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# Group Differences in Safety Climate Among Workers in the Nuclear Decommissioning and Demolition Industry in the United States

Michael Everett Findley
*University of Tennessee - Knoxville*

To the Graduate Council:

I am submitting herewith a dissertation written by Michael Everett Findley entitled "Group Differences in Safety Climate Among Workers in the Nuclear Decommissioning and Demolition Industry in the United States." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Human Ecology.

Susan M. Smith, Major Professor

We have read this dissertation and recommend its acceptance:

Paula Carney, Tyler Kress, Robert Kirk, Gregory Petty

Accepted for the Council:
Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Accepted for the council:

Anne Mayhew
Vice Chancellor and
Dean of Graduate Studies

(Original signatures on file with official student records.)

# GROUP DIFFERENCES IN SAFETY CLIMATE AMONG WORKERS IN THE NUCLEAR DECOMMISSIONING AND DEMOLITION INDUSTRY IN THE UNITED STATES

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Michael Everett Findley
August 2004

# DEDICATION

This dissertation is dedicated to the memory of Albert Crumpton Findley, Jr., son of Albert and Katherine, father of Robbie and Jeremy, and my big brother. Born in Castleberry, Alabama on October 14, 1947, Al lived life to the fullest until September 28, 2003. He retired as a chemical operator from Monsanto in Pensacola, Florida, and then took up a career driving tour buses cross-country. He loved to be with people and the room filled-up when he walked in. He drove his own Ford Mustang racecar and was a volunteer fireman for over thirty years. Al is sorely missed but his spirit has joined our grand parents Sonny and Mary Bell, and our Great Uncles John and George on our family farm.

ACKNOWLEDGEMENTS

To say that this study was a culmination of the efforts of many fails to convey the true nature of the many contributions. First, I wish to acknowledge the mentorship provided by my major Professor, Susan M. Smith. Dr. Smith's enthusiasm and constant pursuit of knowledge was an inspiration. The assistance of my committee members, including Paula Carney, Robert Kirk, Tyler Kress, and Gregory Petty, was key to the success of this study. Mike O'Neil with the UT Statistics Department artfully guided me through the SPSS work.

This study would not have been possible without the support of my employer and the willingness of the workers to honestly and frankly express their opinions. It is my sincere hope that the study findings and conclusions will serve as tool to build on the significant progress made to date in protecting workers in the nuclear decommissioning and demolition industry.

Finally, I wish to acknowledge the support of my friends and family. My friends at work, including Paula, Julie, James, Dave, Tom and Jon, patiently listened to my many treatises on the importance of worker safety attitudes and perceptions. My offspring, including Paige, Colleen, Katie, Matt and Mary, forgave my bowing out of many family outings and for the most part cheerfully yielded the family computer upon request. My youngest daughter, Mary, skillfully proofed the document for format and style. And lastly, my gratitude goes out to my better half who encourages me to fulfill my dreams. I love you, Melissa.

Abstract

This study investigated group differences in safety climate among workers in the nuclear decommissioning and demolition (D&D) industry in the United States. The study population representative of workers in a high reliability industry included employees and subcontractors who worked at one of 10 locations in the United States managed by a multi-national corporation performing nuclear D&D operations. Safety climate was measured with a self-reported questionnaire, the Health and Safety Executive's Health and Safety Climate Survey Tool (CST). The voluntary and anonymous responses totaled 1,587 out of an available population of 3,296 for an overall response rate of 48.1 percent. Significant differences ($p<0.001$) were found by location, job position, on-the-job injuries and illnesses, and safety oriented behavior. Differences in self-reported safety climate among locations in high reliability industries were attributed to elements other than safety management systems. Differences in the self-reported safety climate among job positions in high reliability industries adduced evidence of two safety cultures in high reliability industries characterized by a negative relationship between hands-on work and safety climate. Differences in self-reported safety climate by self-reporting of on-the-job injuries or illness attested that worker safety attitudes and perceptions in high reliability industries degrade with the occurrence of on-the-job injuries and illnesses. Differences in self-reported safety climate by self-reported participation in safety oriented behavior bespoke the positive effect that participation in the safety program has on worker safety attitudes and perceptions. Recommended safety improvement strategies included 1) addressing the contributions of elements other than safety management systems such as social, political and human factors to the safety climate across locations; 2) attending to the self reported safety climate of the workers performing hands-on work; 3) implementing immediate and long term follow up with workers experiencing on-the-job injuries or illnesses; and 4) ensuring management support of worker participation in safety oriented behavior. Based on the study findings and conclusions, further research into group differences in safety climate in high reliability industries is recommended to better enable management teams to focus safety process improvements.

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## FORMULATION AND DEFINITION OF THE PROBLEM

### Introduction

Healthy social systems share prominence with robust technical safeguards as essential ingredients in the achievement of safety goals in high reliability industries (Mearns, Whitaker, Flin; 2003). Human factors are the primary causative agent in 60 to 80% of accidents (Flin, 2003). Organizations with complex socio-technical systems pay considerable attention to safety assessments as a tool to monitor significant hazards, even though significant system failures are rarely experienced (Sorenson, 2002). Increasingly these safety assessments rely less on lagging indicators such as injury rates in favor of a greater focus on leading indicators such as the measurement of safety climate (Flin, Mearns, O'Conner, and Bryden; 2000). Examination of the health of social-technical systems through measurement of safety climate holds the promise of predicting weaknesses before system failure (Flin, 1998).

Despite the increasing dependability of technical systems, high reliability industry failures such as the Piper Alpha oil platform in the North Sea (Cullen, 1990), Chernobyl (OECD, 1987), and the Space Shuttle Challenger (Vaugh; 1996) share a common thread of weaknesses in human reliability (Cheyne, Oliver, Tomas, and Cox, 2002). Concern for technical failures has been replaced by human factors as prime causes of system failures in high reliability industries (Weick, Sutcliff, and Obstfeld, 1999) and is evident in the recognition by the nuclear power industry of the importance and need to assess organizational culture (IAEA, 1997). Attention to human reliability and organizational culture must be commensurate with technical concerns within the complex socio-technical systems present in high reliability industries (Reason, 1997).

Fueled by recognition of the importance of human factors to the reliability of complex socio-technical systems, empirical research in the last two decades has resulted in a proliferation of instruments developed to measure safety climate (Flin et al, 2000). Based on an extensive body of organizational culture and climate research, safety culture has come to be recognized as embodied values, beliefs, and underlying assumptions while safety climate is viewed as a descriptive measure of the workforce's safety attitudes and perceptions (Gonzalez-Roma, Peiro, Lloret, and Zornoza; 1999). Notwithstanding the ongoing debates as to supremacy of safety culture versus safety climate (Flin et al, 2000), safety climate has emerged as the preferred measurement tool (Cox and Flin, 1998). Safety climate instruments share a common methodology, self-report questionnaires administered as large scale surveys, but lack a unifying theoretical model (Guldenmund, 2000; Williamson, Feyer, Cairns, and Biancotti, 1997). While safety climate instruments have been designed based on safety research themes and often share common safety dimensions or factors, the instruments are typically customized to the needs of the sponsoring organization and thus, differ significantly in content, style, statistical analysis, sample size, sample composition, industry, and country of origin (Flin et al, 2000).

## Purpose of the Study

The purpose of this study was to investigate group differences in safety climate among workers in the nuclear decommissioning and demolition (D&D) industry in the United States.

## Research Questions

In addressing the purpose of the study the following research questions were developed:

1. Are there significant differences in safety climate among self-reported geographic work locations among workers of a nuclear D&D employer located in the United States who use the same safety management system?
2. Are there significant differences in safety climate among self-reported job positions among workers of a nuclear D&D employer located in the United States?
3. Are there significant differences in safety climate between those who self-reported an on-the-job injury during the previous 12 months and those who reported no injury among workers of a nuclear D&D employer located in the United States?
4. Are there significant differences between self-reported safety climate and safety-oriented behavior, as measured by self-reported participation in a behavior-based safety process, among workers of a nuclear D&D employer located in the United States?

## Need for the Study

The measurement of safety climate has gained prominence as a safety management tool but little consensus exists on its concepts as evidenced by a scarcity of scientifically based research pointing to the presence of an accepted theoretical model (Flin et al, 2000). The concept remains in its developmental stage with most research efforts not progressing beyond face validity to address the more important forms including predictive and construct validity (Guldenmund, 2000). These instruments share the basic assumption that safety culture and safety climate can be described by a finite number of dimensions or factors (Guldenmund, 2000) and reviews of numerous safety climate instruments suggest that a basic set of factors is emerging (Dedobbeleer and Beland, 1998; Guldenmund, 2000; Flin et al, 2000). Definitions of safety culture and safety climate include the premise that workers share a common set of safety values and beliefs (Cheyne, Oliver, Tomas & Cox, 2002). However, differences in safety culture among groups have been identified (Lee, 1998; Mearns, Flin, Gordon, and Fleming, 1998; Geldon and Litherland, 2001; Harvey, Bolam and Gregory, 1999; McDonald, Corrigan, Day, and Cromie, 2000; HSE, 2002; Guldenmund, 2000; Flin, Mearns, O'Connor, and Bryden, 2000). The absence of a cohesive safety cultures raises questions over the effectiveness of interventions without a concomitant understanding of group differences (Pidgeon, 1998). Safety climate measures that fail to recognize the contribution of subcultures do not identify the competing agendas among different groups in an organization (Health & Safety Laboratory, 2002).

The operationalization of safety climate remains a significant challenge (Guldenmund, 2000). Despite an emerging consensus on the factors that comprise safety climate, the existence of subcultures calls for safety climate practitioners to evaluate group differences in safety attitudes and perceptions. Better understanding of these group differences can facilitate the implementation of effective culture change programs (Zohar 2000). Based upon the above information and other factors it is concluded that the specific need for conducting this study is to better understand the role of group differences in safety climate among workers in the nuclear D&D industry

## Assumptions

The basic assumptions made regarding this study were as follows:

1. The Health and Safety Executive (HSE) Health and Safety Climate Survey Tool (CST) was a valid and reliable instrument for measuring safety climate levels among workers in the nuclear decommissioning and demolition industry in the United States.
2. Those workers who were asked to complete the survey instrument were willing.
3. Those workers who completed the survey answered questions honestly and accurately.
4. The fact that the survey instrument was specifically developed through application in the nuclear industry excludes the need for development of a theoretical model for safety climate across multiple industries.

## Delimitation

The research study included the following delimitation:

1. This study was delimited to workers at locations of one employer in the nuclear D&D industry in the United States.

## Limitations

The study was limited in the following ways:

1. The study was limited to self-reported data.
2. There was no control over the number of workers who completed the survey.

## Definition of Terms

The following terms were operationally defined for purposes of this study:

1. High reliability industries: are industries that employ complex defense in depth safety systems due to the potential for extreme hazards to workers, the public and/or the environment. The defense in depth safety systems include an integrated set of engineered barriers and administrative controls arranged to provide multiple and redundant protection from system failures. High reliability industries such as the nuclear and chemical process industries typically have achieved low accident rates when compared to other industry sectors but catastrophic system failures are a real and ongoing threat to safe operations.
2. Nuclear decommissioning and demolition: is a highly controlled and regulated deconstruction process that encompasses the systematic shutdown of obsolete and/or unsafe nuclear facilities and the dismantlement of nuclear equipment and facilities. The process rigorously follows a decommissioning and demolition (D&D) plan designed to ensure protection of workers, the public and the environment. The D&D plan is developed with input from multiple subject matter experts and includes system redundancy to reduce the risk of accidents and

the uncontrolled release of hazardous materials. Nuclear D&D work is extremely hazardous in that severe industrial safety, chemical, and nuclear hazards may be present and the D&D process necessarily requires the removal of systems originally installed to protect from these hazards.

3. Safety climate: is a descriptive measure at one point in time of individual and group safety attitudes and perceptions based on responses to questions related to a set of factors associated with high safety performance. Safety climate refers to surface features of safety culture and the relationship between safety climate and safety culture is analogous to the relationship between temperature readings with a thermometer and the weather.
4. Safety culture: is the embodiment of an organization or group's shared values, beliefs and underlying assumptions that reflects their perceptions of the organizational atmosphere and the status of the safety program. Safety culture provides insight into the way that an organization or group views safety risks and is part of the overall culture of an organization or group.
5. Safety climate factor: refers to a set of safety themes that when combined provide a basis for the measurement of safety culture and climate. Safety climate instrument design typically features a number of questions or items that are grouped into sets of safety climate factors. Individual safety climate factor scores are computed based on an averaging of the item scores that comprise each factor. The overall safety climate score is calculated based on an averaging of the individual safety climate factor scores. Five common safety climate factors

emerging from the research literature include (1) management; (2) risk; (3) safety arrangements; (4) work pressure; and (5) competence and procedures.

6. Workers: refers to those persons employed by the parent company or subcontractors working for the parent company at the 10 locations For purposes of this study workers included the following job positions: senior manager, manager, supervisor, foremen, workfoce/craft, technical support, and administrative.

## Summary

This chapter has presented an introduction to the research problem, which was to investigate the group differences in safety climate among workers in the nuclear D&D industry in the United States. For purposes of the study it was assumed the selected safety climate tool was valid and reliable, workers would be willing to complete the survey, the study participants would answer questions honestly and accurately, and the fact that the instrument was developed specifically through application in the nuclear industry excluded the need for a theoretical model for safety climate across industries. The study was delimited to one nuclear D&D employer in the United States. Study limitations included self-reported data and the fact that there was no control over whether a worker completed the survey. Operational definitions were developed for high reliability industries, nuclear decommissioning and demolition, safety climate, safety culture, safety climate factors, and workers. The organization of the study includes this introduction and chapters that address the review of the literature, methodology, analysis, findings, and the study in retrospect.

