CONSTRUCTION INDUSTRY

The HomeSafe pilot program is a strategic partnership between OSHA Region VIII and the Home Builders Association (HBA) of metropolitan Denver. The 10-point safety and health program was developed by this partnership to address the major risks and hazards unique to residential construction sites. Investigators evaluated site conditions and work practices using a 117-item audit tool developed by researchers at Colorado State University. Participating companies were evaluated at their onset into the program and intervals thereafter. A cohort of n=41 companies with a mean score of 71 at the time of there initiation into HomeSafe were followed for two years. On retest their mean score had increased to 76 demonstrating a significant improvement (p=.04) with prolonged exposure to HomeSafe. Significant improvements (p=.01) were also seen when comparing the cohort to n=41 controls with a mean score of 66. Differences were also noted among trades with roofing and drywall experiencing the largest increases (12%) from previous scores of 80 and 67 to 92 and 79 respectively. Roofers and framers made up 22% of trades evaluated and are at significant risk on construction sites. Analysis of HomeSafe hazard categories showed the best compliance to safe work practices pertained to use of fall protection systems (mean score=89) followed by ladders (mean score=88) and PPE (mean score=83).

In addition to site characteristics this study also evaluated the risk perception and safety culture by using the safety culture and risk perception survey. The surveys were collected from both management and laborers of the HomeSafe partners. This study found the differences (p=.002) in perception of risk and safety culture between these two groups in retest group.

This study identified a weak correlation (-0.15 to 0.18) between the two study tools (audit and safety culture and risk perception survey). The audit tool assessed the work conditions and practices but safety culture survey had the responses based on beliefs, attitudes, knowledge, management commitment to safety, type of relationship between these two groups. There was a difference between the perception of risk and safety culture and work practices and site characteristics.

The findings indicate that HomeSafe has positively impacted the safe work practices and site characteristics of residential construction jobsites in the Denver metro area of Colorado. These data support the potential for positive outcomes with strategic partnership between public and private sectors.

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INTRODUCTION

Background and Fatalities in Construction Industry:

In USA, the construction industry employs more than 7 million persons, representing 6% of the labor force. The Standard Industrial Classification Manual 1987 classifies the United States economy into 10 major industry divisions. Of those 10 industry divisions, construction was the sixth largest civilian employer, the fourth leading employer of men (nearly 7 million), and the seventh leading employer of women (687,000) (Bureau of Labor Statistics, 1990).

Working in the construction industry carries a threefold increased risk of fatal injury compared to all other industries combined. In a study by Sorok et al. (1993), multiple data sources including death certificates, medical examiner reports, occupational safety and health fatality files, and workers' compensation reports were used to identify 200 construction related fatalities in New Jersey during the years 1983 to 1989. The death rate was 14.5 per 100,000 employed person-years over the study period. The leading cause of death was falls (46%). Over 2000 electrocution deaths were identified in a study by Ore and Casini (1996) among United States construction workers from 1980 to 1991, with the highest mean annual crude mortality rate (2.5 per 100,000 people). Death rates were higher among Hispanic and African-American construction workers in New Jersey than among Whites (Sorock et al. 1993). The death rate for construction workers in the United States appears to be substantially higher than the rates elsewhere, including Germany, the Netherlands, Sweden, and Ontario (Center to Protect Workers' Rights,

1993). From 1980-1993, an average of 1,079 construction workers was killed on the job each year.

Nonfatal injuries:

Construction workers in many industrialized countries suffer a disproportionate share of work-related injuries and illnesses. The Bureau of Labor Statistics (BLS) reported an overall rate of lost time or medical injuries or illnesses of 8.4 per 100 full-time workers in 1994. Risk of injury does not appear to be equal for all groups of construction workers. Laborers and Hispanic workers were over represented among the serious cases evaluated through emergency room surveillance (Hunting et al. 1994). Inexperienced workers (<1 year) have been described as being at greater risk of having a serious work-related injury as have small sized construction companies (Ringen et al. 1996). The Buraue of Labor Statistics (BLS) data do not show major differences between residential construction and other sectors of construction industry, although the proportion of all injuries that involve the hands and fingers is somewhat higher among residential workers (BLS, 1996).

To learn more about the causes of nonfatal construction worker injuries, Hunting et al. (1999) conducted a study by establishing an emergency department-based surveillance program in 1990 where 2,791 cases were identified through mid-August, 1997. Lacerations and strains and sprains were the most frequent diagnoses; cutting and piercing objects were the leading causes of injury among all construction workers, followed by falls and overexertion. Injury patterns are obvious among workers from four specific trades: carpenters, electricians, plumbers, and ironworkers. Areas of concern

highlighted by the trade-specific analysis include eye injuries among plumbers; falls from ladders among electricians and plumbers; slips, trips, and falls on the same level among iron workers; electrical exposure among electricians; and amputations among carpenters. Occupational injury rates in the construction trades are high compared to the general workforce in the United States.

Cost related to fatalities and injuries:

Falls caused 3,859 (25.55%) of construction worker fatalities between 1980-1993. The total cost of injuries in construction in the United States ranges from $10 billion to $40 billion annually (Meridian research, 1994); at $20 billion, the cost per construction worker would be $3,500 yearly. 15% of workers' compensation costs are spent on construction injuries. The workers' compensation premiums for three trades- carpenters, masons, and structural ironworkers averaged $28 per $100 of payroll nationally in mid-1993 (Powers, 1994); these rates vary enormously, depending on the trade and jurisdiction. In addition to workers' compensation, there are liability insurance premiums and other indirect costs- reduced work-crew efficiency, clean up (from a cave-in, for instance), overtime necessitated by injury, etc. These indirect costs can exceed the workers' compensation claim for an injury by several multiples (Levitt et al. 1993).

Residential Construction Industry:

A total of 31,113 workers' compensation claims were filed among 7,400 North Carolina Homebuilders Association (NCHA) members and their subcontractors for the

period 1986-1994. Injury rates were found to vary substantially among the residential construction trades (Lipscomb and Dement, 1999).

Data from the analysis of Washington State workers' compensation claims between 1990 and 1995 demonstrated that residential single-family housing had the highest overall absolute number of claims for injuries and illnesses and the fourth highest rate (29.1 per 200,000 hours). Workers' compensation claim rates were found to vary substantially among the residential construction trades, the overall rate of workers' compensation claims was highest for welders and cutters (53.2), insulators (40.9), roofers (29.5), mechanics and repairers (23.9), carpenters (22.9), and plumbers (21.9). Twenty-six work-related fatalities were observed during the 7 years of follow-up, of the 26 deaths among this group, 11 occurred among carpenters, 4 in other non-classified construction trades, 4 in other construction-related occupations, and 3 in brick masons. Other trades with one death included electricians, plumbers, operating engineers, and construction engineers/managers (Lipscomb and Dement, 1999).

Construction industry in Colorado:

According to the National Institute of Occupational Safety and Health (NIOSH) State Profile for Colorado (1998), the construction industry had the second highest number of work place fatalities of any occupation or industry in Colorado. Between 1984 and 1993, 174 construction workers died on the job. In 1991, workers in the Colorado residential construction industry experienced seven fatalities (Baltz, 1997).

Development of HomeSafe program:

Residential home building, an important sector of the construction industry that employs roughly 50% of construction workers in the United States (Guo et al. 1995), has unique health and safety concerns. Smaller companies that have less resources available for safety training employ workers in the home building industry. Work sites are not well controlled as compared to commercial construction projects, and health and safety rules are not as effectively enforced (Bigelow et al. 1998). In 1992 OSHA began to exert focused enforcement of the Federal Regulations 29 CFR 1926 in residential home building. The home building community was initially in opposition to OSHA's enforcement actions. It was apparent to those in the industry that the unique work process and environment of residential home construction did not lend itself well to the applicability of these regulations (Fowler, 1997).

HomeSafe is an acronym for the HomeBuilders and OSHA Mutually Ensuring Safe Accident Free Employment. Development of the HomeSafe program began in 1997, following the seven deaths in the residential construction industry in Colorado. Both OSHA and HBA recognized the need to identify the significant hazards and risks that existed in residential home building (Gilkey et al. 1998). Communication and negotiation between the HBA and OSHA began in 1992 and continued through 1996. During this time, the HBA and OSHA researched the available data and identified the significant risk factors associated with the incidence of construction safety violations, work-related injuries and illnesses, and fatalities in the construction industry. The HomeSafe project represents a collaborative effort born from adversity, persistence, negotiation, research, compromise, problem solving, hazard focus, prevention strategy development and

meaningful outcome action. The HomeSafe 10 point program focuses on those significant hazards unique to residential home building and construction, such as fall protection and excavations (Fowler, 1997). The HomeSafe program, which began in January 1997, is a training and incentive program offered to employers in the home building industry who work in a six-county test region of Denver, Colorado. The program is accepting participants up until its scheduled endpoint in April 2001. The overall goal of the program is to reduce accidents, injuries, illnesses, and workers' compensation costs (Bigelow et al. 1998).

Built into the HomeSafe program two major theoretical constructs designed to increase the chances of successful implementation. First, it is a community-based intervention that was developed through an interactive process involving builders, employers, the HBA, and OSHA. Community-based programs actively involve stakeholders and have been found to be highly efficacious (Ferguson and Scharf, 1996). Second, the program has an incentive component, as the partnership with OSHA involves a focused vs. general inspection for HomeSafe partners. Incentives, in combination with other program attributes, are often used successfully in improving in work place health and safety (McAfee and Winn, 1989; Peters, 1991).

Evaluation tools for the HomeSafe Program:

The risk of injury on a construction site is a complex interaction of particular activities and behaviors with the conditions found on the site. Exposure assessment must address conditions that might result in an injury at any location on the site (Seixas, et al.1998). The effectiveness of the HomeSafe program will be determined by developing

and administering an evaluation of both participants and non-participants of the program. The evaluation should consist of questions that will be answered by employee and observation by the evaluator. The questions in the audit tool are based on the ten points highlighted in the HomeSafe program.

Safety programs cannot be proven effective without appropriate evaluation (Vojtecky and Berkanovic, 1985). Direct observation is an established method to determine the effectiveness of safety programs (Tarrants, 1970; Fitch et al. 1976; Vojtecky and Schmitz, 1986; Cooper et al. 1993). The audit tool used in this study is an on-site, behavior-based observation tool to assess safety hazards and safety compliance in the residential construction industry (Greenstein, 1998). A person who has been trained in the HomeSafe program and was familiar with the code of Federal Regulations, part 1926, the OSHA construction standards administered the on-site safety audit. The audit consisted of 117 items, which were divided into ten sections based on the major components of the HomeSafe program. Assistance in designing the audit came from members of the Denver Home Builders Association, the safety specialists in OSHA Region VIII and consultants of the Colorado OSHA 7(C)1 consultation program (Bigelow et al. 1998).

To scientifically measure the effect of an intervention program on the target population, measurable changes in performance criteria must be recorded in a format that can be mathematically analyzed. For example, hard hat use is an observable behavior that can be translated into a dichotomous variable such as yes/no. In the safety and health industry, the most common tools used to record and translate safety performance information are data collection instruments such as questionnaires, checklists, and audits

(Greenstein, 1998). The use of these instruments is well established, as demonstrated by studies published by Goldenhar and Schulte (1994), Chokar and Wallin (1984), Cooper et al. (1993), and Dedobbeleer and German (1987). The purpose of the audit tool is to collect data that could be used to establish a causal link between participation in the HomeSafe program and increased safety performance.

Part of the present evaluation process, this study wants to explore the relationship between employees' risk perception and safety culture and that of management's. The safety culture and risk perception survey tool was designed to measure attitudes towards safety and safety culture due to implementation of the HomeSafe program. The survey tool uses selected items from the 'safety culture survey' developed by Geller (1996), asks subjects to respond to statements using a five-point Likert scale. In addition to items on safety perception and attitude, the instrument has a scale that predicts the propensity to actively care for safety. Environmental and behavioral changes can be measured directly using systemic observation but changes in knowledge, perceptions, beliefs, attitudes, and intentions can be assessed indirectly through survey techniques, usually questionnaires. A wide range of specific personal factors might exist in target populations. Questionnaire items include: 1. Perceived amount of management support for safety, 2. The willingness of employees to correct at-risk situations and look out for the safety of coworkers, 3. The perceived risk level of participant' jobs, and 4. The nature of inter personal consequences following an injury (Geller, 1996). Twenty items had been chosen (adapted to the needs of the residential construction workers) from the safety perception and attitude portion of the safety culture survey. Construction workers have asked to respond to straightforward

statements about safety management and improvement. General laborers' responses are compared with the responses from the management.

LITERATURE REVIEW

Risk and Risk Perception

Risk:

Risk means many things to many people. The dictionary (Anon, 1989) defines risk as 'exposure to the chance of injury or loss'. Risk is individual to a person or organization because what is perceived by one as a major risk may be perceived by another as a minor risk. Perception is very much a factor. To some, risk is defined as the chance of loss. But in reality it is more. Risk also concerns how much could be lost. The major elements of risk include probability and magnitude that an event will or will not occur. What is the chance it will happen to me? If so, will the consequences be serious or not so serious? Risk theory tells us that people recognize risks inherent to activities but are willing to trade them for perceived benefits. People also strive to maintain balance in the amount of risk to which they expose themselves. "Risk homeostasis theory maintains that, in any activity, people accept a certain level of subjectively estimated risk to their health, safety, and other things they value, in exchange for the benefits they hope to receive from that activity" (Wilde, 1994).

Coping with Risk:

How does one deal with risk? Clifton Scientific Trust (1997) experts' report found seven major ways people deal with risk.

1. Ignoring it.
2. Taking set safety precautions often without thinking, then forgetting about it.
3. Minimizing the risk by taking all possible safety precautions.

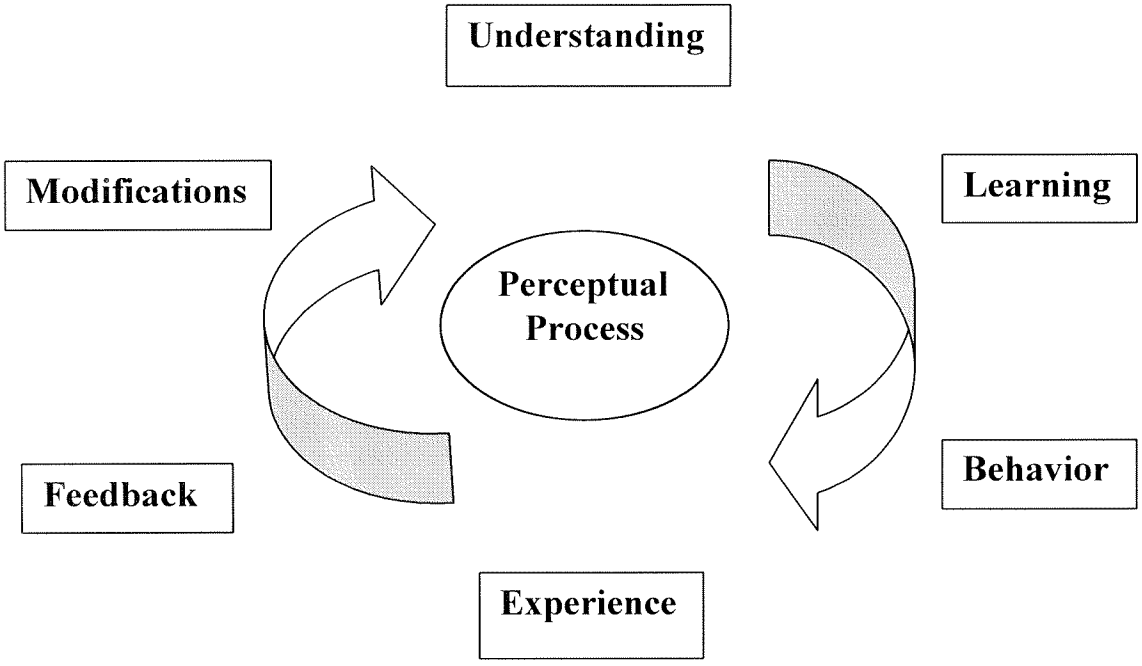
4. Weighing the pro's and con's of pursuing an action, judging the degree of risk involved, and making a balanced judgment as to whether or not an activity is safe.
5. Relying on other people's judgment.
6. Going against their own judgment by succumbing to peer pressure.
7. Enjoying it.

Three ways of "ignoring it" are, not thinking about it, not believing it can happen, or deliberately choosing to deny that risks exist and focusing on only the perceived benefits. "Taking limited safety precautions" usually entails those measures easily carried out without taxing one's own self-efficacy. To "minimize the risk by taking all possible safety precautions" means planning, well thought out risk management strategies such as: being knowledgeable and well trained, selecting the right equipment, familiarity, practice, superior skill sets, and constant awareness. "Relying on the judgment of others" is a common coping strategy, especially in children; however, many adults also choose not to think for themselves or question the judgment of others, especially superiors. "Succumbing to peer pressure" can be a powerful influence to behavior. People participate in risky behavior for fear of rejection from the group or the organization. "Enjoying it" may be the way the individual obtains a "buzz" or the "adrenaline high" so often sought in sports and competitive activities (D.P. Gilkey, personal communication, November 18, 1999).

Risk Perception:

Risk perception is the individual's perception of the potential event that really matters and determines whether they will engage the activity and take a chance. Risk perception is a complex and difficult process to understand and influence.

Neisser (1976) describes the perceptual process as a circular experience of understanding, learning, behaviors, experiences, feedback and modifications to the original understanding.



The "Perceptual Process", Abstracted from Neisser, 1976.

People's perception becomes living, growing, developing entities affected by their experiences, learning, and feelings about the feedback they receive. Perception is "the process through which we select, organize, and interpret information gathered by our senses in order to understand the world around us" (Greenberg and Baron, 1997). Changes in perception of risk affect our willingness to take increasing risks. This means

that people's understanding or perception of a situation determines how they behave or what actions and risks they are likely to take (Hollnagel, 1997). "As each day goes by without receiving an injury, or even a near hit, we become more accepting of the common belief, 'it's not going to happen to me' " (Geller, 1996). Construction workers take risks every day; each of the risks taken must be appreciated in the context of their "beliefs, expectations, needs, loves, hopes, and fears which justify it or which, at least make it explicable in human terms" (Sagoff, 1985). Risk perception is influenced by so many factors additionally, including knowledge, experience, attitudes, motivations, and beliefs (Dejoy, 1984; Hofmann et al. 1995; Hyytiainen, 1994; Leather, 1987; Slovic et al. 1980). "Risks and its perception is embedded in a network of cultural and personal attitudes, requiring understanding and interpretation" (Sagoff, 1985). Cultural influences and differences do indeed affect risk perception says Vredenburg and Cohen (1995).

Safety Culture

Unsafe Acts:

It becomes apparent that perceptions are influenced by many forces outside of the individual's control, the work itself, experience, coworkers, superiors, resources, materials, and even the management policies under which they work. There are many reasons for the worker to perform in a way that management would describe as an "unsafe act" (Bird and Schlesinger, 1970). Following are some examples:

1. The advantages and satisfaction to be gained by the worker at that particular moment seem greater to him than the disadvantages and dissatisfactions.

2. The unsafe act "makes real sense" to the employee. Typically, the older employee will justify himself by saying that he has been doing it that way for years.

3. The unsafe act actually gives the worker personal satisfaction, it may attract the attention of coworkers, gain their approval and admiration.

4. To the worker, his "unsafe" act may be perceived as having definite job-related advantages- advantages that include either such monetary incentives as getting his job done sooner, thus increasing his work-output and his take-home pay-especially if he is on piece-work pay or personal incentives such as avoiding extra effort or fatigue and having more "personal control" over product-quality. A reason for workers indulging in unsafe behaviors is the low perceived probability of an unsafe act resulting in an accident and an accident resulting in an injury (Peterson, 1982).