# CHAPTER II

# REVIEW OF RELATED LITERATURE

## Introduction

The purpose of this study was to investigate the group differences in safety climate among workers in the nuclear decommissioning and demolition (D&D) industry in the United States. The purpose for this chapter was to present a comprehensive review of literature and research related to the problem to be researched. This chapter will address the literature and research in three categories. They are as follows:

1. Literature and research related in content.
2. Literature and research related in content and methodology.
3. Literature and research related in methodology.

## Literature and Research Related in Content

### *Organizational Culture and Climate*

Interest in the role of organizational culture in program effectiveness arose with the work of Elton Mayo and W. Lloyd Warner who reported on the social, technical, and ideological relations of the workers in the Hawthorne plant in the late 1920's and 1930's (Roethlisberger & Dickson, 1946). In the late 1940's and 1950's a number of researchers theorized that values and attitudes influence organizational performance (Selznick, 1949; Gouldner, 1954; Blau, 1955; & Dalton, 1959). The 1980's saw the concept of culture gain an increased role in studies of organizational performance (Peters & Waterman, 1982; Ouchi, 1981; Shein, 1984).

The link between an organization's culture and performance resides at the heart of the debate over the existence of organizational culture. Deal and Kennedy (1983) found that the organizational structure alone does not explain performance and suggested culture as an important influence. Peters and Waterman's (1982) review of a series of leading companies identified numerous similarities among organizations and industries that were necessary for superior organizational performance. However, ten years later, Denison (1990) observed that many of the companies examined by Peters and Waterman (1982) were no longer industry leaders and thus, argued that no evidence supports the link between organizational culture and performance.

Multiple levels of organizational culture are most commonly proposed (Van Mannen & Barley, 1985; Schien, 1990). Schein's (1990) model of organizational culture includes three levels: 1) artifacts, 2) espoused values, and 3) basic underlying assumptions. Artifacts are environmental and physical characteristics that are the more superficial manifestations of culture. Espoused values are the leaders' articulation of the beliefs and values of the organization that may or may not be accurately portrayed. Basic underlying assumptions are the unconscious bias of organization that validates organizational practices. Van Mannen and Barley (1985) identified four levels or domains for organizational culture. The first domain, the ecological context, includes physical space as well as the larger social context of the organization. The second domain consists of the differential interactions that form the network of exchanges that link members. The third domain is made up of the collective understandings of the organizational members and may be compared to Schien's underlying assumptions. The fourth domain addresses the reproductive and adaptive capacity that is necessary to sustain an organization's culture.

Interest in organizational climate began in the 1930's (Lewin, Lippitt, & White, 1939). Climate has been defined in terms of formal policies and worker needs, values, and personalities (Argyris, 1958). More recently Reichers and Schneider (1990) described climate as the shared perceptions regarding both formal and informal organizational policies, practices, and procedures.

The relationships between climate and culture have been a common area of discussion among organizational researchers (Schneider, 1990; Schein, 1990; Denison, 1990). Cox and Cox (1996) compared culture to personality and climate to transient mood states. Climate and culture researchers both examine connections between beliefs and assumptions and the organization's behaviors and practices. The interdependent and reciprocal relationships between systems and individuals present difficulty to both concepts. Both concepts struggle with the objective definition of the psychological characteristics of an organization.

### *Safety Culture and Safety Climate*

The study of the link between organizational performance and culture was extended to the field of safety management in the 1980's (Zohar, 1980) amid the growing realization that human factors rather than technical failures are the root causes of accidents in high reliability industries (Weick, Sutcliffe, and Obstfeld, 1999). Major events such as the Chernobyl accident propelled interest in safety culture and climate to the forefront (IAEA, 1986). High reliability industries such as the nuclear power industries now recommend that facilities routinely assess safety culture and climate (ACSNI, 1993; IAEA, 1991, 1997).

The longstanding debate between proponents of organizational culture and climate has become common among safety researchers (Flin, Mearns, O'Connor and Bryden, 2000). Advocates of both safety culture and safety climate rely on the extensive body of organizational research where culture is seen as the embodied values, beliefs, and underlying assumptions and safety climate is a descriptive measure of individual and group perceptions and attitudes (Gozalez-Roma, Peiro, Lloret, and Zornoza, 1999). Cox and Flin (1998) concluded that when the operationalization of the construct into a practical tool was the foremost concern, safety climate was preferred over safety culture. Out of the discourse between safety culture and climate proponents safety climate has emerged as a measure of the surface features of safety culture based on worker attitudes and perceptions at one point in time (Schnieder and Gunnarson, 1991; Cox and Flin, 1998; HSE, 1999). Safety climate has been compared to a snapshot that serves as an indicator of the underlying safety culture (Flin, Mearns, O'Connor and Bryden, 2000).

### *Safety Climate*

The study of safety climate arose from the work of organizational researchers and was influenced by findings that companies with low accident rates possessed common organizational features (Cohen, Smith, & Cohen, 1975; Shafai-Sharai, 1971). Beginning in the 1980's, safety climate has come to the forefront as a proposed indicator of safety program effectiveness. Interest in organizational factors linked to successful safety programs (Shafai-Sharai, 1971; Cohen, Smith & Cohen, 1975; Cohen, 1977; Cleveland, Cohen, Smith & Cohen, 1978) led Zohar (1980) to assert that workers share common perceptions regarding safety and that the sum of these perceptions is the organization's safety climate. Zohar proposed that safety climate varied among organizations and this variance relates to safety performance. Building on the work of Zohar (1980) other researchers identified dimensions or factors believed to provide a measure of safety climate and correlate with safety performance (Brown and Holmes, 1986; Dedobbeleer and Beland, 1991; Seppala, 1992; Donald, Cantaer and Chalk, 1991; Cox and Cox, 1991; Niskanen, 1994; Williamson, Feyer, Carns & Biancotti, 1997; Carroll, 1998; Harvey, Bolam, Gregory & Erdos, 2001). Despite a lack of consensus by these researchers on safety climate factors, general agreement exists on the concept of safety climate and its relationship to safety performance (Lee, 1998; Sorenson, 2002).

Zohar (1980) first applied organizational theory to the measurement of safety climate. Utilizing the literature on organizational characteristics of low accident plants, Zohar identified the following seven organizational factors found to be related to safety performance.

1. Importance of safety training
2. Management attitude towards safety
3. Level of risk at workplace
4. Effects of workplace on safety
5. Status of the safety officer
6. Effects of safe conduct on social status
7. Status of safety committees

Building on Zohar's work (1980), Brown and Holmes (1986) proposed three factors including 1) perceived risk, 2) perceived level of management concern, and 3) perceived level of management action. Lower safety climate scores were reported for workers who had experienced an on the job injury compared to those workers who had no injuries. Replicating the work of Brown and Holmes (1986), Dedobbeleer and Beland (1991) recommended a two factor model of safety climate that included 1) management commitment to safety, and 2) worker involvement in safety. They identified a relationship between safety climate and safety performance. Hofmann and Stetzer (1996) employed the Dedobbeleer and Beland (1991) safety climate measure to examine safety climate at the group level and identified a relationship between safety climate and safety performance. Lee (1998) developed a safety climate questionnaire based on the reported safety beliefs and attitudes of workers gathered through focus groups and confirmed a positive relationship between safety climate and safety performance.

Amid the widespread proliferation of safety instruments, a set of core features has emerged (Flin, Mearns, O'Connor, and Bryden, 2000; Guldenmund, 2000). In a review of 18 safety climate instruments, Flin, Mearns, O'Connor, and Bryden (2000) concluded that three factors are core features of safety climate. They found that these safety climate instruments shared a common design approach. Each of the safety climate instruments measured factors or themes derived from a review of the safety literature that were often customized based on interviews and focus groups. Three factors were found to appear in two thirds of the reviewed safety climate instruments and included management, safety systems, and risk. Two factors, competence and work pressure, were prevalent in one third of the reviewed instruments. In a review of 15 safety climate studies, Guldenmund

(2000) identified the most frequently employed factors to include management, risk, safety arrangements, procedures, training, and work pressure.

Despite a significant amount of safety climate research, the proliferation of safety climate instruments and the emergence of a set of core factors, an accepted model of the relationship of safety climate with safety performance is lacking (Guldenmund, 2000; Sorenson, 2002). In a review of the literature and research on safety culture and safety climate, Guldenmund (2000) concluded that the constructs had not progressed beyond the developmental stages that rely on the assumption that safety climate be measured through a limited number of factors. These factors are revealed through organization-wide questionnaires that include individual items linked to the selected themes. Guldenmund (2000) argued that most safety climate efforts have not progressed beyond face validity and thus, the evidence for safety climate as an alternative safety performance indicator is wanting.

Sorenson (2002) in his review of the safety culture and climate reported that the body of literature, albeit voluminous, was fragmented. Sorenson (2002) pointed to the lack of agreement on the concept of safety culture and climate. Too often studies were found to focus on a small set of management and organizational attributes and the differences in attributes chosen between one study and another makes comparisons difficult. Sorenson (2002) observed that while it is possible to correlate management and organizational factors with safety performance in certain industries that have sufficiently high numbers of unwanted events, the low accident rates characteristic of high reliability industries such as the nuclear industry present no basis for comparison of organizations.

*System Failures in High Reliability Industries*

Human factors are an important element in system failures among high reliability industries (Reason, 1998). In the 1930's Henrich's domino theory was based on the premise that a social environment conducive to accidents was the first domino to fall (Ostram, Wilhelmsen & Kaplan, 1993). Major safety disasters among high reliability industries such as the escape of deadly gas at Bhopal in India share similar root causes. Despite comprehensive engineering and technical safeguards, failure occurred due to human error. The incident investigations concluded that the causes were "malpractices that corrupted the large parts of the socio-technical system." (Lee, 1998, p. 217). In Clarke's study (1996) of hazard reporting by train operators, responses to serious but routine hazards had been trivialized and thus, were a key factor in a number of train accidents. Regulatory or technical solutions fail to address the rapidly changing socio-technical systems where precedents become redundant and regulations do not affect the way work is done. (Lee, 1998).

Root causes of serious accidents in high reliability industries are present long before an obvious accident sequence can be identified (Reason, 1997). The interaction of latent conditions with local triggering events results in organizational accidents. Disaster preconditions are a by-product of the normal operation of managerial and socio-technical systems (Turner, 1994). Pidgeon (1998) warned that basing risk management strategies on anticipation of all possible hazards presents serious problems when unanticipated hazards occur. These strategies contribute to organizational pre-conditions to major system failures. Reason (1998) points to unsafe culture where the role of unsatisfactory resolution of production over safety is a major contributor to organizational accidents rather than individual accidents. Pidgeon (1998) identified organizational preconditions to major system failures and suggested that safety climate acts as a precondition for both safe operations and system failures among high reliability industries.

Worker attitudes and perceptions are recognized as a key factor in organizational performance of high reliability industries. Thompson (1996) found that customer satisfaction, absenteeism, labor grievances, profit, and safety were strongly related to organizational performance. Clarke's (1996) study of train engineers found a correlation between the behavioral response of the engineers and risk perception, and that shared perceptions among managers and staff was a key feature of a healthy safety culture. McLain (1995) proposed that worker perceptions of risk impact a number of culture and climate factors including job satisfaction, satisfaction with work conditions, work stress, and distraction from task performance. In Zohar's study (1980) of 20 industrial organizations, worker's perceptions of the relative importance of safety shaped their behavior. According to Geller (1994) sustained improvement in safety performance depends on the incorporation of safety into the organization's beliefs and attitudes.

### *Group Differences in Safety Climate*

A number of studies have identified group differences in safety climate (HSE, 2002) that suggests groups do not share an overall view of safety (Collinson, 1999). In a review of safety culture and climate research since 1998, the Health and Safety Laboratory (2002) found that despite the prevailing definitions of safety culture and climate that propose a cohesive set of safety values and beliefs, many of the recent studies point to the existence of subcultures that often do not share common safety attitudes and perceptions. These dissimilarities in safety attitudes and perceptions among different groups within an organization were attributed to divergent management styles and levels of concern for safety issues. While the differences were not viewed as necessarily undesirable, it was argued that neglect of these differences could result in failure to identify competing agendas and disparate risk perceptions.

Harvey, Bolam, and Gregory (1999) demonstrated evidence of group differences in safety climate among high reliability industries in their study of safety climate within the nuclear industry. They found two distinct safety subcultures including a management subculture comprised of management, professional, and technical staff and an industrial worker subculture. Differences between managers and workers were presupposed to cause multiple safety issues related to communications and risk taking behavior.

McDonald, Corrigan, Daly and Cromie (2000) identified two safety subcultures across four separate aircraft maintenance organizations that differentiated between management and technicians. They entitled one a 'professional subculture' comprised of technicians who maintained that they were responsible for the safety of the aircraft and fulfilled this responsibility by exercising professional skill and knowledge. On the other hand management believed that technicians were to perform their work by closely following the written procedures. McDonald et al (2000) suggested this difference in job perception represented a weakness in the organizations' safety program.

Cheyne, Oliver, Tomas, and Cox (2002) reported evidence of an industry wide safety culture in their study of the safety climate within a two manufacturing organizations. Differences between the two organizations were attributed to dissimilar organizational and environmental influences. Cheyne et al (2002) postulated that the similarities between the two organizations were indicative of a shared cultural structure within an industry while the differences reflected an organization specific safety climate.

Flin's review (2003) of research into managerial behavior and leadership styles in relation to safety cited evidence of differing safety climates among supervisors, site managers, and senior managers. Flin recommended that organizations regularly monitor how effectively management commitment to safety is transmitted through the management chain by using safety climate surveys.

Glendon and Litherland (2001) reported differences in safety climate between construction and maintenance job categories within the road construction industry. Construction crews' higher score on 'relationships' was attributed to their greater contact with supervisors. Glendon and Litherland believed that more contact with supervisors beneficially contributed to healthier safety perceptions. Higher safety climate scores for maintenance crews on 'safety rules' were ascribed to maintenance personnel's more favorable opinion of safety rules as they have fewer to follow.

Prussia, Brown and Willis (2003) examined a model for predicting safe work behaviors and its relationship to shared safety attitudes and perceptions between managers and workers. They reported differences in safety perceptions linked to overall safety climate scores. Group variation in perceptions of safety responsibility widened as safety climate scores degraded. Prussia, Brown and Willis (2003) suggested that improvements in safety climate scores required closer agreement between managers and workers over safety responsibility.

Zohar's (2000) test of a group-level model of safety climate identified within-group homogeneity and between-group variation. Different perceptions of written procedures versus supervisory practices were reported among groups. Zohar (2000) reported that workers within distinct groups share perceptions concerning supervisory safety practices and that the resultant dissimilar safety climate scores among groups predicted safety performance. Zohar concluded that the results of his study (2000) provided three validation criteria for safety climate as a group level construct. First, within group homogeneity was supported by worker development of similar perceptions regarding supervisors. Second, between groups variance was evident through variations in perceptions between groups. Third, the demonstrated link between group level safety climate and injury rates supported a relationship between group level safety climate and performance.

Differences in group safety attitudes and perceptions can lead to misunderstandings and conflict (Health and Safety Laboratory, 2002). Misunderstandings and conflict between the day and night shifts of the Piper Alpha offshore platform in the North Sea is believed to have contributed greatly to its catastrophic failure (Mearns, Flin, Gordon, and Fleming, 2001). Differences in wages and benefits between contract workers who comprise the bulk of the crews working on off shore oil and gas installations and company workers were cited by Collinson (1999) as contributing to the contract workers being distance from the organization's safety culture and resulting in greater frequency of accidents among contract workers.

Group differences in safety climate suggests an absence of a cohesive safety culture (Health and Safety Laboratory, 2002) and brings into question the effectiveness of safety culture intervention programs that do not take into account these group differences

(Pidgeon, 1998). Safety climate studies that omit the contribution of different groups fail to identify competing agendas (Health and Safety Laboratory, 2002).

### *Summary*

The extensive body of organizational culture and climate research that supports the correlation of organizational culture and climate with organizational performance provides a theoretical basis for the link between safety culture and climate and safety performance. Although safety culture and climate research dates back little more than 20 years, safety researchers have benefited from the work by organizational researchers. Safety researchers have taken up the longstanding debate between proponents of organizational culture versus climate. Based on the practicality of the measurement tool safety climate has emerged as the preferred approach. A core set of safety climate factors has emerged over the last 20 years of safety climate research. Despite the significant amount of safety climate research resulting in the development of many safety climate tools an accepted model of the relationship between safety climate and safety performance is lacking. However, evidence supports the important role of human factors in the safety performance of high reliability industries. The importance of group differences in safety climate has come to the forefront of research and has implications for the effective implementation of safety climate interventions.

Based on this review of literature and research related in content, the following is observed regarding the proposed study. A theoretical basis for safety climate research is provided by the extensive organizational culture and climate research. While no accepted model for the relationship between safety climate and safety performance has been agreed upon, evidence of the role of human factors in accident causation among high reliability industries favors the evaluation of safety attitudes and perceptions through safety climate surveys. Recent safety climate research has brought to light the existence of group differences and the impact these differences may have on the effectiveness of safety program interventions. Finally, this review of literature and research related in content to the proposed study underscores the value of the investigation of group differences in safety climate among workers in high reliability industries.

## Literature and Research Related in Methodology

### *Measurement of Organizational Culture and Climate*

Organizational researchers apply dissimilar methodology to investigate organizational culture and climate based on the differences in the two constructs (Schein, 1984; Denison, 1990). Culture research employs largely qualitative methods due to the unconscious and highly subjective content of culture (Schein, 1984). Schein argues that the study of organizational culture requires the skilled probing and interviewing skills of clinicians. In Schein's view, standardized instruments fail to accurately measure culture because an organization's culture is unique to itself.

Climate research utilizes more quantitative methods to measure artifacts, or surface level characteristics of an organization (Denison, 1990; Reichers & Schnieder, 1990; Schein, 1990). Individual perceptions of organizational practices and interactions that represent underlying values are measured with surveys. Denison (1990) likened the measurement of climate to the use of a thermometer that provides information on the current state of the weather while culture research is similar to the use of barometer that permits patterns of change.

Climate measurements can be made at the individual level, the work group level, or the organizational level (Dansereau & Alutto, 1990) but some climate researchers maintain that the work group is the lowest level of division as climate requires the aggregation of the perceptions of multiple individuals (Drexler, 1977; Glick, 1985). Rousseau (1985) asserted that the critical aggregation issue in combining individual perceptions into work group or organizational climate levels was to provide the respondents the right frame of reference. Culture researchers support analysis at the organizational level (Peters & Waterman, 1982; Ouchi, 1981) and at multiple levels (Martin, 1991).

Based on a review of organizational culture research methodologies, Martin (1991) identified two perspectives. The etic perspective looks at differences between cultures. The emic perspective examines only the universal elements common to all cultures. As with climate research, the etic perspective lends itself better to quantitative measurement than does the emic perspective.

Dansereau and Alutto (1990) identified two approaches to studying climate. The dominant climate theory, the wholes perspective, addresses the differences among and the commonness within groups. Standardized instruments have been developed to quantify differences among the units of analysis at a given level. The less common theory, the parts perspective, holds that each unit of analysis demonstrates the similar differences within the unit as with the other units. In the parts perspective, inability to conduct comparative analysis among groups diminishes the strength of comparisons among different organizations.

*Developmental Stages in the Measurement of Safety Climate*

Zohar (1980) developed the first safety climate questionnaire based on a review of safety literature on the characteristics of low accident plants and validated the instrument through application in a stratified sample of 20 industrial organizations in Israel. Organizational characteristics that differentiated between high versus low accident-rate companies formed the basis of Zohar's (1980) safety climate tool. Most safety climate researchers that have followed employed Zohar's (1980) use of a literature review as the theoretical basis for identification of safety climate dimensions (Brown and Holmes, 1986; Dedobbeleer and Beland, 1991; Hoffman and Stetzer, 1996) although focus groups have also been used to customize the individual items to the study population (Lee, 1998).

Zohar's (1980) initial questionnaire included seven climate factors represented by seven short statements with a 5-point Likert scale to signify level of agreement. The questionnaire's 49 items were phrased positively so that full agreement resulted in a higher numerical score. A pilot administration of the initial survey was conducted at 4 plants by a team of three interviewers who read the items aloud to workers and recorded their level of agreement on the 5-point scale. Factor analysis of the safety climate factors was performed using a principal-components factor analysis with varimax rotation. Zohar confirmed the validity of questionnaire by demonstrating that the resultant 8 safety climate factors largely overlapped the original 7. Zohar's deletion of nine items not found to be related to the eight safety climate factors resulted in a 40-item safety climate questionnaire phrased positively with a 5-point Likert-style agreement scale.

Brown and Holmes (1986) tested the validity of Zohar's (1980) safety climate questionnaire through the measurement of the safety climate of 425 American production workers. Based on confirmatory factor analysis, the resultant unsatisfactory performance of the questionnaire was attributed to the development of the Zohar questionnaire for a different population. Cautioning against the blind acceptance of a measurement model without indication of the instruments reliability and validity for the study population, Brown and Holmes (1986) used an exploratory factor analytic approach to modify the Zohar (1980) questionnaire. The three factors retained included worker perceptions of 1) how concerned management was about worker well being, 2) how active management was in responding to a concern, and 3) how they perceived physical risk. The reliability and validity of the Brown and Holmes modified three-factor safety climate questionnaire was confirmed by factorial invariance tests that yielded a maximum likelihood indicating the climate structures did not differ between workers who had experienced an accident and those who had not.

Dedobbeleer and Beland (1991) tested the Brown and Holmes (1986) modified questionnaire on construction workers. Using linear structural relations procedures that included the maximum likelihood used by Brown and Holmes (1986) and weighted least squares, a good fit of the model was reported. However, Dedobbeleer and Beland's use of the weighted least square procedure led to revision of the instrument from three to two factors that included 1) management commitment to safety and 2) worker involvement in safety.

Hoffman and Stetzers' (1996) applied the Dedobbeleer and Beland (1991) questionnaire to measure the safety climate of 222 workers of a chemical processing plant in the Midwest. Using a cross-level research strategy, three group-level factors including 1) group processes, 2) safety climate, and 3) intentions to approach other members engaged in unsafe acts, and one individual-level factor, perceptions of role overload, were found to influence the frequency of reported unsafe behaviors. Hoffman and Stetzer concluded that development of safety climate instruments must focus on organization diagnosis and not individual safety attitudes and perceptions.

*Current State of the Safety Climate Research*

Safety climate has gained prominence as an alternative safety performance indicator in high reliability industries where safety effectiveness can not be accurately measured by traditional safety indicators (Guldenmund, 2000) and is most often investigated through site wide administration of questionnaires aimed at identifying worker perceptions and attitudes toward selected safety dimensions or features (Flin, Mearns, O'Connor and Bryden, 2000). A plethora of instruments have been developed in response to the growing interest in the measurement of safety climate (Flin, Mearns, O'Connor and Bryden, 2000). In Flin et al's (2000) review of 18 safety climate instruments, the questionnaires differed in content, style, statistical analysis, sample size, sample composition, industry, and country of origin. High reliability industries led the field of industry types who incorporated safety climate surveys as part of their safety management systems as evidenced by 9 of the 18 the reviewed studies coming from the energy/petrochemical sector. The number of items found in the 18 instruments ranged from 11 to 300. Flin et al (2000) identified 100 safety factors and then reclassified these into 35 themes. Their analysis revealed that the five most common relabeled themes in order of greatest to least frequency were (1) management; (2) safety systems; (3) risk; (4) competence; and (5) work pressure. Instrument validation was reported in 10 of the 18 safety climate questionnaires reviewed by Flin et al (2000). The validation method most often used in the 10 studies was a comparison of safety climate scores with retrospective accident data. The analysis and interpretations of the results of safety climate surveys has largely focused on the factors associated with safety performance (Flin, Mearns, O'Connor and Bryden, 2000). A more detailed discussion of safety climate research following this review by Flin et al (2000) follows.

Cheyne, Oliver, Tomas, and Cox (2002) conducted a safety climate survey at eight United Kingdom manufacturing sites operated by one multinational company. The questionnaire originally developed by Cheyne, Tomas, Cox and Oliver (1998) included 30 statements grouped into five safety factors using a five-point Liker-type scale. The five safety climate factors included: (1) safety management; (2) communication; (3) individual responsibility; (4) safety standards and goals; and (5) personal involvement. A total of 708 questionnaires were completed that resulted in a 66 percent response rate. Instrument reliability was examined through computation of Cronbach alphas for the five safety climate factors. All but one factor, individual responsibility, had Cronbach alphas greater than 0.60 and were judged reliable. The researchers utilized multivariate analysis of variance (MANOVA) and one-way analysis of variance (ANOVA) to investigate mean differences in safety climate factors and the overall safety climate score. Statistically significant differences ($p < 0.001$) were reported for each of the five safety climate factors across sites and post-hoc comparisons with Scheffe tests identified significant differences ($p < 0.01$) between one site and the other four for all five factors. Cheyne et al (2002) concluded that evidence existed for a sector wide safety culture and differences in safety climate among sites was attributed to organizational and environmental influences.

Gillen, Baltz, Gassel, Kirsch and Vaccaro (2002) examined the safety perceptions of 255 construction workers in the western United States who had sustained non-fatal falls. The wording of the safety climate instrument developed by Dedobbler and Beland (1991) was modified slightly based on the results of a pilot survey by telephone. Instrument reliability was confirmed by a Cronbach's alpha of 0.78. Chi-square tests were employed to compare responses between union and non-union workers and ANOVA was used to analyze multilevel groupings. The safety climate of injured union and non-union workers differed significantly ($p < 0.05$) with union workers viewing the safety climate more favorably.

Glendon and Litherland's (2001) studied the safety climate of 192 road construction and maintenance workers from two locals in Australia. An adapted version of a 40-item safety climate instrument developed by Glendon, Stanton and Harrison (1994) was utilized. The instrument's 6 safety climate factors included: (1) communication and support; (2) adequacy of procedures; (3) work pressure; (4) personal protective equipment; (5) relationships: and (6) safety rules. Instrument reliability was established through calculation of a Cronbach's alphas for the instrument (0.96) and the six safety dimensions (0.72 – 0.93). Significant differences ($p < 0.05$) in safety climate between construction and maintenance job categories were identified through MANOVA.

Mearns, Whitaker and Flin (2001) conducted a longitudinal study of the safety climate of nine offshore oil installations in the United Kingdom with a safety climate instrument previously developed and validated by Mearns et al, (1998) to address the specific characteristics of offshore work environments. The instrument included 24 items grouped into six safety climate factors that included: (1) satisfaction with safety activities; (2) perceived supervisor competence; (3) perceived management commitment to safety; (4) willingness to report incidents; (5) unsafe behavior/general; and (6) unsafe behavior/incentives. Completed questionnaires totaled 521 and 624 in year one and year two, respectively. Cronbach's alphas for all six factors exceeded 0.60. Greater mean safety climate score variations ($p < 0.05$) were noted among installations in year one than year two. Mann-Whitney tests identified improvement in safety climate scores from year one to year two. Discriminant function analysis was applied and management commitment to safety and willingness to report accidents were found to predict personnel accident involvement. A relationship between changes in management commitment and changes in safety behavior was found.