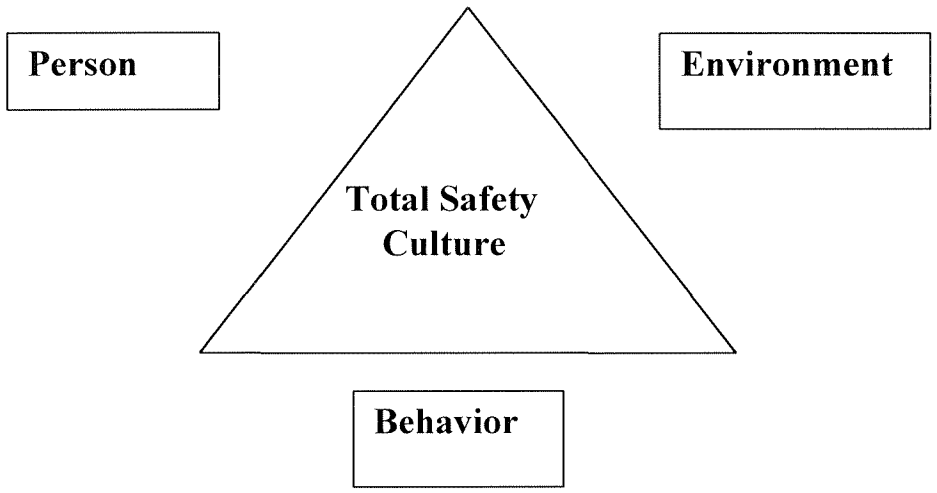
Unsafe work practices are often followed by motivating consequences (i.e., comfort, convenience and faster job completion). Conversely, safe work practices often require personal sacrifice (i.e., discomfort, inconvenience, delayed work break). Furthermore, since some perceive work injuries to be rare, a worker may believe, "it's not going to happen to me." This perspective can foster the perception that certain safety precautions are unnecessary ("more trouble than they're worth") (Geller, 1994).

Organizational Culture:

If the organizational culture sends a message to workers that health and safety are not important because the company does not want to implement costly controls, workers may resent this and refuse to practice safe behaviors.

Safety should become a value rather than a priority. Because, priorities often change depending upon the situation; values remain constant, values are deep-seated personal beliefs that are never compromised. Companies should view safety as a value, not a priority. Making safety a value throughout a corporate culture is clearly a difficult task. It cannot be achieved overnight- no "quick fix" can be implemented (Geller, 1994).

Geller (1994) models the 'Total Safety Culture' as having three major foundation elements:



While the model appears simplistic, the elements are described in more detail to include: 1) person- knowledge, skills, abilities, intelligence, motives, and personality, 2) environment- equipment, tools, machines, housekeeping, heat / cold, engineering, and 3) behavior-compliance, coaching, recognition, communication, demonstration, and actively caring. " These factors are dynamic and interactive- changes in one factor eventually impact the other two". Looking at the 'person', six specific characteristics are identified as key to increasing the value: self-efficacy, personal control, optimism, empowerment, self-esteem, and belongingness. Certainly, risk perception is a fundamental part of the

'person' and can be added to this model; it is also affected by the environment as well as past behavior.

Organizational cultures vary widely as a function of personnel, history, work process, environment, etc. As a result, implementation procedures must be customized based on input from employees- those protected by the coaching process and from whom long-term participation is needed (Geller, 1995).

Culture Vs. Perceptions

The culture of the company has a great deal to do with perceptions by workers about safety. Hofmann et al. (1995) outline some of the misperceptions often promulgated by wrong attitudes and bad work cultures:

1. A perception that using safety is a sign of weakness.
2. A perception that health and safety issues are someone else's concern.
3. A perception that management is not committed to safety, why should they.
4. A general lack of motivation to think about safety issues.

Management has the power to affect the work culture positively through efforts that addresses workplace hazards and put into place effective safety and health programs. Work cultures that foster a somewhat 'macho-mentality' decision-making are likely to be plagued with injury and unnecessary loss. Management's commitment to safety and health is a fundamental cornerstone for positive workplace culture. Management must work to dispel misperceptions and myths about safety and health and actively care about worker's health and well-being.

One way to increase the supportive consequences for safe behaviors and the aversive consequences for unsafe behaviors would be for management to make rewards contingent on safe work practices and penalties contingent on unsafe work behaviors. However, managers are often absent when dangerous work is accomplished. Although managers and supervisors make rounds to check on employees, they are typically in an office during a large percentage of the workday. Actually, in most work situations, a person's co-workers are the ones most likely to be present when a work process warrants certain safety precautions (Geller, et al. 1995).

Dedobbeleer and Beland (1991) investigated safety climate measures on construction sites. They found employee risk perception as one of the three major elements of climate measure. Their statistical analysis revealed management commitment, management safety activities, and employees risk perceptions accounted for .46 of the model. Looking further at the contribution, it was found that employee risk perception made up .75 of the .46 explanation. Elements that significantly affected the employees' risk perception were control, risk, and injuries. Prior experience with injury was the strongest influence at .84, followed by control at .61, and then risk trailing last at .29. The total coefficient of determination for factors enhancing the safety climate was management's commitment to safety and worker's involvement (D.P. Gilkey, personal communication, December 10, 1999). Rundmo (1995) investigated 915 workers in offshore petroleum installations for their risk perceptions relating to safety status and job stress. He found that perceived risks were based on three fundamental underlying dimensions: 1) ordinary workplace types injury, 2) catastrophic events, and 3) post accident intervention measures. He also found that injury experience affected workers'

perception of their safety status. He concluded, "Accidents may be an important consequence of risk perception or, more precisely, an inaccurate perception of the risk". Rundmo (1995) found high correlation of risk perception to safety status and job stress. He concluded that risk perceptions affect choices, actions, and the occurrence of workplace accidents.

Health Behavior Theories/ Approaches

Different studies have been conducted in the past on work place self-protective behavior. All the studies over the years have generally taken one of the three approaches. First, a group of studies have considered various characteristics of employee on job-site and their relationship to perform the job safely and injury experience as well. Employee characteristics studies have included: hazard and safety-related attitudes and beliefs (e.g. Cox and Cox, 1991; Dedobbeleer and German, 1987; Leather, 1988; Walters and Haines, 1988); personality dimensions and risk-taking tendencies (e.g. Jones and Wuebker, 1985; Landeweerd et al. 1990); subjective risk assessments (e.g. Edwards and Hahn, 1980; Goldberg et al. 1991; Howarth, 1987; Zimolong, 1985); and job demands and other stressors (e.g. Cooper and Sutherland, 1987; Levenson et al. 1980; Murphy, 1984; Smith et al. 1982). A Second group of studies have examined different operant-based approaches and used contingent reinforcement to modify the safety-related behaviors of workers.

Reinforcers have included information feedback, goal setting, social recognition, and praise, as well as more conventional rewards and incentives. Other studies included in this group have attempted to influence multiple safety-related behaviors and overall

safety performance (e.g. Komaki et al. 1978; Sulzer-Azaroff and DeSantamaria, 1980). A third group of studies has emphasized on the organizational and environmental factors of good job safety performance. These studies tried to identify key factors of effective safety programs (e.g., Cohen, et al. 1975; Cohen and Cleveland, 1983; Fiedler et al. 1984; Planek and Fearn, 1993; Simonds and Shafai-Sahrai, 1977; Smith et al. 1978) or the major dimensions of positive or supportive organizational safety climates (e.g. Brown and Holmes, 1986; Dedobbeleer and Beland, 1991; Mattila et al. 1994; Niskanen, 1994; Zohar, 1980).

Value-Expectancy Models

The focus of the value-expectancy models is based on the fact that people evaluate the riskiness of a job, examine the costs and benefits of different actions, and accordingly choose a course of action that will maximize the expected outcome (Cleary, 1987). Value-expectancy models have a variety of forms, prominent examples are: the Health Belief Model (Becker, 1974); the Theory of Reasoned Action (Azjen and Fishbein, 1980); and Protection Motivation Theory (Rogers, 1983).

Weinstein (1993) states that value-expectancy models have four common characteristics: (a) motivation for self-protective behavior comes from the perception of negative consequences of an action and the desire to minimize these consequences, (b) the effect of the perceived negative consequence on motivation depends on the beliefs about the likelihood that this consequence will happen, (c) motivation to act arises from the expectation that the particular action will reduce the seriousness of harm and (d) the

anticipated benefits of that particular action will be weighted against the anticipated costs of taking that action.

When Health Belief Models, the Theory of Reasoned Action and Protection Motivation Theory are viewed as a group, these models do highlight several factors that are relevant to work-place self-protective behavior. These factors are: (a) threat related beliefs, (b) self-efficacy, (c) response efficacy, (d) barriers, and (e) normative expectations.

Value-Expectancy factors applied to workplace self-protective behavior (Dejoy, 1996)

Factor	Definition	Workplace Example
Threat-related Beliefs	Beliefs about hazard susceptibility and severity	Construction worker's beliefs about his/her likelihood of falling off scaffolding
Self-efficacy	Beliefs about one's ability to follow indicated safety measures successfully	Emergency medical technician's beliefs about being able to dispose of used needles
Response efficacy	Perceived effectiveness of available safety measures	Underground coal miner's confidence in automated carbon monoxide detection system
Barriers	Factors that interfere with the use of available safety measures	Physical discomfort associated with wearing hearing protectors in textile plant
Normative Expectations	Social/organizational factors that influence worker self-protection	Supervisor's indifference to safe lifting practices in warehousing operation

Contextual or Environmental Models

The theories under value-expectancy models have been primarily concerned with how the individual's attitudes, beliefs, and expectations influence his or her reactions to

various health threats. The environmental or contextual models explain the interactionist perspective that individual and situational or environmental factors combine multiplicatively in influencing worker behavior. The interactionist approach to work place safety and health has been discussed in general terms by several authors (e.g. Dejoy and Southern, 1993; Dejoy et al. 1995; Sheehy and Chapman, 1987; Smith and Beringer, 1987).

PRECEDE model

The PRECEDE model developed by Green and colleagues (Green and Kreuter, 1991; Green et al. 1980) qualifies as a contextual model. 'PRECEDE' is an acronym for "predisposing, reinforcing, and enabling causes in educational diagnosis and evaluation" and this model was intended to be used in planning health education programs. In PRECEDE model, development of prevention strategies are rooted from three sets of behavioral factors. Predisposing factors are the characteristics of the individual (beliefs, attitudes, values, etc) that facilitate or hinder self-protective behavior. Enabling factors refer to objective aspects of the environment or system that block or promote self-protective action. Reinforcing factors involve any reward or punishment that follows or is expected as a consequence of the behavior (Dejoy, 1996). Efforts to influence the beliefs and attitudes of workers that lead them to motivate to follow safe practices may fail if the environment is non-supportive. Thus, it is important to focus on job-related barriers, the ready availability of safety equipment and devices, and the skill-based training in facilitating self-protective behavior. Another important point is acknowledgement or reinforcement by peers, supervisors, and management is necessary even for well-

motivated and well-trained workers otherwise they may not respond appropriately. Performance feedback and the safety-related attitudes and actions of management would appear to be especially important in this regard.

Behavior Change Models

This category of models includes those that explain the process of behavior change. The best example of this category are the Transtheoretical Model (Prochaska and DiClemente, 1982) and the Precaution-Adoption Process (Weinstein, 1988). A fundamental tenet of the process of behavior change perspective is that people at different points in the change process require different types of information and assistance to move to the next stage. The factors that are important at one stage may be quite unimportant at another stage.

Transtheoretical Model:

In this model, the process of behavior change has five principal stages: (a) precontemplation, (b) contemplation, (c) preparation, (d) action, (e) maintenance (Prochaska, DiClemente and Norcross, 1992). For many behaviors, information seeking and consciousness raising activities are relevant for people entering precontemplation or contemplation stages, stimulus control and social support are important for those in the action and maintenance stages.

Precaution-Adoption Process:

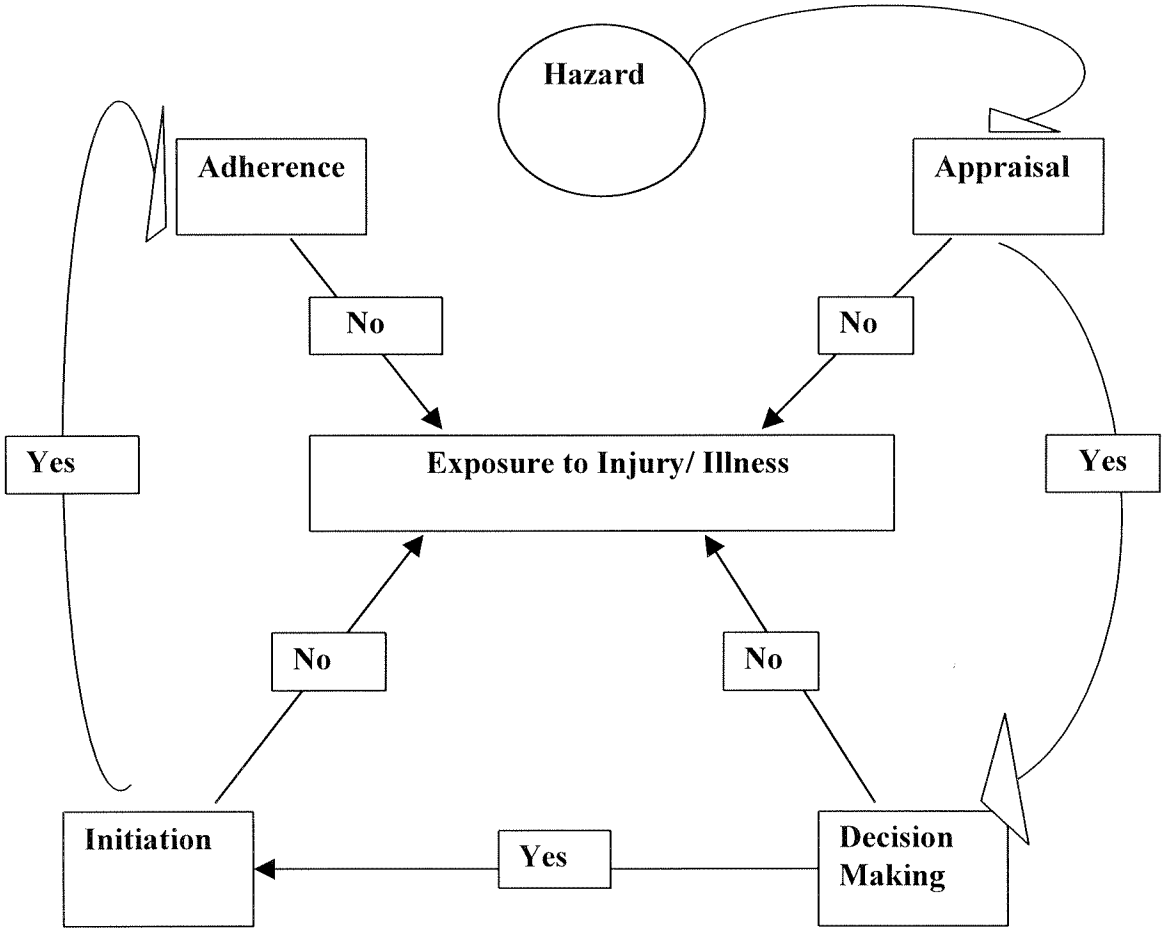
This also has five stages: (a) has heard of the hazard, (b) believes in susceptibility of others, (c) acknowledges personal susceptibility, (d) decides to take precaution, and (e) takes precaution (Weinstein, 1988). The main feature of this model is that personal susceptibility is treated as a series of three stages rather than as a single dimension. Workers are likely to have little interest in taking precautions unless they feel personally vulnerable. This is more applicable to construction workers. They work in a risky environment days after days that they might not identify the risk and therefore, they do not feel vulnerable to different unsafe acts. This model is important for the construction workers in a sense that the workers need to feel vulnerable to the risk so that they can decide to take precautions and with the help of environmental factors, ultimately they will feel comfortable to take the precautions. However, since the stages are cumulative, decision-making does not begin until the third stage has been reached. Environmental or situational barriers are particularly important in translating a decision into action (stage 5).

An Integrative Model

Thus far each of the models has something to contribute in workplace self-protective behavior. The value-expectancy models explain a fair set of person-focused variables that are important to any type of self-protective behavior. The PRECEDE model, as an environmental or contextual model, directs attention to the interaction of person and situational factors. The behavior change models emphasize that precautionary behavior is inherently dynamic and comprised of qualitatively different stages or phases (Dejoy, 1996).

An integrative model can be developed from the fundamentals of all those above models which portrays self-protective behavior as consisting of four stages: (a) hazard appraisal, (b) decision making, (c) initiation, and (d) adherence.

Sequential Stages of an integrative model of self-protective Behavior (Dejoy, 1996)



Five general variables are important to self-protective behavior in the work place. These variables are almost same like those described earlier, with two modifications. The term facilitating conditions focuses the need for environmental supports in self-protective behavior. Safety climate is used as well to represent the manifold of social and organizational factors that may affect the workplace behavior. Current knowledge is not

sufficient enough to exclude any of the variables at a particular stage, thus the five variables are labeled as being of either primary or secondary importance for each stage. Like other stage models, the stages should be treated as cumulative; for example, the individual must believe that a particular hazard represents a serious threat before he or she will enter the decision making stage. Efficacy considerations and facilitating conditions will be of little importance for those who are unaware of the hazard or for those who have appraised the hazard as insignificant.

Relationship of the Stages of Self-protective Behavior model with different variables

Stages	Primary Variables	Secondary Variables
1. Hazard Appraisal	* *Threat-related beliefs* * *Response efficacy*	* *Self-efficacy* **Facilitating conditions* **Safety climate*
2. Decision-making	* *Response efficacy* * *Self-efficacy* * *Facilitating conditions* * *Safety climate*	* *Threat-related beliefs*
3. Initiation	* *Facilitating conditions* * *Safety climate*	* *Threat-related beliefs* **Response efficacy* * *Self-efficacy*
4. Adherence	* *Facilitating conditions* * *Safety climate*	* *Threat-related beliefs* **Response efficacy* * *Self-efficacy*

Hazard Appraisal

The primary component in this stage is the individual's threat-related beliefs. Perceived likelihood and severity can interact to form perceived threat. The availability of effective preventive strategies is also important at this stage. Self-protective motives may help the individual to dismiss or discount a hazard for which preventive strategies are unavailable or of limited effectiveness (Miller and Ross, 1975). Over confidence may as well play a role in hazard appraisal (Weinstein, 1987). Workers should benefit from the information about the hazard itself, including risk estimates, exposure modes, available control measures etc.

Decision-making

Both self-efficacy and response efficacy play an important role in decision making stage. Response efficacy includes effectiveness of available precautionary measures and self-efficacy emphasizes individual's perceptions of his or her ability to successfully perform those precautionary measures. Self-efficacy can be developed through education/training and skill-building exercises.

Personal weighing of costs and benefits also plays significant role. Costs may include time constraints, imagined reduction in the employee's performance or productivity due to safe acts, physical discomfort and so forth. Perceived benefits associated with taking a particular action must outweigh the barriers related to that action. Ready availability of needed safety equipment, training in correct usage of this equipment and redesigned job and equipment are the facilitating conditions that

essentially help in decision making for self-protective behavior. Considerations of safety climate also help in this stage.

Initiation

Above mentioned facilitating conditions and safety climate are prime factors for the initiation stage. During this stage, the focus shifts to the environmental and organizational factors, which are important to support and reinforce the self-protective action. These factors are needed at this stage as behavioral intention is translated into action. Attitudes and actions of management play a prominent role in the safety climate of the organization (Brown and Holmes, 1986; Dedobbeleer and Beland, 1991; Zohar, 1980).

Another important aspect of safety climate is safety performance information, and feedback received from coworkers and supervisors.

Adherence

Facilitating conditions (both environmental and organizational) and safety climate play a significant role in maintaining long-term adherence to self-protective behavior. But this long-term adherence mainly depends on creating task or work environments that are supportive of safe behavior, even under the most stressful or demanding situations. If this condition exists, the self-protective behavior becomes automatic and eventually helps in sustaining long-term adherence.

Applicability of the Model to HomeSafe Program

Hazard Appraisal

At construction sites, the environment, the work to be done, and the composition of crews change continually, which expose the worker to unforeseen and unaccustomed hazards. Moreover, construction workers exposed to a risky environment for long time, may overlook the riskiness of their job. Therefore, during this stage, workers must understand both what is dangerous and whether they can protect themselves by taking specific actions. It is generally accepted that awareness and knowledge are necessary to start the behavior change process, especially in hazard appraisal stage.