Mearns, Whitaker and Flin (2003) reported the results of longitudinal safety climate study, similar to their previous research (2001), in which 682 and 806 completed questionnaires were received from nine offshore oil installations. Differences in safety climate by group were analyzed by ANOVA. Supervisors were found to have significantly more favorable ($p < 0.001$) safety climate on eight of 11 safety climate factors examined in year one and all ten factors investigated in year two. No significant differences ($p < 0.01$) in groups characterized by years of service were reported in year one for all factors except involvement in health and safety. Analysis of this difference with Tukey's HSD indicated that workers with less than one year of service reported less involvement in health and safety. Statistically significant differences ($p < 0.05$) in safety climate scores by years of service were reported in year two for (1) perceived confidence in the Offshore Installation Manager; (2) willingness to report/rules satisfaction; and (3) communication about health and safety. Analysis by Tukey's HSD identified workers with one to five years experience as having more favorable perceptions of their Offshore Installation Manager and more favorable scores on communication about safety and health.

Mohamed (2002) investigated the safety climate of construction workers in Australia with 68 questionnaires completed across six construction sites. Satisfactory item reliability was demonstrated with Chronbach's alphas greater than 0.60. Composite reliability was confirmed by Chronbach's alphas greater than 0.60 for each factor. Discriminant validity or the degree to which safety climate factors differed from one another was demonstrated by comparing the average variance extracted for each factor to the variance shared with other factors. The research hypotheses were tested with structural equation modeling (SEM) that permitted examination of relationships within a theoretical model. Mohamed concluded that management, safety systems, and risk systems influenced safety climate and a relationship existed between safety climate and safe behavior.

Oliver, Cheyne, Tomas, and Cox (2002) investigated the safety climate of 525 workers in Spain who were undergoing annual medical tests at the government managed occupational medical clinic. The safety climate instrument was previously developed and validated by Cheyne et al (1998) and included (1) demographic information; (2)

information on occupational accidents; (3) 5-point Likert-type items comprising organizational involvement; and (4) 5-point Likert-type items concerned with quality of working conditions and environmental variables. Oliver et al (2002) proposed seven variations of a model that described the effects of organizational variable and individual-centered variables on occupational accidents. Internal consistency of the safety dimensions were confirmed through verification of Chronbach's alphas greater than 0.60. The relationships between the variable in the model were tested with SEM. All variables were found to have an effect on occupational accidents and general health and safe behavior mediated the effects of organizational involvement and physical work environment.

Prussia, Brown, and Willis (2003) examined the relationship between the safety climate of managers and workers in a steel plant in the southeastern United States. The 672 respondents included 121 managers and 551 workers. Significant differences ($p < 0.05$) between managers and workers on four of the safety climate factors were revealed by $t$ tests. Managers perceived the safety climate stronger, believed workers were more likely to react to pressure and expressed less confidence than workers in their ability to work safely. Workers estimated that the frequency of safe behavior was greater than that estimated by managers.

Zohar (2000) tested a group level safety climate model through administration of a questionnaire to 534 production workers, categorized into 54 work group, in a metal-processing plant in Israel. The questionnaire was developed based on 73 interviews with individual production workers who were not affiliated with the final study groups. The interviewed workers recollections of their safety interactions with supervisors were used to devise a 23-item 5-point Likert-type scale questionnaire. Principal components analysis (PCA) resulted in two factors: (1) supervisory action and (2) supervisory expectation. Alpha reliability coefficients for the two factors were 0.93 and 0.91. Analysis with ordinary least squares (OLS) supported the two following hypothesis: (1) safety climate factors predicted injury rates in individual work groups and (2) group-level safety climate predicted group injury rates.

### *Summary*

This section provided a review of literature related in methodology to the proposed study. An overview of the extensive body of research on the measurement of organizational culture and climate was provided. The developmental stages of the measurement of safety climate were described and its reliance on organizational culture and climate methodologies was noted. The current methodologies used to measure safety climate were described through a review of selected safety climate research published since the year 2000.

Based on this review of literature and research related in methodology, the following is observed regarding the proposed study. Safety climate methodologies have benefited from the extensive research into the measurement of organizational culture and climate and over the last five years has become more defined and standardized. Despite the absence of an accepted model and concerns over instrument validation, the measurement of safety climate through administration of self reported questionnaires comprised of organization specific safety climate factors linked to multiple items with Likert responses has come to be an accepted methodology in the field of safety climate research. Use of this accepted methodology is deemed adequate to define the safety climate of organizations and groups within the study population.

## Literature and Research Related in Content and Methodology

### *Relationship Between Safety Culture and Performance in High Reliability Industries*

While a good deal of literature and research is available that correlates the safety culture and climate of mid to high accident organizations, a paucity of empirical studies exists that relate management and organizational factors with safety performance in high reliability industries such as the nuclear industry (Sorenson, 2002). Concern has been voiced over the extrapolation of safety culture and climate studies from one industry to another (Hale, Kirwan, and Guldenmund, 1999) and thus, the direct relationship between safety culture and safety climate, and safety performance in high reliability industries is weak (Sorenson, 2002).

Sorenson (2002) believes that the demonstration of the link between safety culture and climate, and operational safety depends on the demonstration of two components. First, a relationship must be established between the attributes of safety culture and climate, and the safety of operations. In Sorenson's model of this relationship, safety culture attributes must be formulated based on the organization's characteristics and the definition of safety culture. Next, evaluation techniques are designed and data is collected, analyzed, and correlated with external safety metrics. Significant safety attributes are identified. The second component of Sorenson's (2002) model deals with the use of the significant safety attributes to identify performance indicators. These performance indicators are used to modify risk assessment tools that account for and predict human error and thus, permit calculation of risk.

### *Studies Comparing Safety Culture and Performance in High Reliability Industries*

In a review of safety culture studies within high reliability industries, Sorenson (2002) found no studies that addressed all the components necessary to demonstrate a direct relationship between safety culture and safety performance. Sorenson reported that the available studies in the chemical industry provided empirical evidence of the positive relationship between safety climate and safety performance but these same studies failed to yield performance indicators that predict the probability of human error. At the same time, Sorenson (2002) found that studies in the nuclear industry lacked the extensive safety performance data common to the studies in the chemical industry.

#### *The chemical industry*

Safety audits and personnel surveys have constituted the principal means that safety researchers have linked safety culture and safety performance in the chemical industry (Sorenson, 2002). Sorenson points out that the researchers in the chemical process industry have benefited from the sufficient frequency of industry specific accidents that provide statistically valid safety measures.

Donald and Canter's (1994) study of ten chemical plants operated by one company is representative of the research that examines the relationship between safety climate and safety performance in the chemical process industry. Using the literature on the characteristics of low accident plants, Donald and Canter (1994) identified six factors they believed to be associated with high safety performance. These six factors included:

(a) management commitment; (b) safety training; (c) open communication; (d) environmental control and management; (e) stable workforce; and (f) positive safety promotion policy. These six factors were coupled with other factors found by Donald and Canter to discriminate among the ten locations and then used by the researchers to propose three facets of safety attitude including people, attitude behavior and activity. Donald and Canter (1994) developed a questionnaire based on these three facets that was administered at each location and the results demonstrated a strong relationship between safety climate and safety performance. Notwithstanding Donald and Canter's (1994) confirmation of a strong link between safety climate and safety performance, Sorenson (2002) pointed out that this study failed to identify performance indicators that quantify the level of risk represented by the attributes of safety climate.

*The nuclear industry*

Sorenson (2002) reported that safety culture and climate studies in the nuclear industry focused on management and organizational factors assumed to be important to safety performance but lacked empirical data found in the safety culture studies in the chemical industry and thus, the safety culture studies in the nuclear industry failed to establish the empirical link between safety climate and safety performance. One important exception is Lee's 1998 study of the safety climate in the nuclear reprocessing industry that can be considered as belonging both to the chemical and nuclear industry (Sorenson, 2002).

Lee (1998) conducted an assessment of safety climate at a large nuclear reprocessing facility in the United Kingdom. Lee used focus groups to formulate the safety climate survey questionnaire. A draft survey questionnaire was developed based on the focus groups' feelings, attitudes and beliefs about safety management and then administered to the focus group participants. A follow up meeting was held to elicit feedback from the focus group members. Following a pilot administration of the revised survey to 161 randomly selected workers at the facility, the resultant instrument was a 172-item questionnaire with Likert-type responses on a seven-point scale. The 172 items were divided into nine 'domains' that included 19 attitudes toward safety.

Lee's 172-item safety climate questionnaire (1998) was administered at a large nuclear reprocessing facility in the United Kingdom. The questionnaires were self-completed by mangers, staff, and workers during monthly team meetings. Participants viewed a 12-minute video with a persuasive introduction by the Site Director and summary of the aims and methods of the survey prior to completing the survey questionnaire. Completed questionnaires were placed in seal-able envelopes preaddressed to the researcher. A total of 5,296 workers or 80% of the workforce completed the survey.

Lee's validation of the survey instrument focused on whether the results could be applied as a predictor of behavior. Mean factor scores were computed for two groups: 1) those who reported an accident resulting in a day away injury of 3 days or more and 2) those who did not report a day away injury. Eighteen of the 19 factors were in the expected direction. Based on *t*-tests 15 of the 19 factors significantly discriminated ($p < 0.05$) between the two assigned groups. A discriminant function analysis was used to determine the relative effectiveness of each of the 19 attitudes in predicting whether the worker had a day away injury. Biographical and work-related worker attributes as well as worker safety attitudes were found to be predictive with the rank order of correlation with discriminant function identical for all variables and attitudes only. Principal criterion analysis resulted in 17 of the 19 factors with Eigen values > 1.0 that were predictive of a day away injury ($p < 0.05$).

In order to reduce the length of the instrument, a cut-off of a maximum of nine items per factor was used and resulted in the questionnaire being reduced from 172 to 81 items. The best 15 of the nineteen factors were selected and found to discriminate significantly ($p < 0.05$) between those who had a day away injury and those who did not using a two-tailed *t*-test.

Lee (1998) found significant differences in safety climate scores by organizational level. Lee's analysis of the safety attitudes of workers at differing organizational levels confirmed variations by job title for several attitudes to safety. Safety related specialists were markedly less confident in safety than any other job type. Craft and process workers expressed more negative attitudes toward personal caution over risks than supervisors and managers. Perceived level of risk by senior managers was more positive than the attitudes of other managers, supervisors, and craft. Managers, especially senior managers, expressed greater trust in the workforce than craft or process workers.

The nuclear reprocessing organization studied by Lee (1998) has used a number of different tools over the decade of the 1990's to measure and characterize safety climate (Rycraft, 2002). Reviewing the results of their earlier safety culture surveys, company management concluded that the improvements realized did not match the effort to collect and analyze the data (Rycraft, 2002). The analysis proved difficult to prioritize. The following barriers for the data's effectiveness were identified:

1. Too long between survey/data collection and results/analysis feedback.

2. Lack of understanding of managers as to what the results mean in a practical or behavioral sense.

3. Lack of ownership of the results.

4. Inability to prioritize and identify those factors that would improve or develop the safety culture by the greatest amount.

This nuclear reprocessing organization employs over 7,000 at one of its United Kingdom facilities. This large facility has achieved safety improvements over the years as evidenced by low accident rates (Rycraft, 2002). However, the occurrence of unwanted safety events prompted the Health and Safety Executive's (HSE) United Kingdom (UK) Nuclear Installation Inspectorate, the UK counterpart to the US Occupational Safety and Health Administration, to raise questions over the safety climate at the site. A proposal was made by the company to the HSE to measure and benchmark the site's safety climate using the HSE Health and Safety Climate Survey Tool (CST). The perceived advantages of the CST included:

1. The survey is relatively simple but covered the main areas of safety culture factors.

2. Strengths in culture could also be revealed alongside improvement areas.

3. Experience in using the tool had been gained in local areas on site and in the rest of the organization.

4. The HSE offered a benchmarking service against other organizations.

5. The computer software package automatically collates and immediately presents the results in graphical form.

The CST was administered at the UK site in June of 2000 and then again as a follow-up in November of 2001. Both surveys achieved a greater than 70% return rate. According to a company Environment, Health, Safety and Quality Manager, application of the CST "has been successful in measuring the safety climate of the workforce on the UK site and has provided a good baseline and information on which to develop the safety culture." (Rycraft, 2002).

*The Health and Safety Climate Survey Tool (CST)*

The Health and Safety Executive (HSE), the government agency charged with regulating occupational health and safety in the United Kingdom, developed the CST to measure safety climate (Health and Safety Executive, 1997a). This survey questionnaire includes 71 items and has been applied across 40 sites for over 10,000 workers.

An evaluation of the effectiveness of the CST based on interviews of users was reported in 2002 (Keil Centre, 2002). This evaluation included an analysis of 213 CST user responses to a telephone interview, follow-up interview of 25 CST users, three case studies on how the CST was used. Ninety one percent of those interviewed initially by phone indicated their expectations of using the CST had been met. Twenty-five CST users interviewed as part of the follow-up and the three case studies reported they had taken at least one action to improve health and safety as a result of using the CST. Those who reported the most success also reported they followed the process guidelines that accompany the CST.

The CST includes by two supportive texts. The Process Guidelines (HSE, 1997a) provides introductory information on the use and benefits of the questionnaire, questions to answer when considering using a climate survey tool, a step-by-step guide to preparing, administering and analyzing the survey, and finally suggestions follow-up actions including communicating the survey results, identifying issues, and implementing improvement plans. The Software Manual (HSE, 1997b) describes the software program that supports analysis of the survey results.