The HomeSafe program took this into consideration and required that each company must attend one three-hour group orientation and training session. The session included an introduction and description of the HomeSafe program. A page-by-page slide presentation of the HomeSafe booklet was conducted that included discussion about safe and at-risk behaviors and explanation of the requirements set forth by the HomeSafe program. The HomeSafe booklet consists of ten sections that describes the most common and serious safety hazards encountered on residential construction sites. Nearly all items in the 10 point list are also represented in OSHA's list of the 100 most frequently cited construction standards (OSHA, 1993). The booklet was designed with the intend that workers could carry it with them while on the job site to use it as a safety reference (Safe Guard, 1998). The booklet uses a simple straightforward approach to encourage proper safety characteristics and behaviors with respect to each of the sections. Safety issues

presented in the booklet are exemplified by a number of simple, yet humorous illustrations (Greenstein, 1998).

Decision Making

Individual's subjective beliefs related to costs and benefits play a central role in most of decision making. Safety has been traditionally seen as weakness from workers' point of view. Construction workers have a macho mentality in general. The workers perceived beliefs about threat is overcome by unsafe acts; workers think that nothing will happen to them. Also, the age of the worker play a significant role. Most of the workers in construction are young in age and are likely to take risks in their daily activities to get attention from peers.

The HomeSafe program is intended to shift this behavior and tries to identify the barriers. The site safety committee educates employers and employees about hazardous site characteristics. The program tries to make the workers understand that safety is a value rather than a priority, because priorities might change whereas value is constant.

Initiation

Ready availability of needed safety equipment, proper training in the use of this equipment, creating an atmosphere of trust between employees and management are prime factors at this stage. This Safety culture and risk perception survey tool was designed to identify if there are any barriers existing in the work environment. Attention should be focused on the environmental and organizational factors that support and

reinforce self-protective actions. Performance feedback by peers and management is a valuable tool at this stage.

The HomeSafe program encourages the participating companies by providing different incentives, so that the workers of those companies are in supportive working environments to accept and initiate the self-protective actions. The most beneficial part is good partnership with OSHA. This relationship provides unique benefits like: 1) no programmed inspections, 2) limited scope complaint inspections, 3) use of phone and fax procedures to expedite the handling of complaints, whenever necessary, 4) focused inspection based on the HomeSafe 10-point list rather than the full OSHA construction safety standard, 5) appropriate penalty reductions for serious hazards, 6) no citations or penalties for other than serious hazards corrected in the compliance officer's presence, and 7) priority technical assistance (Safe Guard, 1997). Another incentive offered to companies is the workers' compensation premium discounts.

Adherence

All those above incentives were offered to the participating companies in the HomeSafe program with the hope that the companies would follow safe work practices and create safe work environments that promote self-protective behavior and minimize hazardous exposures under all conditions. The Safe work environment and positive safety climate will help the workers adhere to safe work behaviors by preference rather than a burden. High levels of both individual and collective control provide a positive safety climate. So, situational and environmental factors are very important beyond the hazard

appraisal stage, for the rest of the stages to enable and reinforce the self-protective behavior in workplace.

Summary:

The HomeSafe participants in this study have been active in this strategic partnership for more than two years. The program has demonstrated its ability to significantly reduce the accidents, injury and fatality rates, workers' compensation costs, and loss working days.

Direct observation of the work practices and environmental conditions was an appropriate method to determine the effectiveness of this study program. That same method of observation was conducted in 1998 after the onset of the program, this study was necessary two years later, after the program was introduced to the participants to determine the safety performance relative to "time in the program". To assess the effectiveness, an on-site observational audit tool was used. Audit tool scores for the companies of the current study were compared to the scores of the same companies collected two years ago. It was expected that the audit scores would be higher than those collected two years previously.

Total safety culture is very important for the residential construction industry because there is a complex interaction among the worksite characteristics, work practices, work force characteristics, stages of construction as well as management commitment to safety and health. Geller (1994) states three major factors (person, environment, and behavior) for total safety culture and risk perception are fundamental for person and behavior evaluation.

Another objective (hypothesis) of this study is to evaluate the relationship of the two study tools (audit and safety culture and risk perception survey). It was anticipated that the scores from these tools are highly correlated. The study investigator anticipated a positive link between the work conditions, work practices and what the workers and management perceive the risk and safety culture within their companies. There might not necessarily exist a match between beliefs, attitudes about risk, companies' safety culture with the work practices and site characteristics. Exploring this area was thought to be helpful for the program to be more effective and deeply understood. In connection to this, another important hypothesis of this study was to determine if management scores were the same in the safety culture survey compared to those of general laborers.

Different Health Behavior models (Dejoy, 1996) suggest that all behaviors begin with perceptions and judgments before actions are taken. Another concern of the study was to evaluate risk perception in the context of exposure, knowledge, attitudes, beliefs etc. "Accidents may be an important consequence of risk perception or, more precisely, an inaccurate perception of the risk" (Rudumo, 1995). How people act depends on what they believe (Dedobbeleer and Beland, 1991). Thus, in addition to environmental conditions and safety-related behaviors, a comprehensive safety program requires an assessment of changes in states such as perceptions, attitudes, beliefs, and intentions (Geller et al. 1996). Several researchers and educators have suggested that one cannot expect to see an improvement in safety until people increase their perception of risk and reduce their overall attitude to unsafe conditions and behaviors (Geller, 1996; Howarth, 1987; Leather 1987).

The results of the safety culture survey are useful. Because they can be used as a performance measure to assess the success of safety improvement efforts. Specifically, when implementing a behavior-focused safety improvement process, care and attention must be paid to employees' perceptions about safety and their opinions about the behavior change processes. Otherwise, if behaviors change without subsequent attitude change, the change is likely to be relatively short-term and limited in scope.

The discussion of the integrative model indicates different stages (hazard appraisal, decision making, initiation, and adherence) for behavioral changes. The general laborers need the supportive management, examples shown by the management to improve in these different stages of behavioral change process. Safety culture and risk perception responses collected from both management and laborers would indicate the similarities and differences. The differences in the responses between these two groups can be reduced by appropriate actions or recommendations, but first it is necessary to assess if the management and laborers score almost same in their responses, this study helps to identify that link.

METHODS

Study Methods

Scope

OSHA has specific interests in outcome measurements of the HomeSafe evaluation project that are focused on overall injury and fatality rates (injury rates, severity rates, lost work days incidence rates, fatality rates). These rates will not be calculated until the end of the Pilot test stage and after all data have been collected.

The focus of this study is to evaluate changes in workers safety performance and site characteristics associated with the participation in the HomeSafe program as well as explanation of risk perception and safety culture. Data collected from this study has multiple purposes, each essential to the overall evaluation process. First, the information produced from this study can be used to pinpoint deficiencies and fine-tune the program so that chances of success are increased. Second, data can provide more information that will aid in the understanding of what components of the program are effective in changing worker safety performance.

Hypotheses:

1. The HomeSafe Audit tool scores obtained 2 years post intervention are higher than those obtained previously.
2. Scores obtained from the HomeSafe Audit tool are positively correlated to scores obtained from Safety Culture and Risk Perception Survey.
3. The scores obtained using the Safety Culture and Risk Perception Survey from general laborers are the same compared to those obtained from managers.

Study Design

A quasi-experimental study design was used in this study because the subjects could not be randomly assigned to exposure groups. Use of this study design to evaluate safety and health intervention programs has been well established in the literature and is recommended when a true experimental design is not possible (Goldenhar and Schulte, 1994; Hennessy, 1995; Lipsey, 1996; Rossi et al. 1979; Vojtecky and Berkanovic, 1985). The design incorporated three comparison groups: **1. Re-test group, 2. Control group,** and **3. Non-audited group.**

Study Population

Because companies are responsible for the health and safety of their employees at construction work sites, the units of analysis for this study will be the companies. Any company performing work in the residential construction industry in the six county Denver Metropolitan area is eligible for inclusion this study.

In the construction industry, General Contractors are the highest level management and responsible for coordinating the activities of other companies (for example, subcontractors) hired to perform construction. So, individual subcontractors are contracted by general contractors to perform various aspects of this building process. General contractors usually do not have employees that perform labor on-site. They participate in the HomeSafe program as representatives for their subcontractors with the intent of passing the program along to them. Therefore, the safety performance of these contractors was measured based on the performance of their individually subcontracted companies. For the purpose of this study, the study population was divided into three

groups: 1. **Re-test group**— this is the group who were evaluated two years ago (1998) and are participants in the HomeSafe program, 2. **Control group**— is the group who were not participants in the HomeSafe program and were audited at the same time period in six test counties, 3. **Non-audited group**— is the group whom are HomeSafe participants, but who were not audited since their participation in the program to see if their safety performance is different from the other two groups.

In this study, safety culture and risk perception surveys were distributed among the general laborers of those participating subcontractor companies. It was important to sample the frontline workers because they are involved on the work site with exposure to associated risks. Their responses also provide a comparison measure of the safety culture and risk perception to those reported by management.

Audit Tool Development

An on-site, behavior-based audit form designed to collect health and safety related data on residential construction. It was used by a CSU investigator on the HomeSafe project, with assistance from members of the Denver Home Builders Association, Safety Specialists in OSHA Region VIII, and Consultants of the Colorado OSHA 7.C.1. Consultation program. This audit was used to provide a measure of the safety for each company participating in the study. The audit tool consists of 117 items, divided into ten sections based on the components of the HomeSafe program. The scoring is done by all-or-none (AON) method, the high score indicating higher safety performance. A copy of this audit tool is shown in Appendix A.

Similar to the study conducted by Chokar and Wallin (1984), the method of scoring the audit is all-or-none (AON). Each scored item on the audit form pertained to a behavior or characteristic that is scored either 'yes' or 'no'. Thus, if three ladders were being used by a company and only one of them had a defect, the question pertaining to the structural soundness of the ladders was marked 'no' (Greenstein, 1998). In some instances, behaviors and work site conditions that were included on the audit form were not seen on-site because they were specific to certain stages of construction or work tasks, in those cases a code indicating that the item was not applicable was recorded. Several items on the audit form were used for data analysis and were not included in determining scores (e.g. degree of safety training, knowledge of HomeSafe). The score of each evaluation was determined by dividing the total number of 'yes' responses by the total number of questions that were applicable; this ratio was then multiplied by 100. A high score is related to a high level of compliance with the program (Bigelow et al. 1998).

Cooper et al. (1993) as well developed and tested a safety audit checklist to measure safe behaviors on construction sites. The method of measurement was termed the "Proportional Rating Scale" (PRS). As an example given by the authors, the PRS would measure the proportion of unsecured ladders on a work site by counting the number of ladders improperly secured and calculating this as a percentage of the number of ladders in position or available for use. The authors claim that use of the PRS is superior to the all-or-none (AON) scoring system since PRS has a lower overall variance, the measure avoids possible floor and ceiling effects seen with the use of AON, and the PRS is more likely to detect any improvements in safety performance. But any safety

hazard, no matter what the proportion safe/unsafe, is still a safety hazard and has the potential for causing injury or death. Also, the PRS scale would not be useful in the residential construction setting as in the commercial setting because there were, at most, only two or three pieces of the same equipment on each site (Bigelow et al. 1998).

A study was conducted by Seixas, et al. (1998) where the method uses a construction site as a whole as the unit of analysis and evaluates the risks associated with working on that site. At each location, the presence or absence of each hazard was noted and rated with respect to how well it was protected. The site was then evaluated on the basis of the frequency of each hazard, the average degree of protection, and a summary score, which integrated the frequency, and degree of protection across the hazards. The results demonstrated that the injury exposure assessment tool is feasible and can distinguish between sites and over time with respect to individual hazards and the summary hazard score. However, there was a significant difference between the observers in both the frequency of hazard identification and the rating of its degree of protection. On each location at which a hazard was present, the degree of protection afforded the hazard was also rated on a scale from 0 (no protection) to 10 (fully protected). This scale introduces an element of subjective judgment into the evaluation process (Seixas et al. 1998). The greatest limitation observed in the study by Seixas et al. 1998, was the significant degree of inter-observer variation. An observational measurement system is highly vulnerable to the skills, experience, and motivation of the person conducting the inspection. For instance, an engineer may observe very different conditions than a psychologist. Another limitation of this tool used in their study is that it weights each hazard equally, even though some may be more important than others may.

Validity and reliability are two issues that must be addressed concerning the accuracy of the audit (Lipsey, 1996; Rossi et al. 1979). Establishing validity meant ensuring that the audit was actually measuring what it was intended to measure (Rossi et al. 1979). Sulzer-Azaroff and Fellner (1984) recommend selecting evaluation criteria that are related to actual causes of accidents to increase validity. Addressing reliability meant assuring that the results of the audit were consistently repeated when the situation being measured did not change between measurements (Rossi et al. 1979). Suggestions for reducing measurement unreliability include standardizing the intervention implementation and measurement procedures (Rossi et al. 1979). In response to the first suggestion, procedures related to the implementation of the HomeSafe program were well standardized. All participating companies attended the three hours orientation/training session. The format of the sessions was the same each time the class was offered. Additionally, all companies received the same program materials and handouts (i.e. booklets), and all companies were requested to complete the questionnaires, and submit OSHA 200 logs, and related loss history. Likewise, procedures related to the evaluation of the program were well standardized. All study subjects were administered the same audit using the same administration protocol. Additionally, only the study investigator administered the audit. This eliminated variability in scores due to individual differences (i.e. preferences, knowledge, and biases) among multiple auditors.

Survey Questionnaire Development

Environmental and behavioral changes can be measured directly using systematic observation, but changes in knowledge, perceptions, beliefs, attitudes, and intentions can

be assessed indirectly through survey techniques, usually questionnaires. A wide range of specific person factors might exist in target populations.

Another aspect of this study is to evaluate the safety culture of the HomeSafe participant companies by using the 'safety culture and risk perception survey'. The survey responses were analyzed to explore relationships of the perception of risk, culture of the company, and caring among the management and laborers. The 'safety culture and risk perception survey' in this study is adapted from 'Safety Culture Survey' by Geller (1996). The survey tool has a 5-point Likert-scale ranging from highly disagree (1) to highly agree (5). The survey questionnaire has 20 questions where the statements are mixed in terms of positive and negative responses, 4 of such statements were recoded to follow the same positive nature of response with the rest of the questionnaire. A copy of this survey questionnaire is attached in Appendix B in both English and Spanish form. Participation of the general workers in the safety culture survey was 100%. General laborers' responses were compared with the responses from the management.

Data Methods

Data Collection

Although many companies representing a variety of trades participate in the HomeSafe program, not all were selected for participation in this study. A List of the companies who were audited two years previously was obtained from the HBA Denver office. All of those companies could not be contacted for this current study because some had dropped out from the program. The companies were contacted by phone to participate in this study. The company representative was asked not to notify the work crew that the program auditor would be arriving on the site specified the location of a work crew. Occasionally, coordination of auditing times and company work schedules was not possible. Additionally, difficulties associated with telephone communication resulted in the inability of the study investigator to contact certain participating companies.

In many instances, control subjects were sought at the same housing project at which a participant was audited under different general contractor. Since these companies were not members of HomeSafe program, permission was obtained from the employees on the site to conduct the HomeSafe audit, the safety culture and risk perception survey was not distributed among this control group. The same procedure was followed in case of the previously non-audited group. Permission was solicited by telephone and scheduling with these companies was done at the same time, the study investigator requested the company representative not to notify the work crew about the auditing.

Generally, only one company audit was administered at any given site. A site was defined as a single-family home under construction. Upon entering a work site, the audit

administrator announced to the company that a HomeSafe audit was going to be performed. One company employee was identified to answer a few structured questions that were on the audit form. These questions included information about the employee's knowledge of the HomeSafe program and the occurrence of company safety meetings, if any.

The safety culture and risk perception survey (Appendix B) was distributed among the general laborers of both re-test group and non-audited group. The workers completed the survey after the audit was done at the site. Most of the time, there was more than one employee surveyed per company. In that case the workers were requested not to discuss their own response of the survey with other workers. No names were included on the safety culture survey to identify subjects and the respondents were told that their answers would be completely anonymous, although codes were used to categorize the surveys according to companies identifying numbers and evaluation type. The survey took approximately 20 minutes to complete.

Management safety culture and risk perception survey data were collected by the CSU research team at different HomeSafe orientation programs.

Data Analysis

Data from the audit forms were entered into a computer database and analyzed using the Statistical Package for Social Sciences (SPSS) and SAS. The score of each audit was determined by dividing the total number of "yes" responses by the total number of questions that were applicable, this ratio was then be multiplied by 100. A high score was related to a high level of compliance with the program. The overall audit

scores are normally distributed in this study. This study has a fair representation of the HomeSafe participant companies because audits and safety culture surveys were collected from all 6 test regions and were distributed among different trade groups. The auditor approached different company representatives ranging from owners to laborers. Response rate for the audit distribution and safety culture survey responses was 100%, which means that each company approached by the auditor participated in the study.

The difference in mean scores between the three test groups was statistically evaluated by using independent samples t-test and one-way analysis of variance (ANOVA). Scoring of the safety culture and risk perception survey was done using the same computer database. The mean score of the management were collectively compared with that of general laborers. Differences in mean scores between these two groups were statistically evaluated using independent samples-t-test and one-way analysis of variance (ANOVA). Also, several selected items from the survey were used as variables to determine the difference of mean scores among these two groups by using ANOVA test. The safety culture and risk perception survey has a Likert scale (from highly disagree [1] to highly agree [5]) and items in the survey have both positive and negative statements mixed with the same scale which needs to be re-coded for scoring purposes of the surveys. The safety culture and risk perception survey scores obtained from both general laborers and management were compared with the scores of HomeSafe audit tool scores of these same two groups to see if there is a link between safety perception and work practices.

RESULTS AND DISCUSSION

This study investigates work practices, site conditions, safety culture, and risk perception in the HomeSafe pilot program. Work practices and site conditions were evaluated more than 2 years after commencement of the program to look at the effect of temporal exposure. Another investigation looked at these characteristics at the time of partnership onset. The Same audit tool is used for both these studies to maintain the consistency of the scoring.

Audits were administered between the months of May 1999 and August 1999. A total of 107 audits were administered during this time period, representing 17 trades. One audit was distributed for each company and the auditing was done in 3 groups. 41 audits for the Retest group, 41 for Control and 25 for Previously non-audited group. For the Retest group, the highest number of audits was conducted in Douglas county (13); the same number of audits was done in Jefferson county as the highest number for the Control group. The Previously non-audited group had its highest distribution (8) in Adams county. All the participants were involved in single family type dwelling construction.

One company representative was identified at the beginning of auditing on each site and was asked about their job title, familiarity with the HomeSafe program, whether they use HomeSafe as their training program and their knowledge about who their Safety Coordinator is. Table 1 shows the characteristics of all these in the three study groups. If the identified company representative could not answer these questions in English, another person was identified to translate into Spanish.

Among all the employees observed during the data collection process, only two women were seen performing labor on worksites. One woman was working for a landscaping company and the other was working for a fireplace installation company. Both of these women were working for companies that were audited.

Table 1

Descriptive statistics of study population in 3 groups during audit administration.

Characteristics of the study groups	Retest Group (n= 41)	Previously non-Audited group (n= 25)	Control group (n= 41)
Location of the Site			
Adams	9	8	12
Arapahoe	1	2	1
Boulder	9	1	5
Denver	6	2	2
Douglas	13	6	8
Jefferson	3	6	13
Job Title			
Owner	none	none	1
Foreman/ Supervisor	3	none	None
Laborer/ Employee	38	25	40
Heard of HomeSafe			
Yes	34	20	2
No	7	5	39
Use the HomeSafe as their Training program			
None	7	6	41
Weekly with General Contractor	33	19	none
Weekly with the Company	1	none	none
Knows Who the Safety Coordinator Is			
Yes	33	21	23
No	8	4	18

A quasi-experimental design is used in this study since the subjects could not be randomly assigned to exposure groups. This study has three comparison groups. One group was chosen as Retest group from those previously audited to compare their audit scores to present findings. Another group is also from the HomeSafe program who have never been audited. It is expected that the safety performance will be higher in these two HomeSafe participant groups compared to that of a control group who are not HomeSafe participants. All together, 107 audits were conducted in 3 test groups.