The CST was administered in the year 2000 at locations managed by the employer selected for this study. In a field study it was observed that some workers had difficulty completing the survey on-line. When workers were not provided a comfortable location to sit and complete the survey, the number of returned and complete surveys decreased. Based on the findings of this field study, the survey instrument was offered in both on-line and hard copy format, and meeting rooms with ample tables and chairs were provided for the workers to complete the survey (M. E. Findley, personal communication, June 25, 2004).

### *Summary*

This section provided a review of literature and research related in content and methodology to the proposed study. The relationship between safety culture and safety performance among high reliability industries was summarized. An overview of studies comparing the safety culture and safety performance in high reliability industries including the chemical process industry and the nuclear industry was provided. Finally, the development, evaluation and pilot testing of the instrument selected for the proposed study, the health and Safety Executive's Heath and Safety Climate Survey Tool (CST) was reviewed.

Based on this review of literature related in content and methodology, the following is observed regarding the proposed study. The existence of a relationship between safety climate and safety performance among high reliability industries is not as well established as in other industries where the larger frequency of accidents provides greater empirical data for comparison. Efforts to correlate safety climate and safety performance within the chemical process industry has benefited from the larger number of unwanted events than found in the nuclear industry. However, Lee's (1998) study of the safety climate in the nuclear reprocessing industry is directly related to the content and methodology related to the proposed study. Further, Lee's results confirmed the presence of differences in safety climate among groups, a central tenant of the proposed study. The proposed study instrument, the CST, was based on Lee's (1998) development of the safety climate instrument administered at the UK nuclear reprocessing facility. The facility in Lee's study is similar in scope and processes to those found in the population in this proposed study. Finally, the field testing of the instrument revealed that the some workers had difficulty completing an on-line survey and the number of returned and complete surveys increased when a comfortable environment was provided for workers to complete the survey.

## Chapter Summation

The purpose for this chapter was to review literature and research related to the problem to be researched. Based on this review the following is observed regarding the proposed study. First, the literature and research related in content provides a theoretical framework for the study of safety climate based on the extensive body of literature on organizational culture and climate. Second, notwithstanding the fact that safety climate methodologies date back only to the 1980's and questions over the validation of instruments remain, an accepted approach to the measurement of safety climate has emerged in the last 5 years. Third, although the measurement of safety climate in high reliability industries has only partially confirmed the correlation of safety climate with safety performance within chemical process industries, one study of safety climate within the nuclear reprocessing industry has demonstrated this relationship. Fourth, this study of the safety climate within the nuclear industry has identified group differences in safety climate that are directly related to the proposed study problems. Fifth, the proposed study instruments development within an industry sector similar to the proposed study population supports the assumption of its reliability and validity.

## Chapter III

## METHODS AND PROCEDURES

### Introduction

The purpose for this chapter was to describe the methods and procedures used in this study to investigate group differences in safety climate among workers in the nuclear D&D industry in the United States. This chapter includes sections that address the study population, administration of the instrument, statistical design of the study and analysis of the data.

### Study Population

The target population for the study was persons who worked at locations managed by a nuclear D&D employer located in the United States. Selection of the study population was based its being representative of a high reliability industry. The employer performs high risk decommissioning and demolition in nuclear environments that contain both radiological and chemical hazards as well as severe industrial safety concerns.

The potential study participants included all persons working at one of ten locations managed by a nuclear D&D employer located in the United States. Table 3.1 shows the total number of workers and subcontractor workers at each of the ten locations. Those asked to voluntarily participate included senior managers, managers, supervisors, foreman, technical support personnel, administrative personnel, and craft labor.

Table 3.1.

Number of parent company and subcontractor workers by location

| Location | Number of parent company workers | Number of subcontractor workers | Total number of workers |
|---|---|---|---|
| 1 | 1,129 | 194 | 1,323 |
| 2 | 655 | 3 | 658 |
| 3 | 40 | 0 | 40 |
| 4 | 966 | 39 | 1,005 |
| 5 | 12 | 0 | 12 |
| 6 | 37 | 0 | 37 |
| 7 | 28 | 0 | 28 |
| 8 | 7 | 25 | 32 |
| 9 | 115 | 4 | 119 |
| 10 | 33 | 9 | 42 |
| Total | 3,022 | 274 | 3,296 |

## Selection Process

With a target population of 3,296 working at one of the ten locations, the entire population of workers and subcontractor workers was requested to voluntarily and anonymously participate. It was desired to provide each member of the target population an opportunity to express views on the safety climate. Sampling of the study population would have excluded some who chose to participate. In addition, inclusion of the entire target population increased the likelihood of all available groups being represented.

## Instrumentation

### *Instrument selection.*

The instrument selection process began with the development of an operational definition of safety climate level based on a consensus of the literature on safety climate surveys as applicable to the study population. From this operational definition for safety climate the need was identified for an instrument that measured at one point in time the safety attitudes and perceptions of individuals and groups based on their responses to instrument items associated with organizations with high safety performance. The literature and research on safety climate surveys was reviewed with special emphasis on instruments used to measure safety climate level of groups working in high reliability industries. These instruments were compared and contrasted based on comprehensiveness, length, scope, and instrument reliability and validity. The desired features of an instrument for use with the study population examined as part of the instrument selection process included the instruments underlying concepts, variables, items, usability, practicality, and acceptability by the study population's management, supervisors, technical support personnel, and skilled craft.

The instrument selected for use in this study was the Health and Safety Climate Survey Tool (CST) published by the Health and Safety Executive, the United Kingdom's government agency counterpart of the United States Department of Labor's Occupational Safety and Health Administration (OSHA). The CST was judged by the researcher to meet the requirements of the operational definition of safety climate and possessed the desired features for measuring safety climate level of the study population. In addition, the instrument's selection was favored as the target population was familiar with the CST based on a January 2002 administration by the nuclear D&D employer.

The CST includes 71 items that survey respondents' record their views on safety and health issues. The 71 randomly ordered items comprise 11 safety climate factors. These factors included: (1) organizational commitment and communication; (2) line management commitment; (3) supervisor's role; (4) personal role; (5) coworker's influence; (6) competence; (7) risk taking behavior; (8) obstacles to safe behavior; (9) permit-to-work; (10) reporting of accidents and near misses and (11) general job satisfaction. See Table 3.2 for a listing of the items that fall within each factor. Respondents indicate their level of agreement with each of the 71 items based on a five-point Likert scale. The safety climate score is calculated by averaging the 71 item numerical scores. Some of the 71 items are negatively worded and thus, the numerical scoring is reversed to permit a score of 5 to reflect the most positive safety climate. Safety factor scores are computed for each of the eleven safety factors by averaging the numerical score for items that make up the safety factor.

Table 3.2.

CST safety climate factors and items

| Safety climate factors | Items |
|---|---|
| 1. Organizational commitment and communication. | 5, 9, 10, 14, 16, 17, 18, 19, 20, 24, 31, 39, 43, 46, 51, 54, 58 |
| 2. Line management commitment. | 49, 57, 62, 66 |
| 3. Supervisors' role. | 3, 8, 30, 65 |
| 4. Personal role. | 1, 13, 33, 50, 55, 63 |
| 5. Coworkers' influence. | 68, 69, 70, 71 |
| 6. Competence. | 15, 29, 38, 44, 64 |
| 7. Risk taking behavior. | 2, 21, 23, 28, 32, 35, 37, 40, 48 |
| 8. Obstacles to safe behavior. | 7, 12, 25, 26, 36, 41, 42, 45, 47 |
| 9. Permit to work. | 22, 27, 61 |
| 10. Reporting of accidents and near misses. | 6, 11 |
| 11. General job satisfaction. | 4, 52 |

### *CST Safety Climate Factors*

*Factor 1. Organizational Commitment and Communication*

Participants were asked to respond to 17 items pertaining to organizational commitment and communication. These items sought participants' views on senior management's interest in safety, the provision of resources for safety, the relative status of the safety program, worker involvement and communication. The 17 items included the following:

#5. There are good communications here about health and safety issues.

#9. Accident investigations are mainly used to identify who is to blame.

#10. Suggestions to improve health and safety are seldom acted upon.

#14. I feel involved when health and safety procedures, instructions, or rules are developed or reviewed.

#16. Productivity is usually seen as more important than health and safety.

#17. Management sometimes turns a blind eye to health and safety issues.

#18. Management always acts quickly over health and safety concerns.

#19. I am always informed of the outcome of meetings which address health and safty.

#20. Management only bothers to look at health and safety after there has been an accident.

#24. Senior management takes health and safety seriously.

#31. The company encourages suggestions on how to improve health and safety.

#39. Management would expect me to break health and safety procedures, instructions, or rules to get the job done.

#43. The company really cares about the health and safety of the people who work here.

#46. The health and safety committee makes an important contribution to health and safety here.

#51. Management places a low priority on health and safety training.

#54. Sufficient resources are available for health and safety here.

#58. The company shows interest in my views on health and safety.

*Factor 2. Line Management Commitment*

Four items addressed line management commitment to safety. These items explored the extent to which workers perceived that their immediate boss promoted safety and reacted to safety issues. The four items included the following:

#49. My immediate boss often talks to me about health and safety.

#57. My immediate boss would be very helpful if I asked for advice on health and safety matters.

#62. My immediate boss is receptive to ideas on how to improve health and safety.

#66. I don't think my immediate boss does enough to ensure health and safety.

*Factor 3. Supervisor's Role*

Four items addressing supervisors' role were included in the instrument. These items sought participants' views on supervisors' contribution to safety and the effectiveness of the supervisors. The four items included the following:

#3. Supervisors are good at detecting unsafe behavior.

#8. Supervisors here are not very effective at ensuring health and safety.

#30. Supervisors seldom check that people here are working safely.

# 65. Supervisors devote sufficient effort to health and safety here.

*Factor 4. Personal Role*

Six items were included to assess the personal role dimension. These items explored the participants' views of their own contribution to safety and the relative importance they placed on safety. The six items included the following:

#1. Some health and safety procedures, or instructions do not need to be followed to get the job done safely.

#13. There is little advantage to keeping strictly to the health and safety procedures, instructions and rules.

#33. There is nothing I can do to further improve health and safety here.

#50. There are to many safety procedures, instructions and rules given the real risks associated with the jobs for which I am responsible.

#55. Health and safety briefings are a waste of my time.

#63. I sometimes turn a blind eye to less important health and safety procedures, instructions and rules.

*Factor 5. Coworkers' Influence*

Four items addressed the dimension of coworkers' influence. These items sought the participants' views on the importance that their coworkers gave to safety. The four items included the following:

#68. My coworkers would react strongly against people who break health and safety procedures, instructions, and rules.

#69. All the people who work here are fully committed to health and safety.

#70. It is important for me to work safely if I am to keep the respect of the others in my team.

#71. I trust my coworkers with my health and safety.

*Factor 6. Competence*

Five items addressing the dimension of competence were included in the instrument. These items explored the participants' understanding of their safety responsibilities, the risks associated with their work, and the safety instructions, rules and procedures in place. The five items included the following:

#15. I fully understand the health and safety associated with the work for which I am responsible.

#29. I am clear about my responsibilities for health and safety.

#38. The training I had covered all the health and safety risks associated with the work for which I am responsible.

#44. Sometimes I am uncertain what to do to ensure the health and safety in the work for which I am responsible.

#64. I fully understand the health and safety procedures, instructions and rules associated with my job.

*Factor 7. Risk-Taking Behavior*

Fifteen items were included to address the risk taking behavior dimension. These items sought participants' views on the extent to which others take risks or perform work unsafely, and reasons why risk-taking behavior occurs. The 15 items included the following:

#2. People who work here often take risks when they are at work.

#21. People here do not remember much of the health and safety training which applies to their job.

#23. People here always work safely when they are being supervised.

#28. People here think health and safety isn't their problem – it's up to management and others.

#32. Some of the workforce pays little attention to health and safety.

#34. People here always wear their health and safety protective equipment when they are supposed to.

#35. Action is seldom taken against people who break health and safety procedures, instructions and rules.

#37. People who cause accidents here are not held sufficiently accountable for their actions.

#40. Not all of the health and safety procedures, instructions and rules are strictly followed here.

#48. I can trust people who I work wit to work safely.

#53. People here are sometimes pressured to work unsafely by their colleagues.

#56. Some people here have a poor understanding of the risks associated with their work.

#59. People who work here sometimes take risks at work which I would not take myself.

#60. People who work here are not recognized for working safely.

#67. Supervisors sometimes turn a blind eye to people who are not working to the health and safety procedures, instructions, and rules.

*Factor 8. Obstacles to Safe Behavior*

Nine items addressed the dimension of obstacles to safe behavior. The items explored the relevance and practicality of safety instructions, rules, and procedures as well as the people's ability and willingness to comply. The nine items included the following:

#7. Some jobs here are difficult to do safely.

#12. Some health and safety procedures, instructions, and rules are not really practical.

#25. Some health and safety procedures, instructions, and rules do not reflect how the job is now done.

#26. Some health and safety procedures, instructions, and rules are difficult to follow.

#36. Some health and safety procedures, instructions, and rules are only here to protect management.

#41. People can always get the equipment that is needed to work to the health and safety procedures, instructions, and rules.

#42. There are always enough people available to get the job done according to the health and safety procedures, instructions and rules.

#45. Sometimes it is necessary to take risks to get the job done.

#47. Sometimes physical conditions at the workplace restrict people's ability to work safely.

*Factor 9. Permit to Work*

Three items addressing the dimension of permit to work were included in the instrument. These items examined participants' views on the relevance and ease of use of the safety permit system. The three items included the following:

#22. The permit-to-work system is always strictly applied and followed.

#27. The permit-to-work system is 'over the top' given the real risks of some of the jobs it is used for.

#61. The permit-to-work system causes unnecessary delays in getting the job done.

*Factor 10. Reporting of Accidents and Near Misses*

Participants were asked to respond to two items pertaining to the reporting of accidents and near misses. These items sought participants' views on the willingness of people to report accidents and near misses. The two items included the following:

#6. Accidents which happen here are always reported.

#11. Near misses are always reported.

*Factor 11. General Job Satisfaction*

Two items explored issues of general job satisfaction. The items addressed the participants' views on job security and the degree to which they perceived their jobs as boring and repetitive. The two items included the following:

#4. My job is boring and repetitive.

#52. I am worried about my job security.

## *Demographic Variables*

Participants were asked to self-report their own status related to several demographic variables aimed at categorizing the participants into various groups. The researcher revised the demographic items to align them with the characteristics of the study population as well as facilitate the combining of participants' response into groups. These demographic variables permitted grouping of responses by participants' organizational level, assigned employer unit, length of employment and experience, participation in safety oriented behavior, and personal injury experience. See Table 3.3 for a listing of groupings and the items that pertain to these groups.

Table 3.3.

Demographic variables and corresponding instrument items

| Demographic variables | Items |
|---|---|
| 1. Age, gender, race and ethnicity. | 87, 88, 89, 90 |
| 2. Location and employer. | 72, 73 |
| 3. Employment classification and job position. | 77, 83 |
| 4. Work shift. | 80 |
| 5. Length of employment and years of experience. | 81, 82 |
| 6. Union membership. | 78, 79 |
| 7. Behavior-based safety participation. | 74, 75, 76 |
| 8. On-the-job injury/illness experience. | 84, 85, 86 |

*Study Approval and Confidentiality*

The Institutional Review Board (IRB) at the University of Tennessee approved Form A and provided permission to proceed as the study did not include sensitive materials or vulnerable study groups. A certificate for exemption from IRB Review involving human subjects is on file in the Department of Health and Exercise Science at the University of Tennessee, Knoxville and is contained in Appendix A.

Participants were assured in the study information sheet accompanying the questionnaire that participation was strictly voluntary and anonymous. A completed returned questionnaire served as consent to participate in the study. Permission to conduct the study was also obtained from the senior management of the nuclear D&D employer. The study information sheet and questionnaire are contained in Appendix A.

## Data Collection

Safety meetings were held including workers at each of the company designated locations to introduce and distribute the survey. A two-week interval of time was selected for distribution, completion and submission of the survey in order to accommodate the 7-day a week and 24 hours of operation in place at some study sites and the absence of project workers on personal leave. The study packet distributed to all potential participants included a study information sheet, a form for recording comments and suggestions, the survey and an envelope. Study participants choosing to complete the survey were instructed to place the completed survey into the envelop, seal the envelope and then place the sealed envelope into one of several drop boxes placed throughout the study sites. Respondents were instructed not to place any personal identifier on the survey or the envelope. It was estimated that the survey would take no more than 20 minutes to complete. Persons designated by the researcher monitored and collected sealed survey packets from participants the security of the drop boxes. To ensure the anonymity of participant responses, the designated survey monitors were instructed to direct study participants to place the completed surveys in the envelope and then place the sealed envelope with the completed survey into one of the sealed boxes and not to open any survey packets collected. The completed surveys placed in the boxes were collected by monitors and stored in secured files until the completed surveys were transmitted to the company selected by the researcher to perform electronic scanning.

## Statistical Analysis

### *Introduction*

The preparation of the survey data for statistical analysis included electronic scanning of the completed survey forms and the transfer of the scanned data into a data file for subsequent analysis. An independent company selected by the researcher performed electronic scanning of the completed surveys and then input the data into an EXCEL spreadsheet. The researcher transferred the EXCEL data file into a Statistical Package for Social Sciences (SPSS), version 12.0, data file to run statistical analysis. Items stated in reverse order were coded to result in a higher score for each item being consistent with a more favorable safety attitude or perception. Factor scores were computed by averaging the Likert responses for the items making up the factor. Safety climate scores were computed by averaging the 72 item scores. Frequencies and measures of central tendency were computed for all demographic variables. An alpha level of 0.05 was used for all statistical tests.

Reliability analysis was performed to identify the factors and respective items that demonstrated adequate internal consistency. Pearson correlation coefficients were computed to evaluate the correlation between the safety climate score and factor scores. Factors were deemed unreliable and excluded when a correlation coefficient was less than 0.40 and or a significance level was greater than 0.05. Cronbach's Alpha reliability coefficients were computed for each factor. Factors were deemed unreliable and excluded or amended if the alpha was less than 0.60.

Group differences in factor scores and safety climate item scores were analyzed by analysis of variance (ANOVA) and multiple analysis of variance (MANOVA). Significant differences ($p<0.05$) among variables were identified when the $F$ ratio indicated a larger variance among variables than within variables. Post hoc comparisons were performed to determine the specific groups that yielded the significant differences.

### *Statistical Analysis of Research Questions*

In addressing the purpose of the study the data associated with each of the research questions were analyzed by the statistical procedure described below:

1. *Are there significant differences in safety climate among self-reported geographic work locations among workers of a nuclear D&D employer located in the United States who use the same safety management system?* Factor scores and overall safety climate scores were computed for each work location. Differences between factor scores and safety climate scores by location were analyzed by MANOVA

and ANOVA. Post hoc comparisons were performed with Tukey's HSD to determine the specific locations that yielded the significant differences.

2. *Are there significant differences in safety climate among self-reported job positions among workers of a nuclear D&D employer located in the United States?* Factor scores and safety climate scores were computed by for each job position including (a) senior manager; (b) manager; (c) supervisor; (d) foreman; (e) workforce/craft; (f) technical support personnel; and (g) administrative support personnel. Differences between factor scores and safety climate scores by job position were analyzed by MANOVA and ANOVA. Post hoc comparisons were performed with Tukey's HSD to determine the specific job positions that yielded the significant differences.

3. *Are there significant differences in safety climate between those who self-reported an on-the-job injury during the previous 12 months and those who reported no injury among workers of a nuclear D&D employer located in the United States?* Factor scores and safety climate scores were computed for respondents reporting an injury in the last year. The categories of reported injuries in the previous year included (a) an injury requiring first aid treatment; (b) an injury requiring medical treatment; and (c) an injury resulting in on-the-job restrictions or time away from work. Differences between factor scores and safety climate scores by injury experience were analyzed by MANOVA and ANOVA. Post hoc comparisons were performed with Tukey's HSD to determine the specific groups that yielded the significant differences.

4. *Are there significant differences between self-reported safety climate and safety-oriented behavior, as measured by self-reported participation in a behavior-based safety process, among workers of a nuclear D&D employer located in the United States?* Factor scores and safety climate scores were computed for respondents who reported safety oriented behavior including (a) completion of behavior based safety training; (b) completion of behavior based safety observer training; and (c) completion of at least one behavior based safety observation during the previous month. Differences between factor scores and safety climate scores by respondents reporting safety oriented behavior were analyzed by MANOVA and ANOVA. Post hoc comparisons were performed with Tukey's HSD to determine the specific groups that yielded the significant differences.

## Summary

This chapter on the methods and procedures describes the design of the study methodology including the study population, sampling technique, instrumentation, data collection and statistical analysis of the study results. The study population was selected based on its being representative of a high reliability nuclear industry and includes 10 locations managed by a nuclear D&D employer in the United States. The sampling technique employed in the study requested voluntary and anonymous participation by all members of the study population. The study instrument, the CST, was selected based on its previous development and validation in an industry sector similar to the study population. A summary of the statistical techniques used to analyze each of the research was provided.

# Chapter IV

# ANALYSIS OF DATA

## Introduction

This chapter presents the results of the analysis of the survey data. The survey response rate is discussed and descriptive data is presented for the dependent variables including location, company/subcontractor, gender, age, race, ethnicity, employment classification, union membership, years in current profession and at location, job position, work shift, on-the-job injury/illness experience, and behavior-based safety training and participation. The reliability of safety climate factors is examined. Statistical analysis is presented that addresses the research questions and includes group differences in safety climate score and factor scores by location, job position, injury/illness experience, and safety-oriented behavior.

## Survey Response

Survey responses totaled 1,587 out of an available population of 3,296 for an overall response rate of 48.1 percent. See Table 4.1. The response rate by location ranged from 13.8 to 78.6 percent. The location designated as number 2 had the lowest response rate. The second lowest rate was for the location designated as number 4 with 40.6 percent. The highest response rate was obtained from the location designated as number 7 with 78.6 percent. Ninety one respondents (5.7%) did not provide a location and 125 respondents (7.9%) indicated their location as 'other.'

Table 4.1.

Study population and responses by location

| Location | | Population | Frequency of response | Percent of responses | Response rate |
|---|---|---|---|---|---|
| Valid | 1 | 1,323 | 693 | 43.7 | 52.4 |
| | 2 | 658 | 91 | 5.7 | 13.8 |
| | 3 | 40 | 28 | 1.8 | 70.0 |
| | 4 | 1,005 | 408 | 25.7 | 40.6 |
| | 5 | 12 | 9 | .6 | 75.0 |
| | 6 | 37 | 28 | 1.8 | 75.7 |
| | 7 | 28 | 22 | 1.4 | 78.6 |
| | 8 | 32 | 15 | .9 | 46.9 |
| | 9 | 119 | 56 | 3.5 | 47.1 |
| | 10 | 42 | 21 | 1.3 | 50.0 |
| | Other | NA | 125 | 7.9 | NA |
| | Total | 3,296 | 1496 | 94.3 | 45.4 |
| Missing | System | NA | 91 | 5.7 | NA |
| Total | | 3,296 | 1587 | 100.0 | 48.1 |

## Demographic Analysis

*Location, Company, Age, Race, and Ethnicity*

Demographic information on respondent location, company, age, race and ethnicity were self-reported. The 1,587 respondents were from 11 work locations and the numbers of respondents per location ranged from 9 to 693. The greatest number of respondents, 1,101 (69.4%), reported working at locations designated as number 1 or 4. See Table 4.1. The respondents reported company affiliation included the nuclear D&D employer (company #1), a subsidiary of the nuclear D&D employer (company #2) and 4 subcontractors working for the D&D employer with the largest number of respondents (1,006 or 66.7%) employed by company number 1. Company affiliation was not reported by 251 (15.8%) respondents. See Table 4.2. The respondents included those self-reported as 1,062 males (66.9%) and 312 (19.7%) females. Gender was not reported by 213 (13.4%) respondents. See Table 4.3. The majority of respondents (54.7%) self-reported ranging in age from 36 to 55 years of age. The respondents self-reported their race as being 1,182 whites (74.5%), 105 blacks (6.6%), 14 Asians (0.9%), and 51 other (3.2%). See Tables 4.4 and 4.5, respectively. Race was not reported by 235 (14.8%) respondents. Hispanic or Latino ethnic origin was self-reported by 25 respondents (1.6%). See Table 4.6.

*Employment status*

The respondents self-reported employment status included employment classification, union membership and affiliation, years in profession, years at location,

Table 4.2.

Company or subcontractor affiliation of respondents

| Company or Subcontractor | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Parent Company | 1006 | 63.4 | 66.7 | 66.7 |
| | Subsidiary Company | 46 | 2.9 | 3.1 | 69.8 |
| | Subcontractor #1 | 167 | 10.5 | 11.1 | 80.8 |
| | Subcontractor #2 | 13 | .8 | .9 | 81.7 |
| | Subcontractor #3 | 6 | .4 | .4 | 82.1 |
| | Subcontractor #4 | 19 | 1.2 | 1.3 | 83.4 |
| | Other | 251 | 15.8 | 16.6 | 100.0 |
| | Total | 1508 | 95.0 | 100.0 | |
| Missing | System | 79 | 5.0 | | |
| Total | | 1587 | 100.0 | | |

Table 4.3.

Gender of respondents

| Gender | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Male | 1062 | 66.9 | 77.3 | 77.3 |
| | Female | 312 | 19.7 | 22.7 | 100.0 |
| | Total | 1374 | 86.6 | 100.0 | |
| Missing | System | 213 | 13.4 | | |
| Total | | 1587 | 100.0 | | |

Table 4.4.

Age range of respondents

| Years of age | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 18 - 25 | 117 | 7.4 | 8.6 | 8.6 |
| | 26 - 30 | 102 | 6.4 | 7.5 | 16.1 |
| | 31 - 35 | 110 | 6.9 | 8.1 | 24.2 |
| | 36 - 40 | 191 | 12.0 | 14.0 | 38.2 |
| | 41 - 45 | 239 | 15.1 | 17.5 | 55.7 |
| | 46 - 50 | 223 | 14.1 | 16.4 | 72.1 |
| | 51 - 55 | 215 | 13.5 | 15.8 | 87.9 |
| | 56 - 60 | 109 | 6.9 | 8.0 | 95.9 |
| | 61 - 65 | 43 | 2.7 | 3.2 | 99.0 |
| | 66 plus | 13 | .8 | 1.0 | 100.0 |
| | Total | 1362 | 85.8 | 100.0 | |
| Missing | System | 225 | 14.2 | | |
| Total | | 1587 | 100.0 | | |

Table 4.5.

Race of respondents

| Race | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | White | 1182 | 74.5 | 87.4 | 87.4 |
| | Black | 105 | 6.6 | 7.8 | 95.2 |
| | Asian | 14 | .9 | 1.0 | 96.2 |
| | Other | 51 | 3.2 | 3.8 | 100.0 |
| | Total | 1352 | 85.2 | 100.0 | |
| Missing | System | 235 | 14.8 | | |
| Total | | 1587 | 100.0 | | |

Table 4.6.