Table 2 shows distribution of all the trades among the three test groups. Among the Retest Group, the highest number of audits were from roofing, drywall, insulation, and electric companies and no audits were done among plumbing, interior trim and painting companies in this group. The highest number of audits in the control group was taken from electric, and excavation companies and no audits were done in exterior trim, insulation, roof gutter, concrete flatwork, interior trim, drainage, landscaping and fireplace installation companies. Among the previously non-audited group, the highest number of audits was from framing, excavation, and electric companies and no audits were taken from plumbing, insulation, foundation, roof gutter, landscaping and fireplace installation companies.

Table 2

Distribution of audits among all trades in 3 test groups

Trade	Previ-ously Non-audited	%of Audit among the same trade	Re-test	%of Audit among the same trade	Con-trol	%of Audit among the same trade	Total Audits in 3 groups
Frame	4	33.3	3	25	5	41.7	12
Roof	2	18.2	7	63.6	2	18.2	11
Drywall	1	14.3	5	71.4	1	14.3	7
Plumbing	0	0	0	0	5	100	5
Excavator	4	33.3	2	16.7	6	50.0	12
Exterior Trim	1	50.0	1	50.0	0	0	2
Insulation	0	0	4	100	0	0	4
Concrete Foundat.	0	0	3	42.9	4	57.1	7
Roof Gutter	0	0	2	100	0	0	2
HVAC	1	12.5	3	37.5	4	50.0	8
Electric	4	25.0	4	25.0	8	50.0	16
Concrete Flatwork	2	50.0	2	50.0	0	0	4
Interior Trim	1	100	0	0	0	0	1
Paint	3	33.3	0	0	6	66.7	9
Drainage	2	40.0	3	60.0	0	0	5
Landscap-ing	0	0	1	100	0	0	1
Fireplace Installat.	0	0	1	100	0	0	1
Total	25		41		41		107

One employee from each company audited was asked questions related to job title, the number of company employees, knowledge of the name 'HomeSafe', and the amount of safety training the employee had received. Occasionally, no employees in a particular company were able to speak and understand English well enough to answer these questions in that case another employee was identified to communicate in English. Table 3 shows the number of audits that were performed on companies that did not have an employee on-site that could fully communicate with the study investigator (n=36).

In the Colorado region, the construction industry employs a large number of Hispanic workers, who speak only Spanish. HomeSafe participants estimate 50% of their subcontractor companies are Hispanic. In this study, focus has been directed at English and Spanish speaking company representatives. These groups of worker population might make a distinction between skilled workers and laborers. It is interesting to note that the trades which require more physical labor had more Spanish speaking workers (like framing, drywall, exterior trim, roof gutter companies). On the other hand, English speaking companies' laborers were more predominant in excavation, electrical, and HVAC companies. The companies who had exclusively Spanish speaking employees were given the safety culture survey translated into Spanish.

Table 3

Frequency of non English-speaking (Spanish) and English-speaking company representatives by trades among all audits.

Trade	Non English Speaking	% of Audit among the same trade	English Speaking	% of Audit among the same trade	Total Audit
Frame	7	58.3	5	41.7	12
Roof	3	27.3	8	72.7	11
Drywall	4	57.1	3	42.9	7
Plumbing	0	0	5	100	5
Excavator	3	25.0	9	75.0	12
Exterior Trim	1	50.0	1	50.0	2
Insulation	1	25.0	3	75.0	4
Concrete Foundat.	2	28.6	5	71.4	7
Roof Gutter	1	50.0	1	50.0	2
HVAC	3	37.5	5	62.5	8
Electric	5	31.3	11	68.7	16
Concrete Flatwork	0	0	4	100	4
Interior Trim	1	100	0	0	1
Paint	3	33.3	6	66.7	9
Drainage	2	40.0	3	60.0	5
Landscap-ing	0	0	1	100	1
Fireplace Installat.	0	0	1	100	1
Total	36	33.6	71	66.4	107

Table 4 shows the distribution of English and non English-speaking companies by three test groups among all audits. The Retest group had the highest number of English speaking companies among the all audited companies whereas the control group had the highest number of non-English speaking companies. Among the overall audits (n=107), the number of English-speaking companies was 71 (66.4%) whereas the number of Non English-speaking companies was 36 (33.6%).

Table 4
Distribution of non English-speaking (Spanish) and English-speaking company representatives by 3 test groups among all audits.

Test Groups	Non English Speaking	% among all audits	English Speaking	% among all audits	Total audits	%
Previously Non-audited	9	8.4	16	15.0	25	23.4
Retest group	13	12.1	28	26.2	41	38.3
Control group	14	13.1	27	25.2	41	38.3
Total	36	33.6	71	66.4	107	100

Table 5 shows the percentage of each response level with each statement in the safety culture and risk perception survey among all responses from laborers. If we consider "highly disagree" (1) and "disagree" (2) categories in one category and "agree" (4) to "highly agree" (5) categories in another category, we find that more than 50% of the respondents disagreed that safety audits are conducted regularly in their companies to check the use of personal protective equipment. About 90% of the respondents agreed that it is the responsibility of each employee to seek out opportunities to prevent injuries. More than 25% respondents neither agreed nor disagreed that their company is rather risky compared to other companies.

There are few items in the safety culture survey that are of concern because they have negative effect on their companies' safety culture. The respondents as a whole mentioned that management places most of the blame for an accident on the injured employee (48%); "near misses" are not consistently reported and investigated in their companies (49%); working safely is not the number one priority in their companies (43%); many of the first-aid cases go unreported (61%) and lastly safety audits are not conducted regularly to check the use of personal protective equipment (51%). Most of these items indicate that management is not proactive and safety oriented and the above-mentioned information from the laborers' responses can be used to improve their safety culture. It is important for the management to show the workers that they care about safety and improving the safety related concerns would make them look better and workers would be more encouraged to participate in safety improvement there after.

Table 5

Percentage of response levels [a] in safety culture survey.

Variable	1	2	3	4	5
Risk level concern	8.7% n=16	32.8% n=60	4.4% n=8	27.3% n=50	26.8% n=49
Supervisor Appreciative	2.2% n=4	20.8% n=38	7.1% n=13	37.7% n=69	32.4% n=59
Supervisor is informed	1.6% n=3	23.0% n=42	4.9% n=9	34.4% n=63	36.1% n=66
Employee responsibility.	1.6% n=3	6.6% n=12	1.6% n=3	48.1% n=88	42.1% n=77
Productivity Priority	10.4% n=19	43.7% n=80	11.5% n=21	22.4% n=41	12.2% n=22
Management. Caring	0.6% n=1	19.1% n=35	7.1% n=13	41.5% n=76	31.7% n=58
Correcting safety Hazard	1.1% n=2	1.6% n=3	2.7% n=5	27.9% n=51	66.7% n=122
Blaming others	13.7% n=25	18.0% n=33	20.2% n=37	43.2% n=79	4.9% n=9
Near miss	0.6, n=1	48.1, 88	14.2, 26	23.0, 42	14.2, 26
Will warn others	1.1% n=2	0% n=0	2.2% n=4	31.2% n=57	65.6% n=120
Unsafe behaviors	0% n=0	21.9% n=40	12.6% n=23	41.5% n=76	24.0% n=44
Company risk level	14.8% n=27	39.9% n=73	26.2% n=48	14.2% n=26	4.9% n=9
Working safely	1.6% n=3	41.5% n=76	14.8% n=27	18.0% n=33	24.0 n=44
Job training	2.2%, 4	37.2, 68	6.0, 11	32.2, 59	22.4, 41
First aid unreported	8.2% n=15	19.1% n=35	12.0% n=22	52.5% n=96	8.2% n=15
Information is available	0% n=0	14.6% n=27	6.6% n=12	56.3% n=103	22.4% n=41
Management Commitment	1.1% n=2	23.0% n=42	7.1% n=13	41.0% n=75	27.9% n=51
Safety audits done	2.7% n=5	48.1% n=88	11.5% n=21	25.1% n=46	12.6% n=23
Know how to work Safe	0.6% n=1	17.0% n=31	2.2% n=4	41.0% n=75	39.3% n=72
Worker observation Are not OK	7.7% n=14	42.6% n=78	8.2% n=15	28.4% n=52	13.1% n=24

a = response levels (1= highly disagree, 2= disagree, 3= neither disagree nor agree, 4= agree, 5= highly agree); n = 183

To evaluate the safety culture and risk perception, all together 183 responses were collected among which the Retest group had 106 responses and the Previously non-audited group had 77 responses. Scores of these are compared to those from the management collected from the same companies.

Table 6 shows the mean and standard deviation of each question in the survey between the two participant groups. For the Retest group, the mean was highest (4.6) with the least standard deviation (0.7) for the question number 10, which states that the respondents will warn their coworkers about working safely. Most of the respondents agreed most with this statement. The lowest mean (2.7) for this group was for the question number 18, most of the respondents disagreed that safety audits were done at their company regularly. Among the Previously non-audited group, the highest mean (4.6) was for the same question as responded by the Retest group. The respondents were almost highly agreed that they would warn their coworkers about working safely. The lowest mean for this group was 2.2 for question number 12, most of the respondents disagreed with the statement that their company is risky compared to other companies.

Table 6

Means and standard deviations (in parenthesis) of response levels [a] in the safety culture survey among the retest and previously non-audited group of general laborers.

Variable	Retest group (n=106)	Previously non-audited group(n=77)
Risk level concern	3.4 (1.3)	3.2 (1.5)
Supervisor are Appreciative	3.4 (1.3)	4.3 (0.8)
Supervisor is informed	3.6 (1.2)	4.1 (1.1)
Employee responsibility	4.0 (0.9)	4.5 (0.8)
Productivity Priority	2.7 (1.1)	3.0 (1.4)
Management is Caring	3.5 (1.2)	4.4 (0.7)
Correcting safety Hazards	4.6 (0.7)	4.6 (0.8)
Blaming others	3.2 (1.1)	3.0 (1.3)
Near misses	2.8 (1.1)	3.3 (1.1)
Will warn others	4.6 (0.6)	4.6 (0.7)
Unsafe behaviors	3.5 (1.0)	3.9 (1.1)
Company risk level	2.8 (0.9)	2.2 (1.2)
Working safely is #1 priority	2.8 (1.1)	3.7 (1.3)
Job training	2.9 (1.2)	4.0 (1.0)
First aid cases unreported	3.6 (1.0)	3.0 (1.2)
Information is made Available	3.6 (1.0)	4.2 (0.7)
Management commitment	3.3 (1.2)	4.3 (0.8)
Safety audits are done	2.7 (1.1)	3.4 (1.2)
Know how to work Safe	3.7 (1.2)	4.5 (0.6)
Worker observation Are not OK	3.0 (1.3)	2.9 (1.2)

a = response levels (1= highly disagree, 2= disagree, 3= neither disagree nor agree, 4= agree, 5= highly agree); n = 183

The total number of survey responses varied from company to company depending on the number of employees working on that site. On average, each company had three or four workers working on the site, but in some cases, there was only one individual who worked for a company as well as 11 workers for another company. Since the focus is on HomeSafe participant companies' safety culture, the safety responses were averaged to one response for a company, when there is more than one response. Therefore, for the Retest group, there are 106 responses aggregated over 41 companies and 77 responses are aggregated over 25 companies for Previously non-audited group.

Table 7 shows the aggregated frequency of survey responses with percentages within that group in two participants groups by different trades. Roofing companies had the highest number of responses (7, 17.1%) among all trades in the Retest group. The Retest group had the lowest response (1) from exterior trim, landscaping, and fireplace installation trades. Among the Previously non-audited group, the highest number of responses (4) was from framing, excavation and electric companies whereas the lowest responses (1) were from drywall, HVAC, and both exterior and interior trimming companies.

Safety culture survey collected from laborers in this study represent distribution of both English and Spanish speaking companies by different trades. Framing and roofing had the highest number of respondents who were Spanish speaking, on the other hand, electric companies who were English speaking companies had the highest respondents as well compare to other trades.

Table 7

Frequency of aggregated (by individual company) safety culture survey responses in two HomeSafe participant groups by trades.

Trade	Retest group (n=41)	Previously Non-Audited group (n=25)	Total
Frame	3 7.3%	4 16%	7 10.6%
Roof	7 17.1%	2 8%	9 13.6%
Drywall	5 12.2%	1 4%	6 9.1%
Excavator	2 4.9%	4 16%	6 9.1%
Exterior Trim	1 2.4%	1 4%	2 3%
Insulation	4 9.8%	- -	4 6.1%
Concrete Foundation	3 7.3%	- -	3 4.5%
Roof Gutter	2 4.9%	- -	2 3%
HVAC	3 7.3%	1 4%	4 6.1%
Electric	4 9.8%	4 16%	8 12.1%
Concrete Flatwork	2 4.9%	2 8%	4 6.1%
Interior Trim	- -	1 4%	1 1.5%
Paint	- -	3 12%	3 4.5%
Drainage	3 7.3%	2 8%	5 7.6%
Landscaping	1 2.4%	- -	1 1.5%
Fireplace Installation	1 2.4%	- -	1 1.5%
Total	41	25	66

Table 8 shows the overall mean and standard deviation of the scores of the Safety Culture Survey between the two participant groups. The overall safety culture survey mean score indicated that the previously non-audited group have higher safety culture scores than Retest group which might be suggestive that even though one of the HomeSafe participant group has never been audited but might have better perception of risk and good safety culture.

Table 8

Overall mean and standard deviation of safety culture scores in two groups participated as companies in survey questionnaire.

Group	N	Mean	Std. Deviation
Retest	41	3.3	0.5
Previously Non-audited	25	3.7	0.3

Table 9 shows the number of audits and mean scores within each trade that were performed on all companies in the Retest, Previously non-audited and Control groups. Among the 107 completed audits, 41 were Retest, 25 were Previously non-audited groups and 41 were Control audits. Total mean score for the Retest group is higher (76.0) than the other two groups (73.7 and 66.9 respectively).

The Audits were distributed between all 3 groups by different trades. The HomeSafe participant groups have highest score in roofing and electrical trades which again represent both English and Spanish speaking populations. Roofing companies in Retest group scored very high which indicates that HomeSafe is having positive effect on this trade and injury rates are comparatively higher in this particular trade. Another

HomeSafe group scored high in electrical trade, which is another leading cause of injury, and death in construction industry.

Table 9

Number of audits and mean audit scores among all trades in the retest, previously non-audited, and control groups.

Trade	Retest Group		Previously Non-Audited Group		Control Group		Total
	Mean(n)	Std. Dev	Mean(n)	Std. Dev	Mean(n)	Std. Dev	Mean (n)
Frame	79.0 (3)	13.6	65.7 (4)	4.3	66.1 (5)	12.3	69.2 (12)
Roof	91.8 (7)	7.4	84.8 (2)	7.8	53.1 (2)	13.9	83.5 (11)
Drywall	78.5 (5)	10.2	60.0 (4)		72.8 (1)		75.0 (7)
Plumbing	-		-		68.0 (5)		68.0 (5)
Excavator	73.0 (2)	2.8	64.9 (4)	5.8	57.6 (6)	10.7	62.6 (12)
Exterior Trim	91.1 (1)		83.7 (1)		-		87.4 (2)
Insulation	63.9 (4)	10.7	-		-		63.9 (4)
Concrete Foundat.	71.5 (3)	6.1	-		62.2 (4)		66.2 (7)
Roof Gutter	68.4 (2)	3.4	-		-		68.4 (2)
HVAC	69.6 (3)	13.6	58.3 (1)		71.1 (4)	11.4	68.9 (8)
Electric	84.5 (4)	10.7	84.9 (4)	6.2	71.8 (8)	14.3	78.3 (16)
Concrete Flatwork	66.1 (2)	27.5	74.0 (2)	28.0	-		70.0 (4)
Interior Trim	-		79.3 (1)		-		79.3 (1)
Paint	-		73.7 (3)	14.0	73.2 (6)	10.9	73.3 (9)
Drainage	62.2 (3)	10.7	81.0 (2)	8.5	-		69.7 (5)
Landscaping	66.7 (1)		-		-		66.7 (1)
Fireplace Installat.	67.0 (1)		-		-		67.0 (1)
Total	76.0 (41)	13.6	73.7 (25)	13.2	66.9 (41)	13.7	72.0 (107)

Table 10 shows the number of audits and mean scores within each of the HomeSafe 10-point sections except the safety program section since the questions are not scored in that section. The table shows the mean and standard deviation among the Retest, Previously non-audited and Control groups. The Overall mean of the Retest group (76.0) is higher than the Previously non-audited group (73.7) and Control group (66.9).

Table 10 shows the distribution of audits among three test groups by different HomeSafe 10 point sections. Three important sections (PPE, access/housekeeping, power tools) were applicable to all the companies. Among the test groups, Retest group scored higher in PPE, and access/housekeeping sections whereas previously non-audited group scored higher in power tool sections. Both of these groups are HomeSafe participants. These three sections were the most applicable and important sections when the HomeSafe program started three years ago. Improvement in these hazard areas is a positive sign for the effectiveness of the HomeSafe program. Other sections of the HomeSafe program as well have higher scores in these two groups compared to control group. This indicates that the HomeSafe program is working in a significant way in the test regions.

Table 10

Mean audit scores (number of audits) within HomeSafe 10-point sections among the retest, previously non-audited, and control groups.

HomeSafe Sections	Retest Group		Previously Non-Audited Group		Control Group		Total
	Mean(n)	Std Dev	Mean(n)	Std Dev	Mean(n)	Std Dev	Mean (n)
PPE	83.2 (41)	29.2	75.9 (25)	32.2	73.0 (41)	33.1	77.6 (107)
Scaffolding	76.2 (19)	19.6	87.5 (2)	17.7	67.4 (10)	15.3	74.1 (31)
Ladders	88.0 (26)	12.1	85.0 (15)	9.2	78.5 (28)	10.2	83.5 (69)
Access/House Keeping	79.3 (41)	27.6	72.7 (25)	27.6	60.0 (40)	26.9	70.4 (106)
Open holes	25.0 (4)	50.0	50.0 (8)	53.5	18.8 (8)	37.2	32.5 (20)
Fall Protection	89.4 (9)	18.5	91.7(2)	11.8	75.0 (2)	35.4	87.5 (13)
Excavation	85.4 (8)	14.0	76.3 (6)	18.8	69.7 (10)	10.1	76.6 (24)
Power Tools	64.5 (41)	45.8	74.0 (25)	43.6	72.7 (41)	40.5	69.9 (107)
Power Cords	76.3 (24)	25.0	73.5 (18)	21.7	64.5 (31)	22.4	70.6 (73)
OVERALL	76.0 (41)	13.6	73.7 (25)	13.2	66.9 (41)	13.7	72.0 (107)

One-way ANOVA was used to determine significance in mean total scores among all audits in the retest, previously non-audited and control groups. The test indicated that all three test groups differed significantly in mean total scores ($p= 0.01$, Table 11).

Table 11

Comparison of mean scores in retest, previously non-audited and control group among all audits.

Test Group	Mean %	Std. Dev.	95% C.I.	p-value
Retest	76.0	13.6	70.9, 80.4	
Previously non-Audited group	73.7	13.2	65.2, 77.3	0.01
Control	66.9	13.7	58.5, 70.0	

Based on the results of the Tukey's method, the retest group was found to have a significantly higher mean score than the control group (p=0.002). The analysis also indicated that the mean scores between the previously non-audited and control groups were nearly significant (p=0.05, Table 12). No significant difference was detected between the mean scores of the retest and previously non-audited groups (p=0.23).

Table 12

Comparison of mean scores in retest, previously non-audited, and control group among all audits.

Test Grp. (I)	Test Grp. (J)	Mean Difference (I – J)	Std. Error	95% C.I. Lower Upper	p-value
Retest	Previously Non-audited	4.4	2.4	-2.8, 11.7	.23
	Control	12.4	2.9	4.5, 18.3	.002
Previously Non-audited	Retest	-4.4	3.0	-11.7, 2.8	.23
	Control	7.0	2.9	-0.1, 14.1	.05

Analysis of differences between the matched posttest and retest groups among the individual trades was conducted to compare the mean scores and to measure changes in individual trade performance. Statistical differences between mean posttest and retest scores among the individual trades were determined using independent samples t-tests. As shown in Table 13, no significant difference was observed among any of these trades. Any significant differences in any of these trades would indicate that significant improvement had happened in that particular trade between these two test groups. The trade with the largest number of matched audits was performed in roofing companies (Table 13). The mean score improved very significantly in that trade in the retest group with time by following the HomeSafe program.

Table 13

Differences in mean audit scores and p-value of matched audits in posttest and retest groups by trades.

Trade (n)	Posttest % Score Mean	Retest % Score Mean	% Mean Difference	p-value
Frame (3)	76.9	79.0	2.1	0.807
Roof (6)	79.7	91.5	11.8	0.069
Drywall (5)	66.6	78.5	11.9	0.091
Exterior Trim (1)	61.1	91.1	30.0	0.059
Insulation (4)	61.9	63.9	2.0	0.789
Concrete Foundation (1)	67.3	64.5	-2.8	0.853
Roof Gutter (1)	55.6	66.0	10.4	0.493
HVAC (3)	80.2	69.6	-10.6	0.234
Electric (3)	76.3	79.4	3.1	0.724
Concrete Flatwork (2)	60.7	66.1	5.4	0.617
Drainage/Pipeline (1)	90.9	70.0	-20.9	0.178

Some companies in the Retest group were audited more than two years ago as Pretest and Posttest group. Therefore, matching is done to see how much the Retest group in this study improved during this time by having the HomeSafe program. Statistically, matched Retest group has much more higher score (76.8) than Pretest group (71.2), and the Posttest score (71.8). Two years ago, the score did not vary significantly among the Pretest and Posttest groups and the exposure time span was not sufficient (only 4 months) to see any significant improvement between these two groups. Even though there was no significant difference observed in the test groups among any of the trades, the mean scores differed significantly in three test groups (p=0.04, Table 14).

Table 14

Comparison of means and standard deviations among matched audits of pretest, posttest and retest groups.

Test Group	Mean	Std. Dev.	p-value
Pretest	71.2	14.1	
Posttest	71.8	9.8	0.04
Retest	76.8	11.7	

Table 15 shows the mean and standard deviation of each variable in the Safety Culture Survey from both management and laborers in Retest and Previously Non-audited groups. The management responses were collected during different reorientation sessions. Total number of companies represented by management in both test groups was 21, on the other hand, laborers represented 41 companies for Retest group and 25 companies for Previously Non-audited group.

For the Retest group, the management's highest mean (4.8) was for question number 19 which states that the employees in their companies know how to work safely. Most of the respondents were highly agreed on the statement, in the same group, the highest mean (4.6) for laborers was for question number 10, which indicates that they are highly agreed to warn their coworkers about working unsafely.

In the Previously Non-audited group, the highest mean (4.7) for the management was observed for question number 10, which was also highly agreed by laborers in the Retest group. The laborers for this group were highly agreed on correcting the safety hazards by themselves if possible (question number 7).

Safety culture survey score was analyzed by breaking them down into management and laborers groups in both Retest and Previously non-audited groups. Total score for management were higher than laborer in both test groups. The difference between management scores in two test groups is not large whereas the laborers have larger difference between groups.

Table 15

Mean and standard deviation of variables in the safety culture survey (aggregated by individual company) responses among management and laborers in two test groups.

Variable	Retest group (Mean & Standard Dev.)		Previously non-audited group (Mean & Standard Dev.)	
	Management (n= 21)	Laborers (n= 41)	Management (n= 21)	Laborers (n= 25)
Risk level concern	3.8 (1.5)	3.3 (1.0)	3.6 (1.2)	3.0 (1.4)
Supervisor are appreciative	4.1 (0.9)	3.4 (1.0)	4.3 (0.4)	4.3 (0.5)
Supervisor is informed	4.3 (0.6)	3.6 (1.0)	4.4 (0.4)	4.0 (1.0)
Employee responsibility	4.5 (0.7)	4.0 (0.7)	4.5 (0.4)	4.6 (0.5)
Productivity priority	2.4 (1.5)	2.7(0.9)	2.1 (0.7)	2.8 (1.2)
Management is caring	4.2 (0.7)	3.4 (1.0)	4.5 (0.5)	4.4 (0.5)
Correcting safety hazards	4.5 (0.7)	4.6 (0.4)	4.5 (0.4)	4.7 (0.5)
Blaming others	2.8 (0.9)	3.2 (0.9)	2.9 (1.0)	2.9 (1.0)
Near misses	3.0 (1.1)	2.8 (1.0)	3.4 (0.5)	3.1 (1.0)
Will warn others	4.4 (0.8)	4.6 (0.4)	4.7 (0.4)	4.6 (0.5)
Unsafe behaviors	4.2 (0.8)	3.4 (0.9)	3.7 (0.6)	3.7 (1.1)
Company risk level	2.4 (1.1)	2.7 (0.6)	2.2 (0.7)	2.0 (0.9)
Working safely is #1 priority	3.9 (0.7)	2.7 (0.8)	4.0 (0.6)	3.6 (1.2)
Job training	4.1 (0.9)	2.9 (1.0)	4.2 (0.6)	3.9 (0.9)
First aid cases unreported	2.9 (1.5)	2.7 (1.0)	2.7 (0.4)	2.6 (0.9)
Information is made Available	4.2 (0.8)	3.6 (0.8)	4.3 (0.8)	4.1 (0.6)
Management commitment	4.7 (0.4)	3.2 (1.0)	4.5 (0.4)	4.2 (0.6)
Safety audits are done	3.6 (0.8)	2.6 (0.9)	3.6 (0.7)	3.1 (1.0)
Know how to work safe	4.8 (0.4)	3.6 (1.1)	4.4 (0.5)	4.4 (0.5)
Worker observation Are not OK	3.3 (0.9)	2.9 (1.0)	3.2 (0.6)	2.7 (1.1)
Total	3.9 (0.5)	3.3 (0.5)	3.8 (0.3)	3.7 (0.3)

Table 16 shows the mean total scores (%) and mean for both management and laborers in two test groups by different trades for the Safety Culture Survey responses. The roofing companies had the highest score and mean for the management in both Retest and Previously Non-audited groups. On the other hand, insulation companies had the highest score (75.0 %) and mean (3.75) for the laborers in Retest group, and Exterior trim companies had the highest score (81.8 %) and mean (4.09) for laborers in Previously Non-audited group.

The same questionnaire was given to both management and laborers of same companies and the survey was introduced as an information gathering tool to find both positive and negative aspects of the safety climate at their companies. For the purpose of data analysis in this study, the mean total score, mean, and standard deviation are measured and evaluated by each variable as well as by management and laborers in two test groups. These evaluations are done based on overall 20 survey questions and also the survey is broken down into two categories as employee caring and management caring. In a similar study, where this type of survey questionnaire was used showed that workers' perceptions of risk and control may be highly related to workers' involvement or responsibility for safety (Dedobbeleer and Beland, 1991). In that study, the results indicated that construction workers perceive safety as a joint responsibility between individual workers and management. Therefore, this study tries to see the risk perception of both management and laborers. The data from the study of Dedobbeleer et al. also implies that specific questions on both workers' perceptions of management's commitment to safety and workers' involvement or responsibility in safety should be

included in such surveys. In support to that, this study has questions focusing on employee caring and management caring.

HomeSafe is a self regulated program for the participating companies. It has been shown from the very beginning that HomeSafe orientation and re-certification sessions are attended by management mostly subcontractors and only 20% are general contractor companies. So, it is very important for those participating management representatives pass the information and materials to their employees and subcontractors to make the program effective. This responsibility is stressed in the training and orientation sessions by HBA. The construction industry is very dynamic and continually changing in terms of employee turn over, short-term projects etc. The general contractors control building projects and are the ones who can monitor changes and can act accordingly to ensure their new subcontractors are well aware of the components of the HomeSafe program. The Home Builders Association (HBA) is the primary resource for general contractors for additional training and materials in HomeSafe . The HBA representatives periodically conduct the job site safety evaluations with the major builders and provide feedback to the management about the sites visits. The HBA developed a training packet called 'Tailgate Talks' for general contractors and sub contractors to train their employees regarding the HomeSafe program. It was strongly encouraged that general contractors utilize these resources to ensure subcontractors are knowledgeable about HomeSafe.

Table 16 shows that laborers for roofing trade in the retest group scored significantly lower (58.0) than the management (88.6). This difference must have an affect in overall comparison of safety culture and risk perception between these two

groups for that trade; more responsibilities are on the management to make efforts to increase the perception of laborers in their companies.

Table 16

Comparing mean total scores (%) and mean (in parenthesis) of aggregated (by individual company) safety culture survey responses among management and laborers in two test groups by different trades.

Trade (n)	Retest (Mean & Standard Dev.)		Previously non-audited (Mean & Standard Dev.)	
	Management (n= 21)	Laborers (n= 41)	Management (n= 21)	Laborers (n= 25)
Frame (8)	-	71.2 (3.6)	69.0 (3.5)	75.0 (3.8)
Roof (12)	88.6 (4.4)	58.0 (2.9)	83.4 (4.2)	77.8 (3.9)
Drywall (7)	-	63.4 (3.2)	71.0 (3.6)	77.4 (3.9)
Plumbing (6)	72.6 (3.6)	-	72.6 (3.6)	-
Excavator (6)	-	68.0 (3.4)	-	66.2 (3.3)
Exterior Trim (2)	-	58.6 (2.9)	-	81.8 (4.1)
Insulation (5)	66.0 (3.3)	75.0 (3.6)	-	-
Concrete Foundation (7)	78.6 (3.9)	65.0 (3.3)	79.0 (4.0)	-
Mortar/Stucco (1)	-	-	76.0 (3.8)	-
Roof Gutter (2)	-	70.0 (3.5)	-	-
HVAC (4)	-	70.0 (3.5)	-	72.6 (3.6)
Electric (8)	-	70.2 (3.5)	-	71.6 (3.6)
Concrete Flatwork (4)	-	74.0 (3.7)	-	72.2 (3.6)
Interior Trim (1)	-	-	-	73.6 (3.7)
Paint (6)	78.0 (3.9)	-	78.6 (3.9)	77.6 (3.9)
Pipeline/Drainage (5)	-	61.0 (3.1)	-	76.6 (3.8)
Landscaping (1)	-	67.4 (3.4)	-	-
Fireplace Installation (1)	-	64.2 (3.2)	-	-
Total	77.0 (3.9)	66.4 (3.3)	75.6 (3.8)	73.8 (3.7)

The Safety Culture Survey questions were divided into two subcategories besides the overall 20 questions, they are named as Management caring and Employee caring in table 17. The Management caring category involves 6 questions, they are as follows: (1) When told about safety hazards, supervisors are appreciative and try to correct them quickly (statement number 2); (2) My immediate supervisor is well informed about relevant safety issues (statement # 3); (3) The managers in my company really care about safety and try to reduce risk levels as much as possible (statement # 6); (4) Management places most of the blame for an accident on the injured employee (statement # 8); (5) Information needed to work safely is made available to all employees (statement # 16); (6) Management here seems genuinely interested in reducing injury rates (statement # 17).

The Employee caring category includes following 5 questions: (1) It is the responsibility of each employee to seek out opportunities to prevent injury (statement # 4); (2) When I see a potential safety hazard (e.g., oil spill), I am willing to correct it myself if possible (statement # 7); (3) I am willing to warn my coworkers about working unsafely (statement # 10); (4) Employees seen behaving unsafely in my company are usually given corrective feedback by their coworkers (statement # 11); (5) I know how to do my job safely (statement # 19).

The table 17 shows mean total score (%) and p-value on different questions categories in management and laborers. Management's mean total score is significantly different than that of laborers on overall 20 questions and management caring category. But the mean total scores for both these groups are not significantly different in employee caring category.

The scope of this study investigates safety environment and work practices through the audit tool and the safety culture and risk perception in both management and laborers via the safety culture survey tool. Both of these tools help to determine the effectiveness of the HomeSafe program as well as the differences and similarities in the perception of safety culture among the managements and laborers. It has been purported in literature and agreed by the HomeSafe partners that safe work conditions and environment are necessary to reduce the risk of injuries on sites. It is the intension of this study to investigate another important aspect in that regard which is, safe behavior is related to safe organizational culture. Therefore, it is important that both management and frontline workers perceive the risk, management caring, and employee caring in the same manner. If that is the case then the companies as well as the industry will have a safe culture that will prevent and reduce the incidence of injuries and fatalities in a remarkable way.

Table 17

Comparing mean total scores (%) of the aggregated safety culture survey (by individual company) responses among management and laborers by different questions category.

Type of Questions	Type of Respondents	Mean	Std.Error	95% C.I. Lower	Upper	p-value
Overall 20 questions	Management	77.8	2.96	72.0	83.8	.02
	Laborers	70.0	1.60	66.8	73.2	
Management Caring (6 Questions)	Management	25.0	0.99	23.0	27.0	.01
	Laborers	21.8	0.53	20.7	22.9	
Employee Caring (5 Questions)	Management	22.3	0.70	20.8	23.6	.21
	Laborers	21.2	0.37	21.2	21.9	

Table 18 shows the mean total scores (%), mean, and p-values for different questions categories in Safety Culture Survey for both management and laborers in two test groups. To find out which test group has significantly different score among management and laborers, one analysis was done which revealed that the Retest group has significantly different scores among management and laborers in all three question categories, whereas the Previously non-audited test group has similar response in both management and laborers. It is interesting to note such difference in responses even though both test groups are HomeSafe participants. The Retest group has been audited before compare to previously non-audited group, this indicates that previous auditing

might have an affect on management or laborers. While the management in Retest group is compared to other group's management score, there is not a significant difference in their score or responses but, while comparing the same scores among laborers in two groups, laborers' score are much lower in Retest group than that of the previously non-audited group. That might be suggestive of the fact that previous auditing in the Retest group had made the management more defensive than the other management group, on the other hand, laborers in the Retest group are more open to express their perception since they are used to the auditing process and have no fear about the confidentiality of their responses. Another explanation could be the companies chosen for the Previously non-audited group score higher because their existing safety culture is better and there is good communication between the management and laborers in that group to improve the safety performance or the companies chosen for this group have established their safety culture for quite some time, so that the safety is no longer priority rather a habit in their organizational culture. Therefore, from the safety culture results in Retest group, it is obvious that some initiative should be taken to reduce the difference in responses in both management and laborers in that group. For instances, establishing a good safety culture and communicating that in all grass root levels, specially to the subcontractors in an effective way such as having safety meetings more frequently especially when a new subcontractor is contracted, open relationship between the management and laborers, so that they can feel free to express their safety concerns.

Table 18

Comparing the mean total scores (%) and mean (in parenthesis) of aggregated safety culture survey (by individual company) responses among management and laborers by different questions category in two test groups.

Test Group	Type of Questionnaire	Type of respondents	Mean Total Score & Mean	Std.Error	p-value
Retest	Overall 20 Questions	Management	79.0 (4.0)	3.8	0.002
		Laborers	66.2 (3.3)	1.8	
Retest	Management Caring (6 Questions)	Management	25.1 (4.2)	1.3	0.001
		Laborers	20.0 (3.3)	0.6	
Retest	Employee Caring (5 Questions)	Management	22.6 (4.5)	0.9	0.021
		Laborers	20.3 (4.1)	0.4	
Previously Non-audited	Overall 20 questions	Management	76.8 (3.8)	3.7	0.49
		Laborers	73.8 (3.7)	2.3	
Previously Non-audited	Management Caring (6 Questions)	Management	25.0 (4.2)	1.2	0.39
		Laborers	23.7 (3.9)	0.8	
Previously Non-audited	Employee Caring (5 Questions)	Management	21.9 (4.4)	0.9	0.76
		Laborers	22.2 (4.4)	0.5	

To understand the difference in responses of management and laborers further analysis were done by categorizing the questionnaire into management caring and

employee caring. In management caring category, two survey items show significant differences in laborers' responses in both groups while managements' responses are close to each other in both groups. In the Retest group, laborers scored low in the items where they think their supervisors are not appreciative regarding safety hazards and do not correct them quickly, the other item is, they think their management is not committed in reducing the injury rates. This might be a major concern when employees for certain companies feel that way and have an adverse effect on the overall safety performance and organizational safety culture. In employee caring category, there are two survey questions as well which showed significant differences in laborers' responses in two groups. This could explain the relationship between management commitment or caring and employee responsibility. The employees in the Retest group do not believe it is their responsibility to seek out opportunities to prevent injury, and they also responded that they do not know how to do their job safely. This perception and attitude could exist because they find the management are not safety concerned and are not responding appropriately to safety issues. It is less likely that employees in a company will not be safety oriented unless they find management that way, no matter what they perceive about risk.

Attempts were taken to explore the relationship between the two tool scores. Correlation analysis of employee, management and the mean score difference between management and laborers safety culture surveys with the audit tool showed no significant difference. The plots for these showed little linear or flat relationship (Appendix D)

The Relationship between the two survey instruments showed no positive correlation as anticipated, but the difference is not that significant. One explanation could be that the audit tool was used for assessing the environmental conditions and work

practices at job sites. On the other hand, the safety culture survey was the respondents' own perception about working safely and other aspects of the safety culture regardless of the work condition. The work conditions and perception of risk can be contradictory with construction workers since they change companies frequently and their perception about risk and safety culture might not match with their new companies safety culture and work conditions. Another explanation is, since the responses varied widely in the Retest group among management and laborers in all question categories, such difference might have a negative correlation between audit score and safety culture survey tool. However, more responsibilities fall on the management to maintain the standards of safety and ensure their transference to their new and old employees. This can be accomplished through frequent safety meetings, inspections, and continuous auditing. There must be a trustworthy relationship where both management and laborers believe similar about the risk and safety culture in their companies. There still exists the negative correlation (-0.02) between the two tools even after adjusting them with trades, but the difference is not significant. That as well suggests that the difference in responses in laborers and management in Retest group may be responsible for this negative relationship.

Table 19

Correlation analysis of audit tool and safety culture survey scores among the management, laborers, and their difference in scores.

		N(matched)	Mean	Std.Dev.	p-value	Pearson Correlat. Coeffic.
Audit Tool	Employee Survey	66	3.5	0.44	0.24	-0.15
	Management Survey	26	3.7	0.32	0.45	0.15
	Difference between Management and Employee survey	26	0.3	0.70	0.39	0.18

Any technological, engineering, or environmental modifications which make the work environment and its miscellaneous tasks less hazardous are welcomed but good housekeeping and other general site tidiness are also important in that regard, however these are not a complete answer to the problem of improving safety culture. To achieve total safety climate, full account must also be taken of the attitudes and motivations of those working at the sites and of the way in which the companies contribute to the content and direction of these.

LIMTATIONS

Bias associated with the 'Hawthorne effect' may be present but fortunately, however, Hawthorne effects have rarely ever proven to be significant (Rossi et al., 1979). Although some companies expressed a sincere interest in participating in the HomeSafe pilot program evaluation, most were impartial to their participation in the study. Therefore, significant improvement in safety performance among the HomeSafe participants due to the 'Hawthorne effect' was not expected to be a factor in the analysis. Perhaps more important than the Hawthorne effect was potential bias associated with notifying the HomeSafe participants before the inspections were performed. Although company representatives were asked not to notify their employees that the HomeSafe auditor would be arriving on site, there was no way to verify that the representative complied. Companies that were notified that the auditor was arriving may have made certain preparations to the work sites and employees that may have increased the scores on the audit.

On many occasions, the study investigator noted that employees would behave differently while the audit was conducted. These behaviors included donning of hard hats, replacing pinned-up guards on saws, and erecting guardrails around open holes and windows. Most of these actions were readily identifiable and those that were observed were not considered as improvements in safety performance during the auditing process. Employees of both HomeSafe participating companies and control companies were observed performing these 'quick-fix' behaviors. Therefore, any bias associated with this factor of the auditing process likely showed a slight and equal improvement in the safety performance scores among the three test groups.

An issue of concern with data collection was the probability of observing unsafe behaviors and site characteristics during the time that an audit was performed. The audit took only 20 to 30 minutes to complete, depending on the number of hazards present and HomeSafe sections applicable their score was impacted. Thus, each company was scored solely on observations made within that time period. This chance observation was particularly problematic in the residential construction industry where workers often completed a variety of jobs in the course of the day. A design change, lack of supplies, or inclement weather may determine the daily schedule a company follows (Bhattacharya et al. 1997). These above mentioned factors along with any recent adverse experience with management might affect the state of mind of the laborers while they are responding the survey questionnaire. Also, the survey respondents were told to give their honest opinion about the items in the survey but fear of loosing job or lack of trust in confidentiality of their responses might stop them giving honest responses. The study investigator attempted to assure subjects about their confidentiality and requested them not discuss their responses among themselves while responding.