Hispanic or Latino ethnic origin of respondents

| Ethnic origin | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Yes | 25 | 1.6 | 2.1 | 2.1 |
| | No | 1184 | 74.6 | 97.9 | 100.0 |
| | Total | 1209 | 76.2 | 100.0 | |
| Missing | System | 378 | 23.8 | | |
| Total | | 1587 | 100.0 | | |

job position, and work shift. Respondents reporting their employment classification as exempt (salary) numbered 445 (28.0%) and 1,032 (65.0%) indicated their employment classification was non-exempt (hourly). Employment classification was not reported by 110 respondents (6.9%). See Table 4.7. Self-reported union membership was by 466 respondents (29.4%). Of the remaining respondents 924 (58.2%) self-reported they were not a member of a union and 197 (12.4%) did not provide information on union membership. See Table 4.8. Union affiliation or the specific union that a respondent was a member was self-reported by 475 (29.9%) respondents. It is noted that the respondents could self-report that they were not a member of a union at the same that they self-reported union affiliation and thus, this explains the difference between those self-reporting union membership (445) and those self-reporting union affiliation (475). The most frequent self-reported union affiliation was laborer with 216 (13.6%). The second most frequent reported union affiliation was operating engineer with 73 (4.6%). See Table 4.9. The respondents' self-reported years in their current profession regardless of location or employer are presented in Table 4.10. The most frequent self-reported range of years in their current profession was zero to five years (477 or 30.1%) followed by 20 or more years (390 or 24.6%). The most frequent self-reported range of years at a location was five or more years (487 or 30.7%) followed by less than one year (347 or 21.9%). One hundred ninety eight (12.5%) did not report the years in their current profession. See Table 4.11. The most frequently reported job position was workforce/craft with 667 (42.0%). The second most frequently reported job position was technical support with 321 (20.2%). Seventeen senior managers (1.1%), 103 managers (6.5%), 72 supervisors (4.5%), 63 foreman (4.0%), and 114 administrative personnel

Table 4.7.

Employment classification of respondents

| Classification | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Exempt (a) | 445 | 28.0 | 30.1 | 30.1 |
| | Non-exempt (b) | 1032 | 65.0 | 69.9 | 100.0 |
| | Total | 1477 | 93.1 | 100.0 | |
| Missing | System | 110 | 6.9 | | |
| Total | | 1587 | 100.0 | | |

a. Exempt employment classification describes workers who are salaried and do not receive overtime compensation.
b. Non-exempt employment classification describes hourly workers who do receive overtime compensation.

Table 4.8.

Respondents' membership in a union

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Yes | 466 | 29.4 | 33.5 | 33.5 |
| | No | 924 | 58.2 | 66.5 | 100.0 |
| | Total | 1390 | 87.6 | 100.0 | |
| Missing | System | 197 | 12.4 | | |
| Total | | 1587 | 100.0 | | |

Table 4.9.

Union affiliation of respondents who reported membership in a labor union

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Laborer | 216 | 13.6 | 45.5 | 45.5 |
| | Boilermaker | 25 | 1.6 | 5.3 | 50.7 |
| | Pipe fitter | 28 | 1.8 | 5.9 | 56.6 |
| | Electrician | 25 | 1.6 | 5.3 | 61.9 |
| | Carpenter | 1 | .1 | .2 | 62.1 |
| | Sheet metal | 5 | .3 | 1.1 | 63.2 |
| | Teamster | 2 | .1 | .4 | 63.6 |
| | Painter | 3 | .2 | .6 | 64.2 |
| | Iron worker | 18 | 1.1 | 3.8 | 68.0 |
| | Operating Engineer | 73 | 4.6 | 15.4 | 83.4 |
| | Survey technician | 25 | 1.6 | 5.3 | 88.6 |
| | Sprinkler fitter | 3 | .2 | .6 | 89.3 |
| | Mill-wright | 9 | .6 | 1.9 | 91.2 |
| | Brick mason | 3 | .2 | .6 | 91.8 |
| | Other | 39 | 2.5 | 8.2 | 100.0 |
| | Total | 475 | 29.9 | 100.0 | |
| Missing | System | 1112 | 70.1 | | |
| Total | | 1587 | 100.0 | | |

Table 4.10.

Reported years in current profession of respondents regardless of location

| Years | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 - 5 | 477 | 30.1 | 34.1 | 34.1 |
| | 6 - 10 | 129 | 8.1 | 9.2 | 43.3 |
| | 11 - 15 | 220 | 13.9 | 15.7 | 59.1 |
| | 16 - 20 | 182 | 11.5 | 13.0 | 72.1 |
| | 20 plus | 390 | 24.6 | 27.9 | 100.0 |
| | Total | 1398 | 88.1 | 100.0 | |
| Missing | System | 189 | 11.9 | | |
| Total | | 1587 | 100.0 | | |

Table 4.11.

Reported years at current location of respondents

| Years | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Less than 1 | 347 | 21.9 | 25.0 | 25.0 |
| | 1 – 2 | 295 | 18.6 | 21.2 | 46.2 |
| | 3 - 4 | 260 | 16.4 | 18.7 | 64.9 |
| | 5 plus | 487 | 30.7 | 35.1 | 100.0 |
| | Total | 1389 | 87.5 | 100.0 | |
| Missing | System | 198 | 12.5 | | |
| Total | | 1587 | 100.0 | | |

(7.2%) were also reported. Job position was not reported by 230 (14.5%) respondents. See Table 4.12. The self-reported work-shift included 1,177 on weekdays (74.2%), 175 working weekday nights (11%), and 155 working weekends (9.8%). Eighty respondents (5.0%) did report their work-shift. See Table 4.13.

*On-The-Job Injury and Illnesses*

Respondents' self-reported on-the-job injuries and illnesses in the previous 12 months included having experienced an injury or illness that resulted in first aid treatment, medical treatment, or lost time/on-the-job restriction. A total of 126 (7.9%) reported having experienced an on-the-job injury requiring first aid treatment during the last 12 months. Those who reported an on-the-job injury or illness resulting in medical treatment numbered 62 (3.9%). A total of 56 (3.5%) reported experiencing an on-the-job injury or illness that resulted in lost time or on-the-job restrictions. See Figure 1.

*Safety-Oriented Behavior*

Safety-oriented behavior was measured by respondents self-reported participation in behavior-based safety processes and included having received behavior-based safety training or behavior-based safety observer training in the previous 12 months, or having conducted a behavior-based safety observation in the previous month. Behavior-based safety observation training is an eight-hour training course on conducting behavior-based safety observations in work areas. Behavior-based safety observations, conducted by those completing both the introductory training and the observer training, are one-on-one

Table 4.12.

Job position of respondents at current location

| Job Position | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Senior manager | 17 | 1.1 | 1.3 | 1.3 |
| | Manager | 103 | 6.5 | 7.6 | 8.8 |
| | Supervisor | 72 | 4.5 | 5.3 | 14.1 |
| | Foreman | 63 | 4.0 | 4.6 | 18.8 |
| | Workforce/craft | 667 | 42.0 | 49.2 | 67.9 |
| | Technical support | 321 | 20.2 | 23.7 | 91.6 |
| | Administrative | 114 | 7.2 | 8.4 | 100.0 |
| | Total | 1357 | 85.5 | 100.0 | |
| Missing | System | 230 | 14.5 | | |
| Total | | 1587 | 100.0 | | |

Table 4.13.

Work shift of respondents

| Work Shift | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Weekdays | No | 410 | 25.8 | 25.8 | 25.8 |
| | Yes | 1177 | 74.2 | 74.2 | 100.0 |
| | Total | 1587 | 100.0 | 100.0 | |
| Weekday nights | No | 1412 | 89.0 | 89.0 | 89.0 |
| | Yes | 175 | 11.0 | 11.0 | 100.0 |
| | Total | 1587 | 100.0 | 100.0 | |
| Week end (day or night) | No | 1432 | 90.2 | 90.2 | 90.2 |
| | Yes | 155 | 9.8 | 9.8 | 100.0 |
| | Total | 1587 | 100.0 | 100.0 | |

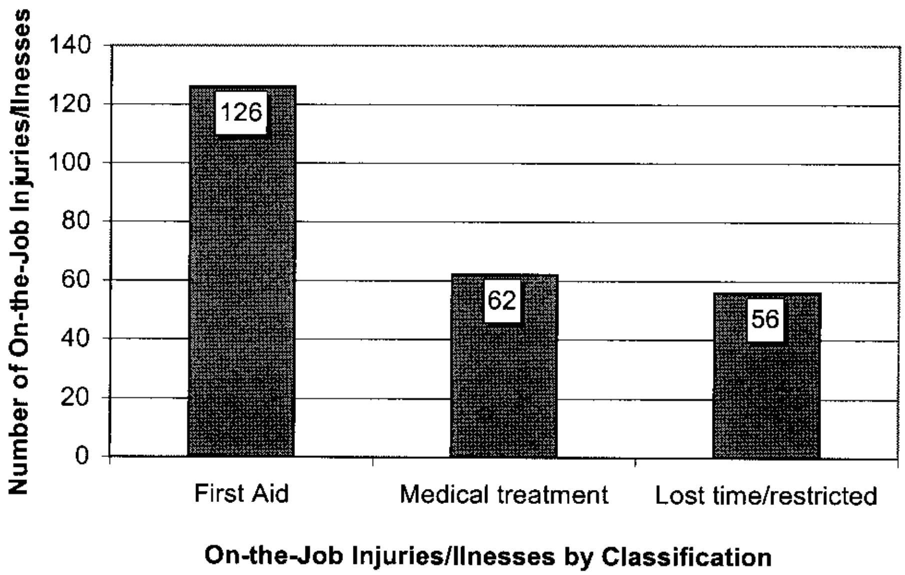


Figure 1. Number of Self-Reported On-The-Job Injuries and Illnesses by Classification

interactions between a behavior-based safety observer and one or more other workers where the safety aspects of the work are openly discussed and positive reinforcement is provided for safe work behavior. Completion of behavior-based safety training in the last 12 months was reported by 1,046 (65.9%). Respondents who reported having completed behavior-based safety observer in the last 12 months numbered 686 (43.2%). A total of 413 (26.0%) reported having conducted a behavior-based safety observation in the last 12 months. See Figure 2.

## Factor Reliability

A factor was considered to have acceptable reliability if the Cronbach's alpha was 0.60 or greater. Nine of 11 factors had Cronbach's alphas equal to or greater than 0.60. See Table 4.14. The Cronbach's alpha for factor 9, permit to work, was 0.484 but improved to 0.657 when item 22 was deleted from the calculation of the factor score. Factor 11, job satisfaction, had a Cronbach's alpha of 0.198. Factor reliability was also evaluated by calculating the correlation of the mean factor scores with the mean safety climate score. The factors were considered to be reliable if the Pearson's correlation coefficient was 0.50 or greater and the significance level was $< 0.05$. Ten of 11 factors had significant ($p<0.01$) correlation coefficients of 0.50 or greater. Factor 11, job satisfaction, was poorly correlated with safety climate item score as evidenced by a correlation coefficient of –0.344. See data set B.1 in Appendix B. Based on these results item 22 was not included in the computation of the mean factor scores for factor permit to

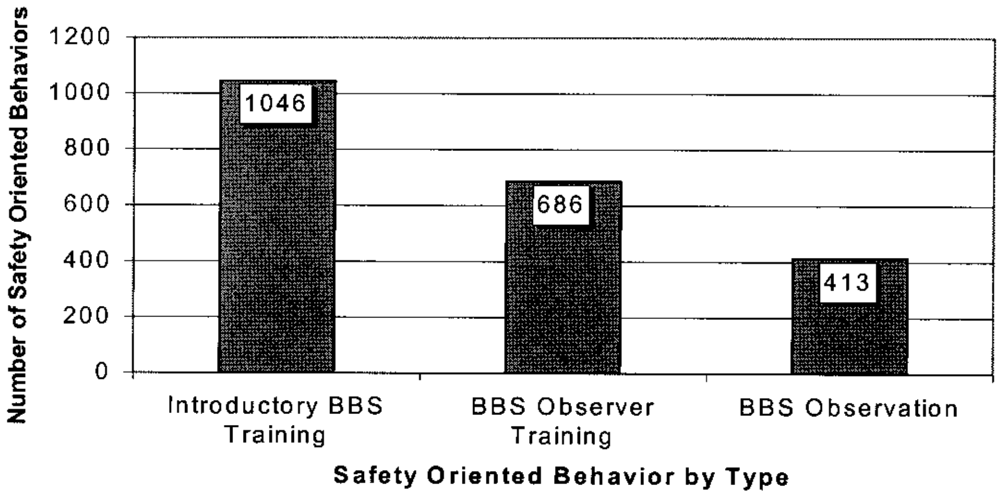


Figure 2. Safety-Oriented Behavior by Type

Table 4.14.

Factor reliability based on internal consistency

| Factor number and name | N of items | Cronbach's Alpha |
|---|---|---|
| Factor 1 - Organizational commitment and communication | 17 | 0.927 |
| Factor 2 - Line management commitment | 4 | 0.824 |
| Factor 3 - Supervisors' role | 4 | 0.775 |
| Factor 4 – Personal role | 6 | 0.700 |
| Factor 5 – Work-mates' influence | 4 | 0.768 |
| Factor 6 - Competence | 5 | 0.739 |
| Factor 7 – Risk taking behavior | 15 | 0.897 |
| Factor 8 – Obstacles to safe behavior | 9 | 0.797 |
| Factor 9 – Permit to work | 3 | 0.484 |
| Factor 9 – Permit to work (Q22 deleted) | 2 | 0.657 |
| Factor 10 – Reporting of accidents and near misses | 2 | 0.654 |
| Factor 11 - Job satisfaction | 2 | 0.198 |

work but the item was included in the generation of safety climate scores. Factor 11, job satisfaction, was not recognized as a factor but the two items, 4 and 52, were included in computations of the safety climate score.