Although inter-auditor differences due to individual biases were eliminated by having only one investigator collect data, the results may reflect some biases of the study investigator. To eliminate the potential for this bias, the investigator was familiar with OSHA construction standards and trained in the regulations of the HomeSafe program. Additionally, the HomeSafe program coordinator was available for consultation when questions arose regarding the auditing process and several trial audits were conducted with others at the beginning of the auditing.

There may be other problems with the assumptions that the general contractors and subcontractors were training their employees using the HomeSafe program. On several occasions during the auditing process, subcontractors indicated no knowledge of the HomeSafe program even though their general contractor or mid-contractor was a participant. It was contradictory that some general and subcontractors that joined the program to improve safety performance on their work sites had not given the program to their workers who were most at risk to safety and health hazards.

CONCLUSION

The results of this study support one of the three hypotheses which is, HomeSafe audit tool score obtained 2 years post intervention is significantly higher than those obtained previously. That means the work environment and work practices are improved with time among the HomeSafe participants. The Residential construction industry is in dire need of improved health and safety compliance. The results of this study will be encouraging for other non-participating companies to adopt this program. The other hypothesis (number 2) was not supported by the study results; the two survey tools (audit and safety culture and risk perception survey) were not highly correlated to each other. Another hypothesis stated that the scores obtained using the safety culture survey from general laborers and management would be same, which is true for the Previously non-audited group, but not the same for the Retest group. It is evident from some of the results that some HomeSafe participant companies' safety culture is not satisfactory; the perception of risk and safety is far different among the frontline workers than in management, which is not desirable. A number of work and organizational characteristics can be recommended from the results of this study to promote safety as a major organizational concerns are as follows:

1. An open-systems perspective: Since companies exist interdependently with their environment, so a number of 'outside' factors can readily affect safety performance, for example market pressure, government legislation or OSHA involvement, the socio-economic conditions facing employees, and the 'macho' social image and stereotype of construction work and those who perform it. Such factors need to be carefully considered in the design of

organizational policies and objectives intended to maintain and improve safety performance.

2. Regular reviews of existing safety policies and objectives (to keep abreast of changing conditions and circumstances).
3. The inclusion of lower organizational personnel (a representative from front line workers) in the policy-making and reviewing procedures (to ensure the 'relevance' of organizational policy and objectives to their needs and situations).
4. A continuous and visible demonstration of safety as a major organizational concern. Since employees' perceptions are based upon many continuing events and experiences rather than single actions or statements, daily experiences must therefore reinforce the need for safe working practices.
5. A full utilization of the significance of group and interpersonal processes. The importance of the work group in determining attitudes and behavior is well known in social psychology. It is important therefore that companies ensure a compatibility between group safety norms and formal organizational norms. This can be achieved by conducting group safety meetings by general contractors, conducting and encouraging group discussions of safety, ensuring good feedback links between these group discussions.
6. A long-term strategy for improving safety performance (and indeed general organizational effectiveness management should do all it can to encourage and promote positive inter-group co-operation. For example, general contractors

may require their subcontractors to attend different HomeSafe reorientation sessions.

7. Formal reward system that equitably rewards time and effort spent in the pursuit of safety. Employees cannot reasonably be expected to follow safe working procedures if to do so means to lose wages or some other desired reward and suffers inequity in comparison to those who do not pursue safety in the same manner or degree. Also some rewards for the HomeSafe participating companies are offered such as, no fines if the hazards can be corrected in the presence of the OSHA compliance officer, less OSHA inspections if they are HomeSafe participants.
8. Frequent and open communications between workers and management on safety issues in all levels from general contractors to subcontractors to their front line workers.

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APPENDIX A:

HomeSafe Audit Tool

ID NUMBER: _____ SESSION # : _____

English spoken? Yes No

EVALUATION CODE *Pre-Evaluation* *Post-Evaluation* *Non-Participant* *Participant*

Date: Training Session Date: Evaluator Name:

Location of Site:

Type of Dwelling: Stage of Construction:

On-Site Company Name: Company Trade:

Pre-Evaluation *Post-Evaluation* *Control* *Participant*

Number of employees working at site (including partners):_____

Number of total employees working for company:____Employee Job Title: Owner Supervisor/Foreman Labor

General Contractor Name (if applicable):

Pre-Evaluation *Post-Evaluation* #_____ *Control* *Participant*

Immediate Contractor Name (if applicable):

Pre-Evaluation *Post-Evaluation* #_____ *Non-subject* *Participant*

Questions	Instructions for Evaluator	Score
SAFETY PROGRAM		
1. Has employee heard of the HomeSafe program?	Question not scored.	1=no 2=yes
2. Has employee or company been trained using the HomeSafe program? Specify details of training (Know about 10 pts? Seen booklet? Know concept of program?	Score 'NA' if this is a Pretest or Control. Question not scored.	1=no 2=familiar 3=trained
3. Specify frequency of safety and health training employee has had with the current employer.	1=none 2=weekly GC 3=weekly company 4=monthly GC 5=monthly company 6=misc. GC 7=misc. company 8=other 9=weekly IC 0=monthly IC 11=misc. IC. Question not scored.	
4. Does employee know who the safety program coordinator is?	Question not scored.	1=no 2=yes
5. Determine if the employees are exposed to chemicals.	If the employee is not exposed to chemicals, score 'no' and skip to question 8. Question not scored.	1=no 2=yes
6. Does the employee know the location of the MSDS book?	Ask the employee for the location of the MSDS book. Score 'no' if employee does not know the location. Question not scored.	1=no 2=yes
7. Are all containers of chemical labeled with the identity of the chemicals and appropriate warnings that provide at least general information regarding the hazards of the chemicals?	Question not scored.	1=no 2=yes 0=NA

PERSONAL PROTECTIVE EQUIPMENT

8. Are employees properly wearing a hard hat when working in areas where there is possible danger of head injury?	Score 'NA' if there is no head hazard. Score 'no' if employee is not wearing a hard hat when the possibility for head injury exits.	1=no 2=yes 0=NA
9. Are the employees wearing good, sturdy boots (or appropriate footwear if roofer)?	Score 'no' if the employees are wearing court shoes (including high-top shoes), and 'cowboy' style boots. A boot is defined as rugged, outdoor footwear that fully covers the ankle. Roofers may wear court shoes	1=no 2=yes
10. Are the employees exposed to any eye hazards?	Inspect the work areas that employees of the contractor work in for tools such as sanders, grinders, saws, and welding equipment. NOTE: the eye hazard needs only to exist. The employee does not have to be currently exposed. Question not scored. If employees are not exposed to any eye hazards, score 'no' and skip to question 14.	1=no 2=yes
11. Do the employees have proper eye protection even if they do not need to wear it at this moment?	Ask to see the eye protection that the employees use. If the employees are observed wearing corrective lenses in an environment hazardous to the eyes, ask if they are approved safety lenses. If employee does not have eye protection or the protection is improper, score 'no' and go to question 14.	1=no 2=yes
12. Is the eye protection properly maintained?	Score 'no' if eyewear is so dirty that vision is impaired or if it is damaged.	1=no 2=yes
13. Are the employees wearing eye protection at all times in areas where there is a risk of eye injuries due to flying objects and intense light exposure such as grinding and welding operations?	Score 'NA' if the employees are not exposed to any eye hazards.	1=no 2=yes 0=NA
14. Determine if employees are exposed to respiratory hazards. type of hazard: _____	Inspect the work site for work situations that require the use of respiratory protection. If such a situation exists, briefly describe what the hazard is in the space provided. Question not scored. NOTE: the respiratory hazard needs only to exist. The employee does not have to be currently exposed. If no respiratory hazards are present, score 'NA' and skip to the scaffolding section. Otherwise, continue on to the next question.	1=NA 2=spray 3=partic
15. Are the employees **using** the appropriate respiratory protection when they are exposed to respiratory hazards?	Score 'NA' if you do not observe a work situation where employees are required to wear respiratory protection.	1=no 2=yes 0=NA
16. Is the respiratory protection properly maintained and in a sanitary condition and ready for use?	Inspect respirators for signs of damage and excessive wear. Respirators must be clean and in a sanitary condition. Score 'NA' if unable to inspect respirator.	1=no 2=yes 0=NA

17. Have the employees been trained in proper use of the respirator? Last training session was ____ months ago	Score 'NA' if the employees do not speak English. Question not scored.	1=no 2=yes 0=NA

SCAFFOLDING

General Requirements

18. Are scaffolds used by the contractor?	If there are no scaffolds used by the contractor, score 'NA' and go to the ladders section. Question not scored.	1=no 2=yes
19. Are all scaffolds erected plumb?	Use your best visual judgment.	1=no 2=yes
20. Is all scaffold footing secure?	This means that the scaffold shall have base plates and mud sills, unless it is sitting on a stable concrete foundation. Unstable objects shall not be used to support the scaffold.	1=no 2=yes
21. Is the scaffold fully planked between uprights?	Each platform unit shall be installed so that the space between adjacent units and the space between the platform and the uprights is no more than 1 inch, except when employer can demonstrate that a wider space is necessary	1=no 2=yes 0=NA
22. Are the scaffold planks 'scaffold grade'?	Inspect the planks for any structural defects.	1=no 2=yes
23. Is proper access to the scaffold provided (ladder, ramp, or walkway) and are employees accessing the scaffold properly?	The cross braces may not be used as a means for accessing the scaffold. Integral specs: Length = 8"; uniform; line up vertically; max. height = 16.75"	1=no 2=yes 0=NA
24. Dose the scaffold appear to be able to hold 4 times its intended weight capacity?	Visually estimate this. If it seems obvious that the scaffold is not capable to carry 4 times its intended load, score 'no'.	1=no 2=yes
25. Is the front edge of the platform 14 inches or less (18 inches or less for plastering and lathing operations) away from the face of the work unless guardrails or personal fall arrest systems are used to prevent the employee from falling?	Score 'NA' if work is being conducted overhead or there is otherwise no 'face' of work that the scaffold is near.	1=no 2=yes 0=NA
26. If a scaffold is greater than 10 feet high, are guardrails properly installed?	If scaffold is 10 feet high or greater, continue to the next question. **If guardrails are not used at all, skip to 28.** If the scaffold is not 10 feet or higher, score 'NA' and go to question 20.	1=no 2=yes 0=NA
27. Are the guardrails installed along all open sides and ends of the platforms?	**Skip this question if guardrails are not used at all.**	1=no 2=yes 0=NA
28. Does the scaffold have a toeboard if there are employees walking/working below it?	If it is likely that employees are working or walking below the scaffold even though you can't see it now and no toeboard is installed, score 'no'. Score 'NA' if no one works/walks below the scaffold.	1=no 2=yes 0=NA
29. Is the scaffold platform a minimum of 18 inches in width, **except** ladder jacks and pump jacks which are minimum 12 inches in width, **and** job-built types (sawhorse and wood pole) which are a minimum 10 inches in width?		1=no 2=yes

30. For wooden platforms only, does the end of each platform, unless cleated or otherwise restrained by hooks or equivalent means, extend over the centerline of its support at least 6 inches?	Score 'NA' if the platform is not wooden or the scaffold is job-built and skip to the job-built wood scaffolding section below.	1=no 2=yes 0=NA
31. For wooden platforms 10 feet or **less** in **length**, does the platform extend 12 inches or **less** over the centerline of the last support, unless the platform is designed and installed so that the cantilevered portion of the platform is able to support employees and/or materials without tipping, or has guardrails which block employee access to the cantilevered end?		1=no 2=yes 0=NA
32. For wooden platforms **greater** than 10 feet in **length**, does the platform extend 18 inches or **less** over the centerline of the last support, unless the platform is designed and installed so that the cantilevered portion of the platform is able to support employees and/or materials without tipping, or has guardrails which block employee access to the cantilevered end?		1=no 2=yes 0=NA

Job-Built Scaffolding (sawhorse and wood pole scaffolding)

33. Is this type of scaffolding used only where conventional scaffolding cannot be used, such as the erection of trusses and drywall?	If no job-built wood scaffolding (sawhorse or wood pole) is being used by the company, score 'NA' and go to the next section.	1=no 2=yes 0=NA
34. Do the planks span 8 feet or less?		1=no 2=yes
35. Are the planks secured from movement?		1=no 2=yes
36. Do the cleats span 3 studs, 2 X 6 or equal, and are they secured with three 16-penny nails or 3 inch screws in each stud?	Score 'NA' if cleats are not necessary.	1=no 2=yes 0=NA
37. If plank are lapped, does each plank lap its support by at least 12 inches?	Score 'NA' if none of the planks are lapped.	1=no 2=yes 0=NA

Tubular Welded (metal frame) Scaffolds

38. Is the scaffold properly braced (cross-bracing used)?	If a tubular welded scaffold is not being used, score 'NA' and go to the next section.	1=no 2=yes 0=NA

Pump Jack Scaffolds

39. Are the pole, legs, or uprights plumb and securely braced with metal braces or collars to prevent swaying and/or displacement?	If pump jack scaffolding is not being used, score 'NA' and go to the next section.	1=no 2=yes 0=NA
40. If wood poles are used, is intermediate bracing used at a minimum of 10 foot intervals?	Score 'yes' if intermediate bracing is provided at intervals less than 10 feet. If wood poles are not used, score 'NA' and skip to question 43.	1=no 2=yes 0=NA
41. Are the poles made of straight grain wood?		1=no 2=yes
42. If 2 X 4's are used to make poles, does each pole consist of 2- 2 X 4's nailed together at the center and on both sides, the seam parallel to the bracket, and spaced at a minimum of 12 inch intervals?		1=no 2=yes
43. Are at least two pole braces used per pole (one at top and one at bottom of pole)?		1=no 2=yes

Ladder Jack

44. Is each employee on the ladder jack scaffold that is 6 feet or higher protected by guardrails or a personal fall arrest system (includes an anchorage, connectors, and a body belt or body harness)?	If a ladder jack is not used by the employee, score 'NA' and go to the next section. Score 'NA' if the scaffold is less than 6 feet in height.	1=no 2=yes 0=NA

LADDERS

45. Are ladders being used by the contractor?	If there are no ladders used by the contractor score 'NA' and go to the access/housekeeping section. Question not scored.	1=no 2=yes 0=NA
46. Are the ladders manufactured properly?	Score 'no' if a job built ladder is being used. **If you score 'no' to this question, skip to the access/housekeeping section.**	1=no 2=yes

Extension ladders

47. Is the area around the top and bottom of the ladder clear of obstructions?	Score 'NA' if extension ladders are not being used and go to the step ladder section.	1=no 2=yes 0=NA
48. Is the ladder set 1 foot out for every 4 feet up?	Score 'no' if the ladder is set either more or less than 1 foot out for every 4 up.	1=no 2=yes
49. When the ladder is used to access an upper landing surface, do the side rails of the ladder extend a minimum 3 feet above the upper landing surface to which the ladder is used to gain access or is a grasping device provided to assist employees, such as a handrail, and is the ladder at least level with the top of the resting surface?	If the ladder is not used to access an upper landing surface, score 'NA' and go to question 51.	1=no 2=yes 0=NA
50. Is the ladder secured at its rest point when it is used for access to an upper landing surface?		1=no 2=yes
51. Is the ladder used only for the purpose it was designed?	The ladder should not be used as a ramp or walkway.	1=no 2=yes
52. Does the employee use the ladder properly?	Score 'NA' if you do not see the employee use the ladder. The ladder should not be 'walked' or extended while an employee is standing on it. Employee must face ladder when using Employee must not be carrying load up/down ladder The employee must not stand higher than the fourth rung from the top.	1=no 2=yes 0=NA
53. Is the ladder free of oil, grease, water, and other slipping hazards?		1=no 2=yes
54. Is the ladder free of structural defects?	Inspect the ladder for visible damage signs of wear and strain.	1=no 2=yes
55. Is the ladder secured or barricaded if it is set in an area where it can be displaced by workplace activities or traffic?	Score 'NA' if the ladder is **not** set in an area that where it can be displaced.	1=no 2=yes 0=NA
56. If the ladder is placed within 10 feet of exposed energized electrical equipment, does it have nonconductive side rails?	Score 'NA' if ladder is not exposed in this manner.	1=no 2=yes 0=NA
57. Is the ladder set on a firm and level surface?		1=no 2=yes
58. Is the top of the ladder placed with the two rails supported equally unless it is equipped with a single support attachment?		1=no 2=yes

Step ladders

59. Is the area around the top and bottom of the ladder clear of obstructions?	Score 'NA' if step ladders are not being used and go to the next section.	1=no 2=yes 0=NA
60. Is the ladder used only for the purpose it was designed?	The ladder should not be used as a ramp or walkway.	1=no 2=yes
61. Does the employee use the ladder properly?	Score 'NA' if you do not see the employee use the ladder. Employees should not stand on the top two steps of the ladder or 'walk' the ladder while it is being utilized.	1=no 2=yes 0=NA
62. Is the ladder free of oil, grease, water, and other slipping hazards?		1=no 2=yes
63. Is the ladder free of structural defects?	Inspect the ladder for visible signs of wear and strain.	1=no 2=yes
64. If the ladder is placed within 10 feet of exposed energized electrical equipment, does it have nonconductive side rails?	Score 'NA' if ladder is not exposed in this manner.	1=no 2=yes 0=NA
65. Is the ladder set on a firm and level surface?		1=no 2=yes

ACCESS/HOUSEKEEPING

66. Are all work areas free of excess debris or other unnecessary hazards?	Inspect the grounds on which the construction is taking place. Note any excess debris or 'garbage' that may be littering the site and hazards such as nails sticking out of boards that are laying on the ground.	1=no 2=yes
67. Are containers provided for the collection of waste?	Score 'NA' if no waste is generated by the contractor.	1=no 2=yes 0=NA
68. Are there ramps or stairways provided when breaks in elevation of 19 inches or higher occur at areas used for access?	This question only refers to points of access and egress that employees are utilizing. If there are no breaks in elevation of 19 inches or more, score 'NA'.	1=no 2=yes 0=NA

OPEN HOLES/UNPROTECTED SIDES AND EDGES

This section pertains only to work areas that employees utilize. Do not evaluate areas that are not accessed by the employees.

69. Are all open sided floors and holes (such as stairwells, door openings not used for access, and skylights) that have a fall distance of more than 6 feet protected by guardrails or covers? **(scaffolds are not included in this question)**	Roof work such as sheathing and truss work, and erection of exterior walls are covered in the fall protection section. Even if the employees are not exposed to any fall hazards at this moment, investigate the work area for potential fall hazards that the employees would be exposed to. If the employees are not exposed to any open holes or unprotected sides and edges, score 'NA'.	1=no 2=yes 0=NA
70. Are all guardrails constructed with 2 X 4's or equivalent, with a top rail at 42 inches, mid-rail at 21 inches, uprights at 8 foot intervals, toeboards if persons work or pass below, and built sturdy?	Inspect the employees work areas for guardrails. Score 'NA' if no guardrails are used by the contractor.	1=no 2=yes 0=NA
71. Is a guardrail provided (42 inches high) at all window openings which have an inside bottom edge below 36 inches and an outer fall distance of 6 feet or greater?	Score 'NA' if there are no window openings with an inside bottom edge below 36 inches or the fall distance is less than 6 feet.	1=no 2=yes 0=NA

FALL PROTECTION

72. Are the employees exposed to fall distances of 6 feet or greater on any surfaces such as roof work, walkways, and runways?	Even if the employees are not currently exposed to any fall hazards, investigate the work area for potential fall hazards. Question not scored. If the employees are not exposed to any fall hazards, score 'NA' and go to the excavations/trenching section.	1=no 2=yes
73. Are employees using conventional fall protection properly?	If you score 'yes', skip the rest of this section and go to the excavation/trenching section.	1=no 2=yes 0=NA
74. Are only trained workers allowed to work on the top of the foundation wall/formwork and only as necessary to complete the construction of the wall?	This question and its subparts apply only to alternate safe work practices that apply to work on **foundation walls and related concrete formwork.** Skip to question 79 if this type of work is not being performed.	1=no 2=yes 0=NA
75. Is all formwork adequately supported before any employee works on top of the foundation/formwork?		1=no 2=yes
76. When adverse weather (such as high winds, rain, snow, or sleet) is creating a hazardous condition, are operations suspended until such time as the hazardous condition no longer exists unless safe footing can be ensured for workers on top of the foundation wall/formwork?	Score 'NA' if no adverse weather conditions are present.	1=no 2=yes 0=NA
77. Are materials and equipment for the work being performed conveniently located to the workers on the top of the foundation/formwork?	Score 'NA' if no equipment or materials are being used.	1=no 2=yes 0=NA
78. Are materials and other objects which could pose impalement hazards kept out of the area below where workers are working or are they properly guarded?		1=no 2=yes 0=NA
79. Are only trained workers allowed to work in attics and on elevated surfaces and only as necessary to complete the construction of the system being installed?	This question and its subparts apply only to alternate safe work practices for workers installing the following while working in **attics** or on **elevated surfaces** including the following: 1. Drywall 2. Insulation 3. HVAC systems 4. Electrical systems 5. Plumbing 6. Carpentry 7. Painting If this type of work is not being performed, skip to question 86	1=no 2=yes 0=NA
80. Is a CAZ properly identified and controlled by signs, wires, tape, ropes, or chains?	This question only applies to alternate safe work practices for workers setting and bracing roof trusses and rafters, installing floor sheathing and joists, and erecting exterior walls	1=no 2=yes 0=NA
81. Is a painted line six feet from the perimeter clearly marked prior to any wall erection activities to warn of the approaching unprotected edge?	This question applies only to workers erecting exterior walls using alternate safe work practices	1=no 2=yes 0=NA
82. While attic or roof work is in progress, are workers that are not involved in such work **not** standing or working below or adjacent to any openings in the ceiling where they could be struck by falling objects?		1=no 2=yes 0=NA

83. Are materials and equipment for the work being performed located conveniently close to the workers?	Score 'NA' if no materials or equipment are being used.	1=no 2=yes 0=NA
84. Are materials and other objects which could pose impalement hazards kept out of the area below where workers are working or are they properly guarded?		1=no 2=yes
85. When adverse weather (such as high winds, rain, snow, or sleet) is creating a hazardous condition, are operations suspended until such time as the hazardous condition no longer exists unless safe footing can be ensured for workers on top of the roof?	Score 'NA' if no adverse weather condition exists. After answering this question, to go the Excavations/Trenching section.	1=no 2=yes 0=NA
86. Are only authorized employees allowed onto the roof?	This question applies to alternate safe work practices for all roofing work including **roof sheathing, roofing removal, repair, and new roofing installation on roofs with a slope of 8/12 or less and a fall distance less than 25 feet from the eave, or any work done on a roof.** Ask the employees if they have been trained in the alternative methods of fall protection. Skip to 62h if the slope of the roof is greater than 8/12 or the fall distance from the eave is greater than 25 feet. Skip to the excavation/trenching section if no roof work is being performed.	1=no 2=yes 0=NA
87. If the employee works on a roof with a slope 8/12 or greater and all slopes with fall distances greater than 25 feet, are conventional methods of fall protection used?	This question applies to roofs with a slope greater than 8/12 or a fall distance greater than 25 feet. Score 'NA' if the slope is less than 8/12 and the roof height is less than 25 feet at any slope, go to the next question. If you score 'yes' or 'no' on this question, go the to Excavations/Trenching section.	1=no 2=yes 0=NA
88. Is the roof free of slipping hazards or are measures taken to prevent employee exposure to such hazards?		1=no 2=yes 0=NA
89. When adverse weather (such as high winds, rain, snow, or sleet) is creating a hazardous condition, are operations suspended until such time as the hazardous condition no longer exists unless safe footing can be ensured for workers on top of the roof?	Score 'NA' if no adverse weather condition exists.	1=no 2=yes 0=NA
90. If the employee works on a roof with a slope less than 6/12 and a fall distance less than 25 feet, are slide guards installed extending the width of the eave?	Score 'NA' if the slope of the roof is greater than 6/12 or the fall distance is greater than 25 feet.	1=no 2=yes 0=NA
91. If the employee works on a roof with a slope 6/12 to 8/12 and a fall distance less than 25 feet, are slide guards installed at intervals not exceeding 8 feet with the bottom row extending the width of the eave and the additional rows placed directly below the workers?	Score 'NA' if the slope of the roof is less than 6/12, greater than 8/12, or the fall distance is greater than 25 feet.	1=no 2=yes 0=NA
92. If slide guards are used, are they constructed using a 2 X 4 as the base and a 2 X 6 as the edge, and are they securely fastened to the roof?	Score 'NA' if slide guards are not being used.	1=no 2=yes 0=NA

93. Are supplies and materials not stored within 6 feet of the rake edge, or three feet where tile roof systems are being installed?	Score 'NA' if no supplies or materials are stored on the roof.	1=no 2=yes 0=NA
94. Is the area below the eaves and rakes kept clear of materials and other objects which could pose impalement or other hazards or are they properly guarded?		1=no 2=yes 0=NA

EXCAVATIONS/TRENCHING

95. Are the employees exposed to any excavations on the work site?	Inspect the work site for any excavations that the company's employees have worked in or will work in the future. Question not scored. If the employees will not be exposed to any excavation, score 'no' and go to the Tools and Equipment section.	1=no 2=yes
96. For excavations greater than 7.5 ft. in depth, is sloping provided starting at the bottom of the excavation at a ratio of 1 up and 1.5 across or benching provided at least two feet horizontally for every five feet or less of vertical height?	.	1=no 2=yes 0=NA
97. If the excavation is below 7.5 ft in depth do the following conditions apply? A. Protective measures been taken (e.g., sloping, benching, boxing) **OR** B. There no water, surface tension cracks, nor other environmental conditions present that reduce the stability of the excavation **AND,** C. There is no heavy equipment operating in the vicinity that causes vibration to the excavation while employees are in the excavation **AND,** D. Work crews in the excavation are the minimum number needed to perform work		1=no 2=yes 0=NA
98. If the excavation is greater than 4 foot in depth, are ramps or ladders provided to access the excavation?	Score 'NA' if the excavation is 4 foot in depth or less.	1=no 2=yes 0=NA
99. If the excavation is greater than 25 feet in length and greater than 4 feet in depth, is there a ladder/ramp provided at every 25 feet of lateral travel?	Score 'NA' if the excavation is less than 25 feet in length or 4 feet in depth.	1=no 2=yes 0=NA
100. Is the face of the excavation at the bottom a minimum of 2 feet away from formwork, walls, and foundations?		1=no 2=yes
101. Is the spoil pile placed a minimum of 2 feet from the top of the slope?		1=no 2=yes 0=NA
102. Are vehicles, heavy equipment and other heavy loads other than the spoil pile kept at a distance from the edge of the excavation equal to or greater than its depth?		1=no 2=yes 0=NA

TOOLS AND EQUIPMENT

103. Are power tools used by the employees?	If no power tools are used, score 'no' and skip to the electrical and power cord section. Question not scored.	1=no 2=yes
104. On all power tools, is all the manufacturer's safety devices (e.g. guarding) in place and operational?	Any missing, damaged or altered safety devices score a 'no'. Score 'NA' if the power tool does not require any safety devices, such as a drill or if the tool cannot be inspected.	1=no 2=yes 0=NA
105. Not considering the safety devices, are power tools and attached power cords properly maintained in a safe condition?	Inspect the tools that the employee used for any obvious defects/damage that may be a safety concern. Score 'no' if any defects/damage is found Score 'NA' if you can't inspect the tool.	1=no 2=yes 0=NA
106. Are all portable electric hand tools equipped with a three-wire cord (regardless of the presence of a ground prong), **OR** are the tools double insulated **and** labeled "Double Insulated"		1=no 2=yes 0=NA
107. Are all power tools used in the manner they were intended?	Tools should only be used for the purpose they were designed. Score 'NA' if you don't see the employees using the tools Score 'NA' if no hand tools are used and skip to the electrical power and cords section.	1=no 2=yes 0=NA

CONSTRUCTION ELECTRICAL POWER AND POWER CORDS

108. Are all utility cords construction grade and have the ground prongs in place?	This section does not include cords directly attached to power tools-score this in the tools section above. If no cords are used by the employee, score 'NA' and skip the rest of this section.	1=no 2=yes 0=NA
109. Is the path to ground from circuits, equipment, and enclosures permanent and continuous?	To test the ground continuity from the power supply to a tool, plug a GFCI tester into the distal end of a utility power cord that is plugged into a GFCI system. Score 'NA' if the cord is not in use (not plugged in) or unable to check or the ground plug is missing on cord.	1=no 2=yes 0=NA
110. Do all cords have the outer insulation properly maintained so that it provides strain relief and protection to the internal wires?	Inspect cords for such things as fraying, improper repairs (e.g. taping exposed wires), and exposed wires.	1=no 2=yes
111. If any cords are spliced, are they a flexible cord number 12 or larger and so spliced that the cord retains the insulation, outer sheath properties, and usage characteristics of the cord being spliced?	Score 'NA' if none of the cords have been spliced.	1=no 2=yes 0=NA
112. Are all electrical junction boxes construction grade and waterproof?	Score 'NA' if no junction boxes are used.	1=no 2=yes 0=NA
113. Is the contractor using a temporary source of power?	If the contractor is not using a temporary source of power, score 'no' and skip the rest of this section.	1=no 2=yes
114. Is all temporary 110-volt construction power on a properly functioning Ground Fault Circuit Interrupter (GFCI) system?	Test the GFCI system with an appropriate testing device. Do not test the power supply if the house has already been wired for power. Score 'NA' if the 110-volt outlet is not being utilized by the contractor.	1=no 2=yes 0=NA
115. Is any split of a temporary 220-volt power supply to 110-volt protected through GFCI and properly wired?	Score 'NA' if a 220-volt power supply is not being used. Continue to the next question.	1=no 2=yes 0=NA
116. Are all temporary power poles securely staked?	Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials is not permitted.	1=no 2=yes
117. Do all temporary power panels include a cover and a dead front?		1=no 2=yes

APPENDIX B:

Safety Culture and Risk Perception Survey

HomeSafe # _____

Safety Culture and Risk Perception Survey

Please complete the following survey and rate each statement on a scale of 1-5, where **1** = Highly Disagree, **2** = Disagree, **3** = Neither Agree Nor Disagree, **4** = Agree, and **5** = Highly Agree.

1 2 3 4 5

❑❑❑❑❑ 1. The risk level of my job concerns me quite a bit.
❑❑❑❑❑ 2. When told about safety hazards, supervisors are appreciative and try to correct them quickly.
❑❑❑❑❑ 3. My immediate supervisor is well informed about relevant safety issues.
❑❑❑❑❑ 4. It is the responsibility of each employee to seek out opportunities to prevent injury.
❑❑❑❑❑ 5. At my company, work productivity and quality usually have a higher priority than work safety.
❑❑❑❑❑ 6. The managers in my company really care about safety and try to reduce risk levels as much as possible.
❑❑❑❑❑ 7. When I see a potential safety hazard (e.g., oil spill), I am willing to correct it myself if possible.
❑❑❑❑❑ 8. Management places most of the blame for an accident on the injured employee.
❑❑❑❑❑ 9. "Near misses" are consistently reported and investigated at our company.
❑❑❑❑❑ 10. I am willing to warn my coworkers about working unsafely.
❑❑❑❑❑ 11. Employees seen behaving unsafely in my company are usually given corrective feedback by their coworkers.
❑❑❑❑❑ 12. Compared to other companies, I think mine is rather risky.
❑❑❑❑❑ 13. Working safely is the Number One priority in my company.
❑❑❑❑❑ 14. I have received adequate job safety training.
❑❑❑❑❑ 15. Many first-aid cases in my company go unreported.
❑❑❑❑❑ 16. Information needed to work safely is made available to all employees.
❑❑❑❑❑ 17. Management here seems genuinely interested in reducing injury rates.
❑❑❑❑❑ 18. Safety audits are conducted regularly in my company to check the use of personal protective equipment.
❑❑❑❑❑ 19. I know how to do my job safely.
❑❑❑❑❑ 20. Most employees in my company would not feel comfortable if their work practices were observed and recorded by a coworker.

(Adapted from the Safety Culture Survey developed by Safety Performance Solutions, Inc.) Reference: Geller, E. S: (1996).*Working Safe*. Radnor, Pennsylvania, Chilton Book Company.

Date _____

Encuesta Sobre Percepcion de Riesgo y Cultura de Seguridad

Por favor complete la siguiente encuesta y asigne un valor en la escala **1-5** para cada afirmación, donde **1** = Totalmente en Desacuerdo, **2** = En Desacuerdo, **3** = Ni en acuerdo ni en desacuerdo, **4** = De acuerdo y **5** = Totalmente de Acuerdo.

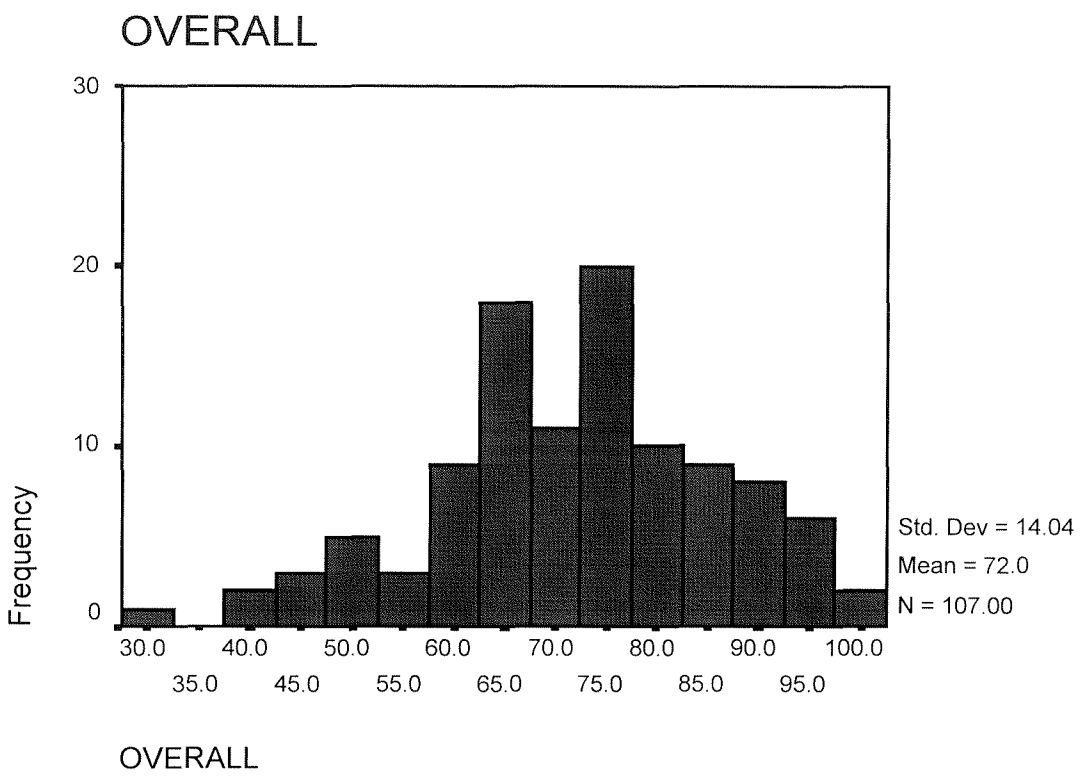
1	2	3	4	5	
❑	❑	❑	❑	❑	1. El nivel de riesgo en mi trabajo me interesa bastante.
❑	❑	❑	❑	❑	2. Cuando se habla acerca de riesgos en la seguridad laboral, los supervisores están muy atentos y tratan de corregirlos rápidamente.
❑	❑	❑	❑	❑	3. Mi supervisor inmediato está bien informado sobre aspectos relacionados con la seguridad.
❑	❑	❑	❑	❑	4. Es responsabilidad de cada empleado buscar la forma de prevenir daños.
❑	❑	❑	❑	❑	5. En el trabajo, la productividad y la calidad generalmente tienen una mayor prioridad que la seguridad laboral.
❑	❑	❑	❑	❑	6. Los directivos en mi compañía realmente cuidan la seguridad y tratan en lo posible de reducir los niveles de riesgo.
❑	❑	❑	❑	❑	7. Cuando yo veo un riesgo potencial en la seguridad (por ejemplo aceite derramado), estoy dispuesto a corregir ésto por mí mismo si me es posible.
❑	❑	❑	❑	❑	8. Según los Administrativos la mayor parte de la culpa en un accidente la tiene el empleado afectado.
❑	❑	❑	❑	❑	9. "Los descuidos" son consistentemente reportados e investigados en nuestra compañía.
❑	❑	❑	❑	❑	10. Me gusta informar a mis compañeros acerca de los peligros en el trabajo.
❑	❑	❑	❑	❑	11. Los empleados que se comportan descuidadamente en mi compañía generalmente reciben indicaciones correctivas de sus compañeros de trabajo.
❑	❑	❑	❑	❑	12. Comparada con otras compañías, creo que la mía es más riesgosa.
❑	❑	❑	❑	❑	13. La seguridad en el trabajo es la prioridad Número Uno en mi compañía.
❑	❑	❑	❑	❑	14. He recibido adecuado entrenamiento en seguridad laboral.
❑	❑	❑	❑	❑	15. Muchos accidentes que requieren primeros auxilios no son reportados en mi compañía.
❑	❑	❑	❑	❑	16. La información necesaria sobre seguridad laboral está disponible a todos los empleados.
❑	❑	❑	❑	❑	17. Los Directivos aquí parecen estar genuinamente interesados en reducir la tasa de daño en el trabajo.
❑	❑	❑	❑	❑	18. Regularmente se lleva a cabo la supervisión en seguridad en mi compañía para checar el uso personal del equipo de protección.
❑	❑	❑	❑	❑	19. Yo sé como desarrollar con seguridad mi trabajo.
❑	❑	❑	❑	❑	20. La mayoría de los empleados en mi compañía no se sentirían cómodos si sus prácticas laborales fueran observadas y registradas por un compañero de trabajo.

(Adaptado de The Safety Culture Survey desarrollado por Safety Performance Solutions, Inc.)
Referencia:Geller, E.S.: (1996). Working Safe. Radnor, Pennsylvania, Chilton Book Company.

Fecha_____

APPENDIX C:

Test of Normality for Audit Distribution



Test of Normality for audit distribution:

N: 107

Mean: 72.0

Std. Dev: 14.04

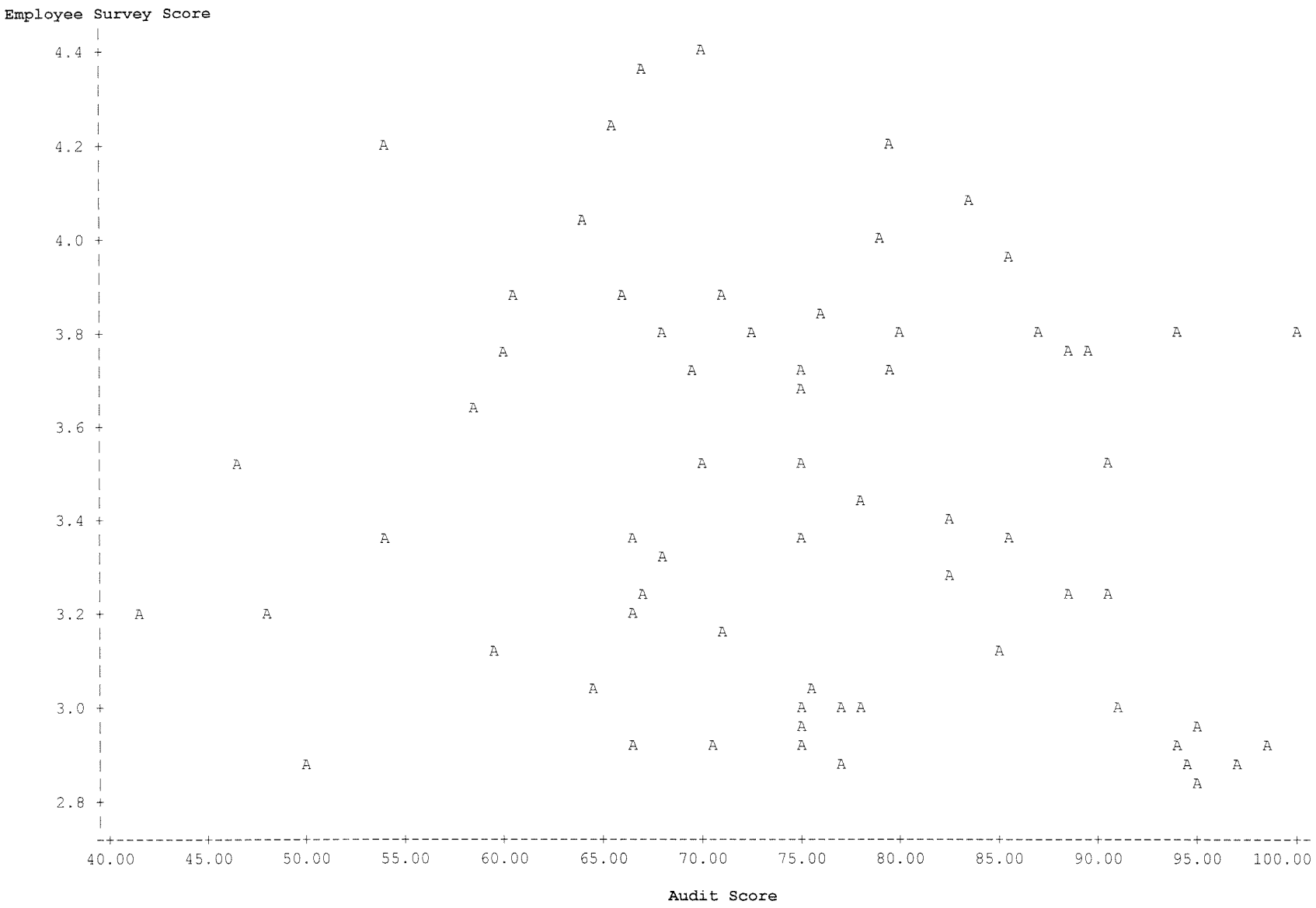
95% Confidence Interval:
Upper: 74.66
Lower: 69.28

Test of Normality: .083
(Kolmogorov-Smirnov)

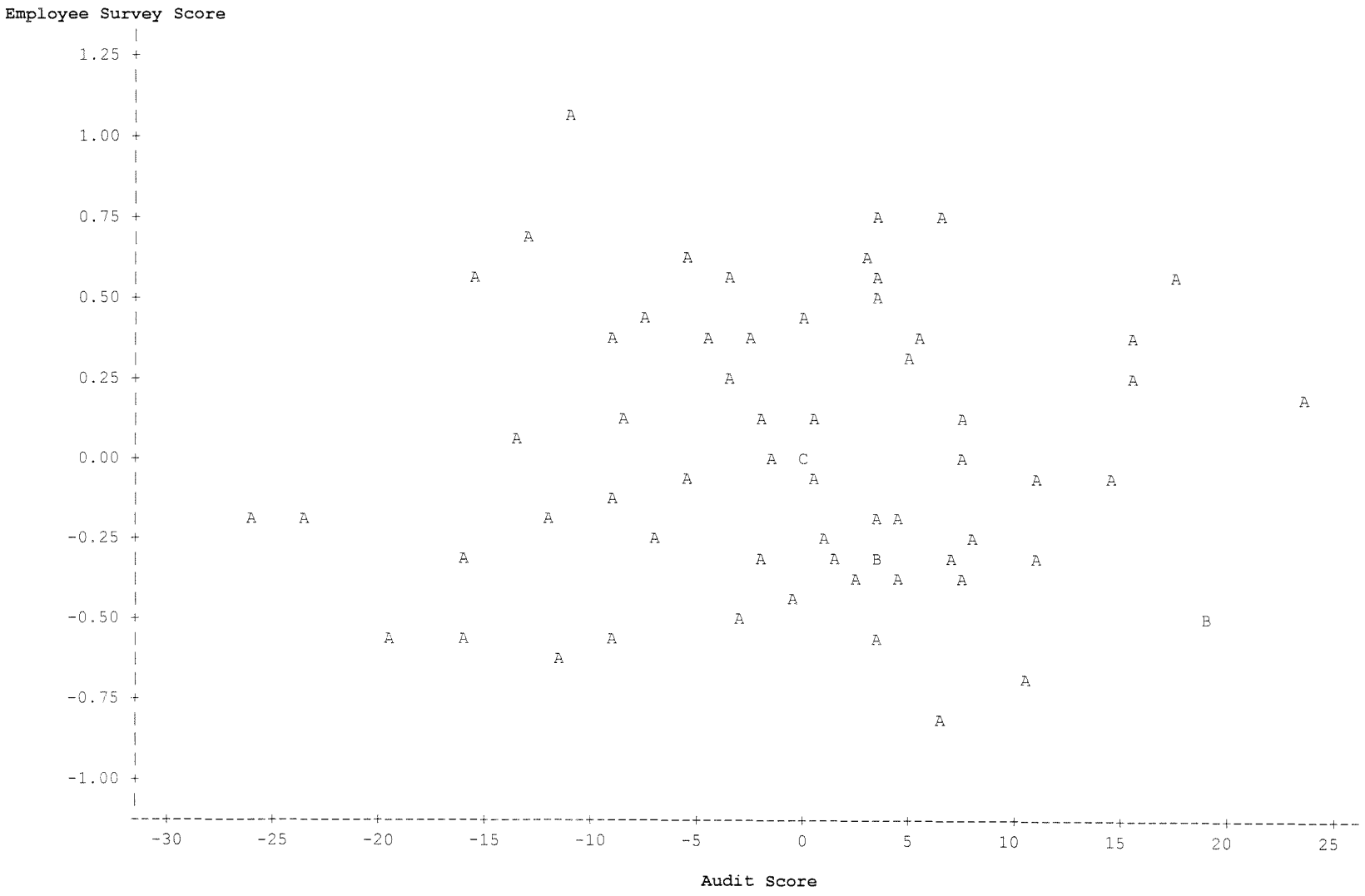
APPENDIX D:

Plots of Surveys and Audit Scores

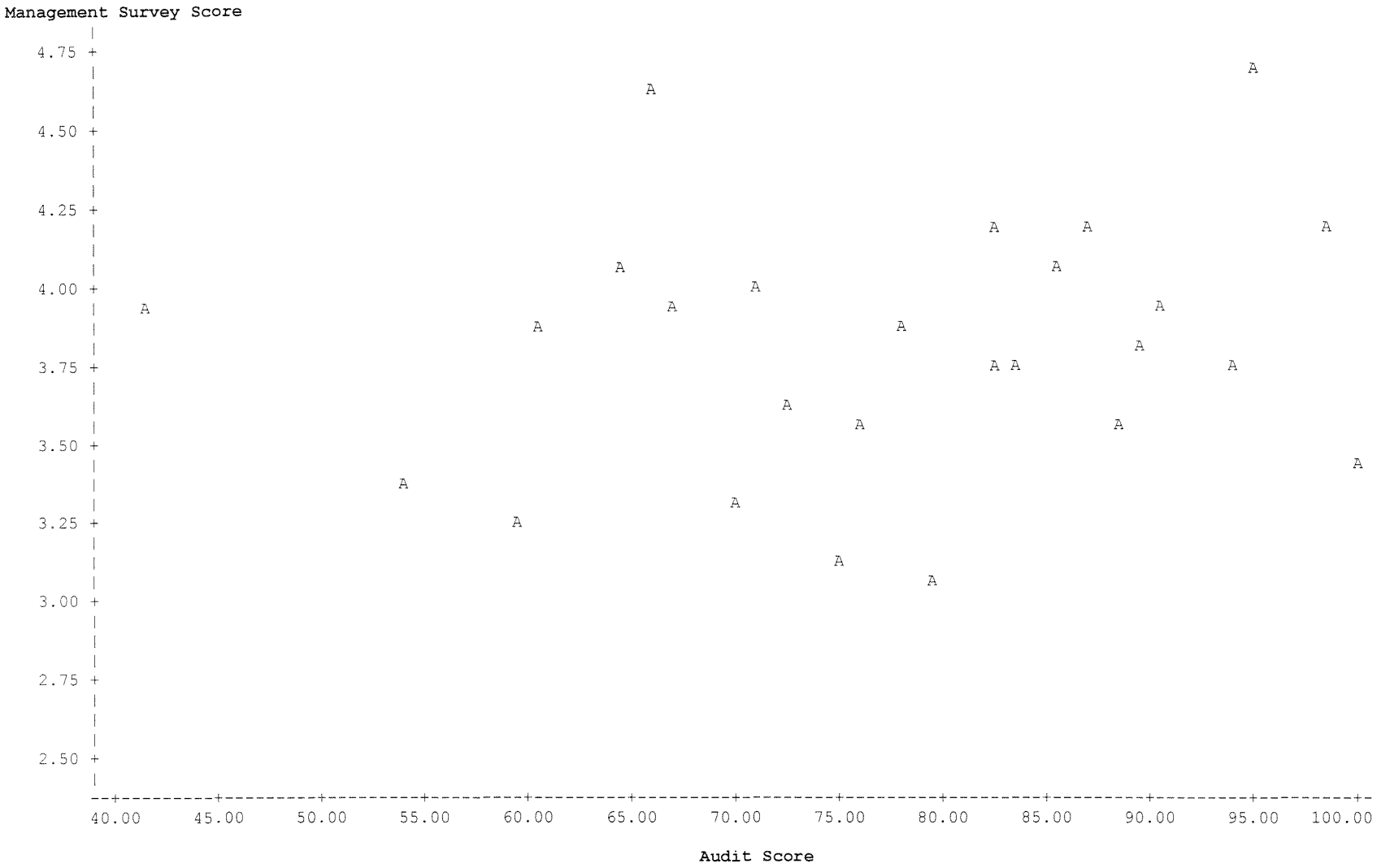
Plot of Employee Survey and Audit Score



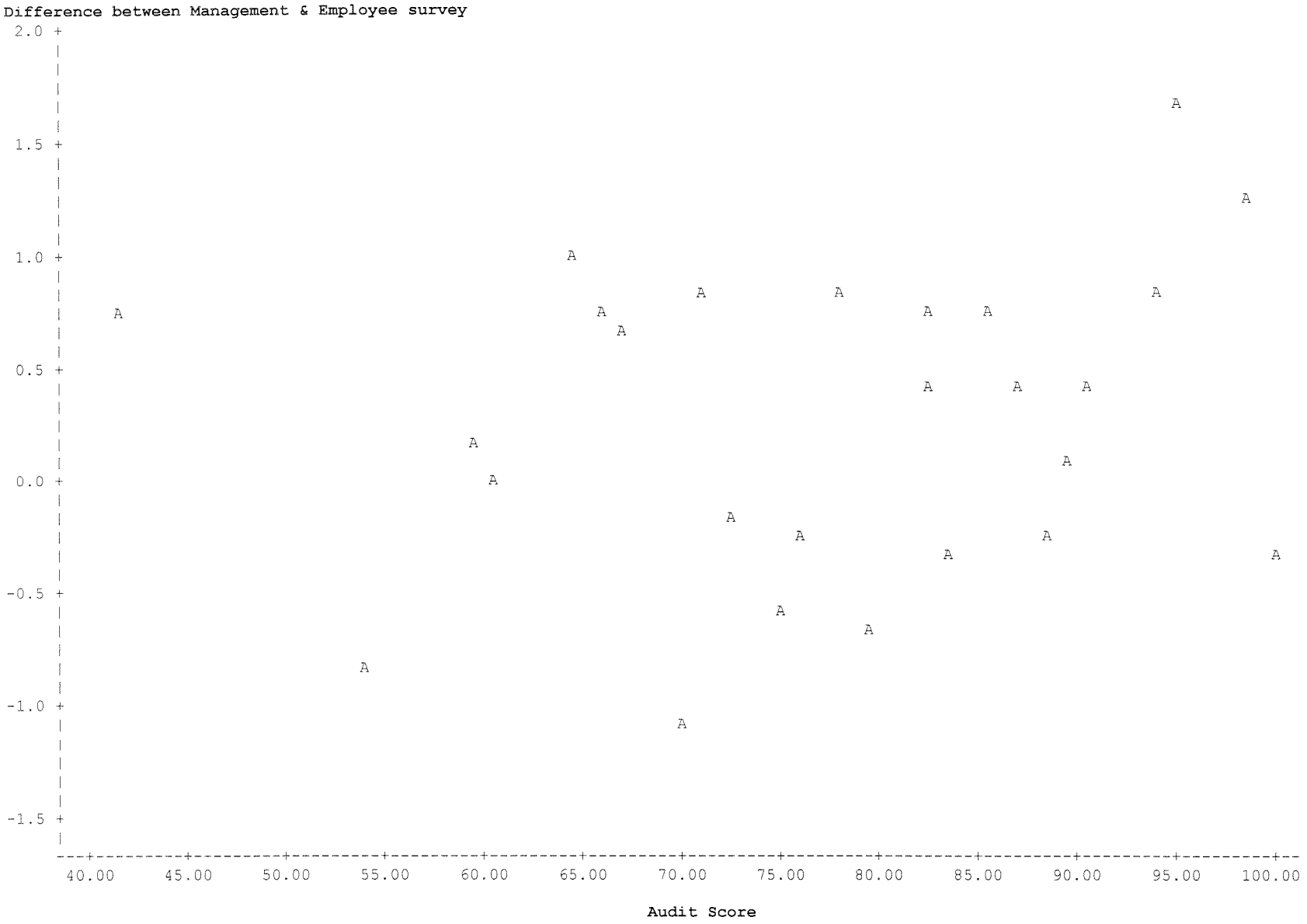
Residual Plot of Employee Survey Score and Audit Score (adjusted by trades)



Plot of Management Survey and Audit Score



Plot of Management and Employee Survey Difference and Audit Score



APPENDIX E:

Examples of Pages Taken From HomeSafe Booklet

Construction employees on the job site must use proper PPE when hazards exist or when there is potential for injury.

Many serious injuries that have happened to construction workers could have been prevented, or at least the severity of the injury would have been reduced, if the victim had been wearing one or more protective devices. (See illustrations.)

The following items must be worn according to company policy:

- Hard hat

Personal Protective Equipment (PPE)

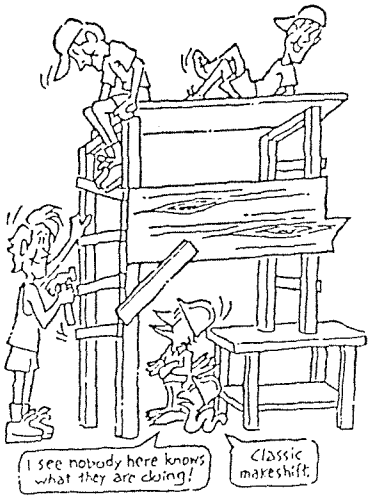
When used, scaffolding must be suitable for the job and adequate for the load.

Types of Scaffolds:

- Job-Built Wood

  This type may be used for erection of trusses and for drywall where conventional scaffold cannot be used.

- No scaffold shall be erected, moved, dismantled, or altered except under the supervision of competent persons.

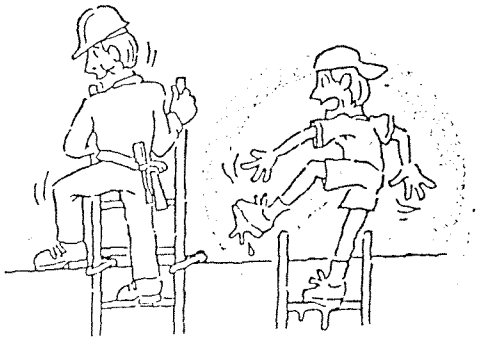


Scaffolding

Ladders must be adequate for the job and properly maintained (i.e. the right ladder for the job).

Guidelines for Use:

- No job built ladders
- Clear scrap and material away from the base and top of the ladder, since getting on and off the ladder is relatively hazardous.
- Always face the ladder when climbing up or down and while working from it.
- Maintain 3-point contact when climbing up or down; that means two hands and one foot or two feet and one hand on the ladder at all times.
- Keep your center of gravity between the side rails. Your belt buckle should never be outside the side rails.



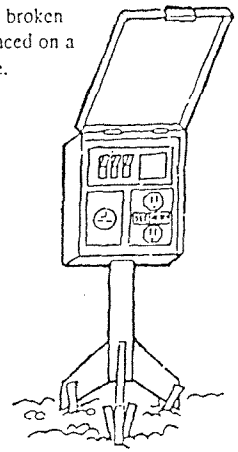
Ladders

All temporary 110-volt construction power must be on a GFCI system.

- Temporary power poles must be securely staked prior to and during use.

Any split of 220-volt power to 110-volt must be protected through GFCI and properly wired.

- Power pole duplex and 220v must be free of all defects.
- All panels must be complete to include cover, dead front and GFCI.
- All defective and broken components replaced on a monthly schedule.



Construction Electrical Power & Power Cords

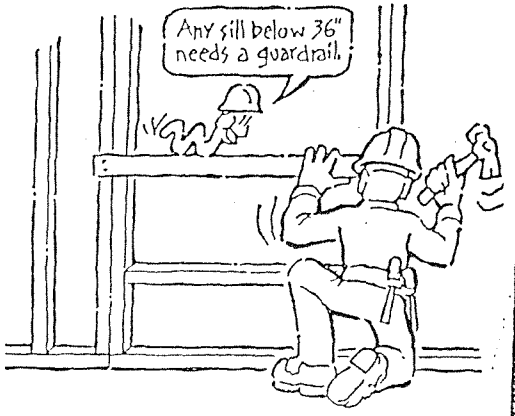
Working areas must be free of excess debris.

- Working areas must have a designated disposal site and a daily cleaning schedule.

Access/Housekeeping

Open-sided floors and holes, such as stairwells, door and window openings, and skylights (that have a fall distance of more than 6 feet) must be protected by use of guardrails or covers as soon as a hazard is created.

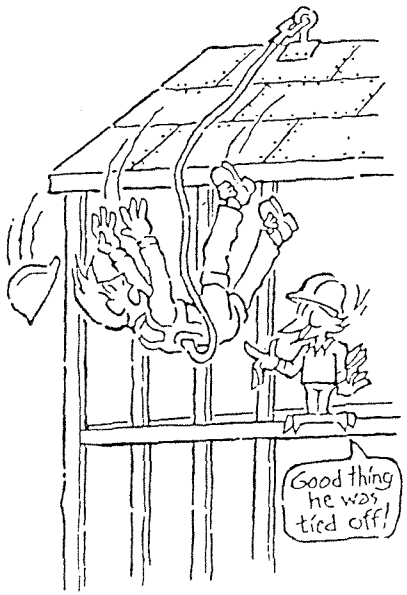
- Windows and doors not used for access will have guardrails.
- Any window with a sill below 36" requires a guardrail at 42".



Open Holes & Unprotected Sides & Edges

All workers exposed to falls of 6' or greater must be protected by the use of conventional fall protection (i.e. guardrails, personal fall arrest systems, or slide guards.)

Refer to manufacturer's specifications for proper installation.

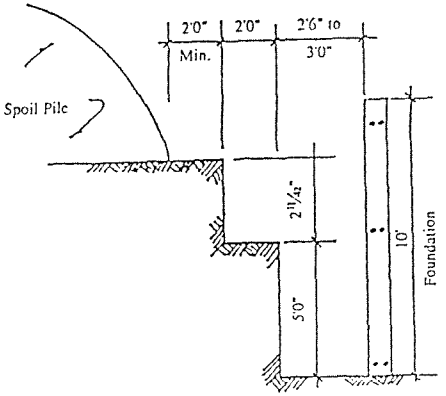


Fall Protection

Excavation:

Foundation excavations shall be sloped and/or benched to the extent possible.

- Limited by property lines and utilities.
- When the house excavation exceeds 7¼ feet in depth, benching or sloping must start at a depth of 5 feet.
- Ramps or ladders must be available to enter or exit the excavation.
- The minimum horizontal width (excavation face to formwork/wall) at the bottom of the excavation is as wide as practicable but not less than two (2) feet.



Excavations/Trenching

Employees using power tools and motorized equipment must be properly trained in the use and operation of that equipment.

- Take the saw to the material. Never place the saw in a fixed, upside-down position and feed material into it. Use a table saw instead.
- If a cut gets off line, don't force the saw back onto the line. Doing so may cause the wood or saw to kick back with tremendous force, causing major injuries to abdomen, legs, and hands. Withdraw the blade and either start over on the same line or begin on a new line.

Power Tools & Motorized Equipment