## Statistical Analysis

The purpose of this study was to investigate group differences in safety climate among workers in the nuclear decommissioning and demolition (D&D) industry in the United States. The following analysis were employed: analysis of variance (ANOVA), multiple analysis of variance (MANOVA) and Tukey's post hoc analysis, when appropriate to interpret group differences. The results of the statistical analysis of group differences in safety climate as related to the research questions follows:

1. *Are there significant differences in safety climate among self-reported geographic work locations among workers of a nuclear D&D employer located in the United States who use the same safety management system?*

Significant differences ($p<0.05$) in mean safety climate scores were found among locations. The mean safety climate scores by reported location ranged from 3.180 to 4.148. See Figure 3. Analysis of variance of mean safety climate scores by location resulted in an F statistic of 22.088 ($p<0.05$). See Table 4.15. Post hoc analysis of the differences in safety climate scores by location were significantly different ($p<0.05$):

1. Location one differed from locations 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11.
2. Location two differed from locations 1, 5, 6, 7, and 8.
3. Location three differed from locations 1 and 5.
4. Location four differed from locations 1, 5, 6, and 8.

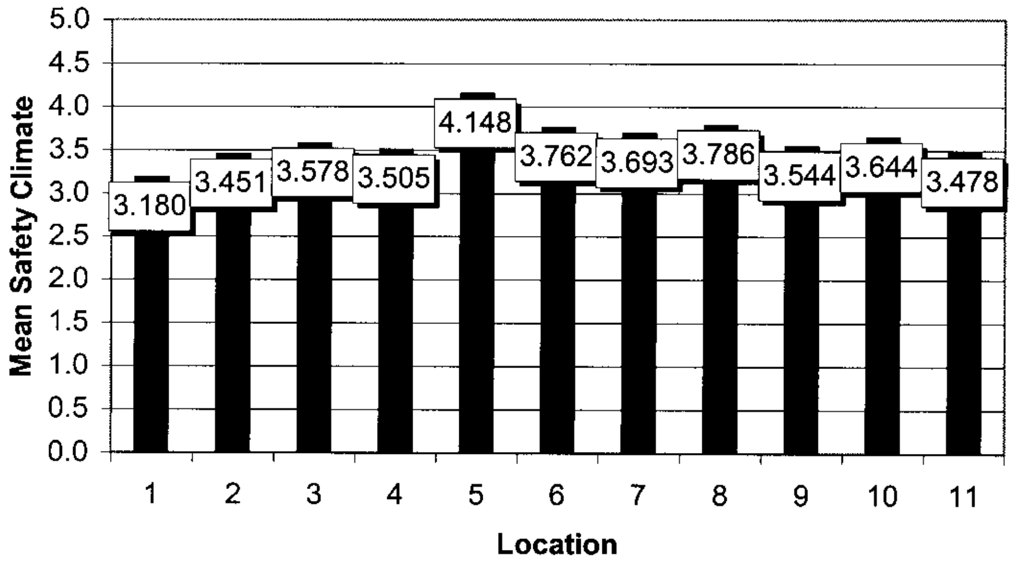


Figure 3. Mean Safety Climate by Location

Table 4.15

Group differences in mean safety climate scores among locations

| | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|
| Contrast | 53.643 | 10 | 5.364 | 22.088 | .000 | 220.881 | 1.000 |
| Error | 360.646 | 1485 | .243 | | | | |

The F tests the effect of location. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05

5. Location five differed from locations 1, 2, 3, 4, 6, 7, 8, 9, 10, and 11.
6. Location six differed from locations 1, 2, 4, and 5.
7. Location seven differed from locations 1, 2, and 5.
8. Location eight differed from locations 1, 2, 4, and 11.
9. Location nine differed from locations 1 and 5.
10. Location ten differed from locations 1 and 5.
11. Location eleven differed from locations 1, 5, 6, and 8.

The results of post hoc analysis of the differences in safety climate score by locations is shown in data set B.2 in Appendix B.

The number of respondents who did not report a work location totaled 91 (5.7%). There was no significant difference ($p<0.05$) in mean safety climate scores between those reporting a work location and those who did not indicate a work location.

Significant differences ($p<0.05$) in factor scores were found among locations. The mean factor scores by location are shown in data set B.3 in Appendix B. Multiple analysis revealed significant differences ($p< 0.001$) in each of the factor scores, except for factor number 4 (personal role). See Table 4.16. Post hoc analysis of the differences in factor scores by locations is shown in data set B.4 in Appendix B.

The mean item scores were reviewed to identify differences in scores by location. For purposes of this review, items were examined when the mean item scores ranged from 2.95 to 3.75 or greater. There were no items that met the stated criteria for examination.

Table 4.16

Group differences in mean factor scores among locations

| Factor score | | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|
| 1 | Contrast | 83.330 | 10 | 8.333 | 18.723 | .000 | 187.235 | 1.000 |
| | Error | 653.786 | 1469 | .445 | | | | |
| 2 | Contrast | 54.866 | 10 | 5.487 | 9.555 | .000 | 95.550 | 1.000 |
| | Error | 843.513 | 1469 | .574 | | | | |
| 3 | Contrast | 82.516 | 10 | 8.252 | 14.819 | .000 | 148.187 | 1.000 |
| | Error | 817.990 | 1469 | .557 | | | | |
| 4 | Contrast | 5.133 | 10 | .513 | 1.433 | .160 | 14.334 | .733 |
| | Error | 526.050 | 1469 | .358 | | | | |
| 5 | Contrast | 33.311 | 10 | 3.331 | 6.464 | .000 | 64.637 | 1.000 |
| | Error | 757.070 | 1469 | .515 | | | | |
| 6 | Contrast | 38.165 | 10 | 3.816 | 10.257 | .000 | 102.574 | 1.000 |
| | Error | 546.569 | 1469 | .372 | | | | |
| 7 | Contrast | 110.937 | 10 | 11.094 | 29.663 | .000 | 296.625 | 1.000 |
| | Error | 549.401 | 1469 | .374 | | | | |
| 8 | Contrast | 46.820 | 10 | 4.682 | 12.281 | .000 | 122.809 | 1.000 |
| | Error | 560.043 | 1469 | .381 | | | | |
| 9 | Contrast | 52.224 | 10 | 5.222 | 6.822 | .000 | 68.219 | 1.000 |
| | Error | 1124.557 | 1469 | .766 | | | | |
| 10 | Contrast | 93.092 | 10 | 9.309 | 12.034 | .000 | 120.343 | 1.000 |
| | Error | 1136.353 | 1469 | .774 | | | | |

The F tests the effect of location. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05.

2. *Are there significant differences in safety climate among self-reported job positions among workers of a nuclear D&D employer located in the United States?*

Significant differences ($p<0.05$) in mean safety climate scores were found among job positions. The mean safety climate scores by job position as shown in Figure 4 ranged from 3.155 to 3.729. Respondents reporting their job position as foreman had the lowest mean safety climate score. The order of job positions based on the lowest to highest mean safety climate score was as follows: foreman, workforce/craft, technical support, supervisor, administrative staff, senior manager, and manager. Analysis of variance of mean safety climate scores as related to job position resulted in an F statistic of 25.249 ($p<0.05$). See Table 4.17. Post analysis of the differences in safety climate item scores by location revealed the following significant differences ($p<0.05$):

1. Senior managers differed from foremen and workforce/craft.
2. Managers differed from supervisors, foremen, workforce/craft, technical support, and administrative.
3. Supervisors differed from managers and foremen.
4. Foremen differed from senior managers, managers, supervisors, workforce/craft, technical support, and administrative.
5. Workforce/craft differed from senior managers, managers, supervisors, technical support, and administrative.
6. Technical support differed from managers, workforce/craft, and administrative.
7. Administrative differed from managers, foremen, workforce/craft, and technical support.

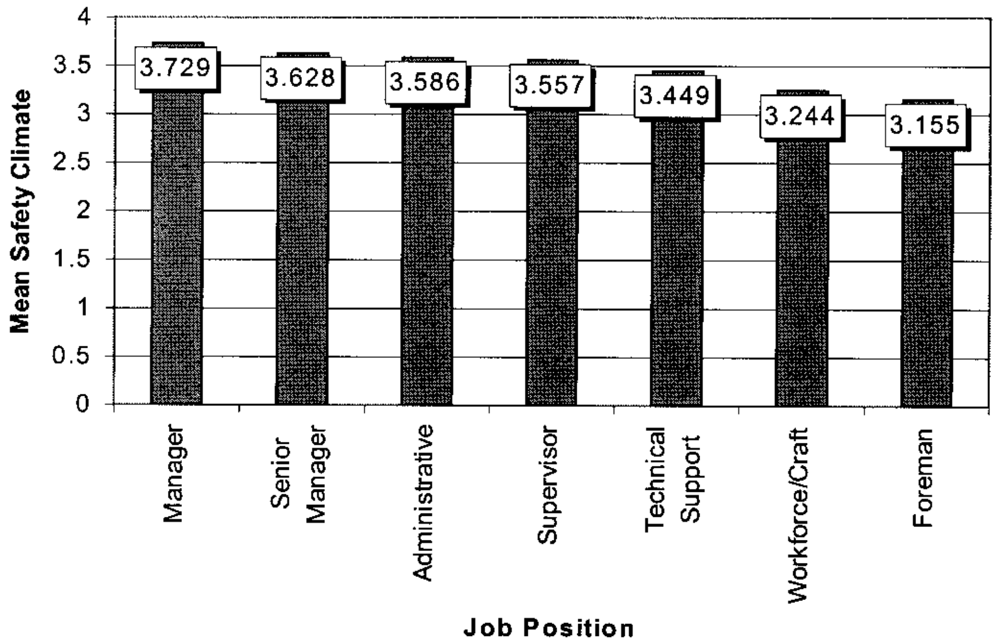


Figure 4. Mean Safety Climate by Job Position

Table 4.17

Group differences in mean safety climate scores among job positions

| | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|
| Contrast | 37.871 | 6 | 6.312 | 25.249 | .000 | 151.491 | 1.000 |
| Error | 337.485 | 1350 | .250 | | | | |

The F tests the effect of job position. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05

The results of post analysis of differences in mean safety climate scores by job positions are shown in data set B.5 in Appendix B.

The number of respondents who did not report a job position totaled 230 (14.5%). There was no significant difference ($p<0.05$) in mean safety climate scores between those reporting a job location and those who did not indicate a job position.

Significant differences ($p<0.05$) in mean factor scores were found among job positions. The mean factor scores by job position are shown in data set B.6 in Appendix B. Multivariate analysis of mean factor scores as related to job position resulted in significant F statistics ($<0.001$) except for factor 9 (permit to work). See Table 4.18. Post hoc analysis of the differences in mean factor scores by job positions are shown in data set B.7 in Appendix B.

The mean item scores were reviewed to identify differences in scores by job position. For purposes of this review, items were examined when the mean item scores ranged from 2.95 to 3.75 or greater. Eight of 71 (11.3%) items were found that met the examination criteria and are presented in Table 4.19. Multivariate analysis was performed to identify significant differences in the eight mean item scores. Each of the eight items differed significantly ($p<0.05$) in mean item scores by job position. Managers reported that people often do not take risks while foremen more often reported people do take risks at work. Senior managers, managers, supervisors, and administrative scored high on the belief that there was good communications about health and safety while foremen scored low. Senior managers reported that accidents are always reported at the same time that foremen believed they were not. Senior managers and managers self-

Table 4.18

Group differences in mean factor scores among job positions

| Factor | | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|
| 1 | Contrast | 73.677 | 6 | 12.280 | 27.769 | .000 | 166.615 | 1.000 |
| | Error | 588.130 | 1330 | .442 | | | | |
| 2 | Contrast | 33.596 | 6 | 5.599 | 9.608 | .000 | 57.646 | 1.000 |
| | Error | 775.128 | 1330 | .583 | | | | |
| 3 | Contrast | 54.296 | 6 | 9.049 | 16.208 | .000 | 97.248 | 1.000 |
| | Error | 742.571 | 1330 | .558 | | | | |
| 4 | Contrast | 12.947 | 6 | 2.158 | 6.189 | .000 | 37.134 | .999 |
| | Error | 463.711 | 1330 | .349 | | | | |
| 5 | Contrast | 35.738 | 6 | 5.956 | 11.762 | .000 | 70.572 | 1.000 |
| | Error | 673.506 | 1330 | .506 | | | | |
| 6 | Contrast | 23.641 | 6 | 3.940 | 10.412 | .000 | 62.474 | 1.000 |
| | Error | 503.291 | 1330 | .378 | | | | |
| 7 | Contrast | 44.791 | 6 | 7.465 | 18.264 | .000 | 109.586 | 1.000 |
| | Error | 543.609 | 1330 | .409 | | | | |
| 8 | Contrast | 33.679 | 6 | 5.613 | 14.441 | .000 | 86.646 | 1.000 |
| | Error | 516.970 | 1330 | .389 | | | | |
| 9 | Contrast | 3.253 | 6 | .542 | .677 | .668 | 4.065 | .273 |
| | Error | 1064.432 | 1330 | .800 | | | | |
| 10 | Contrast | 39.498 | 6 | 6.583 | 8.314 | .000 | 49.882 | 1.000 |
| | Error | 1053.130 | 1330 | .792 | | | | |

The F tests the effect of job position. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05

Table 4.19

Group differences (p<0.05) in item scores among job positions

| Item | Senior manager | Manager | Super-visor | Fore-men | Work-force | Tech-support | Admin |
|---|---|---|---|---|---|---|---|
| 2. People who work her often take risks when they are at work. | | + | | - | | | |
| 5. There are good communications here about health and safety issues. | + | + | + | - | | | + |
| 6. Accidents which happen are always reported. | + | | | - | | | |
| 16. Productivity is usually seen as more important than health and safety. | + | + | | - | - | | |
| 17.Manangement sometimes turns a blind eye to health and safety procedures/instructions/rules being broken. | + | + | | - | | | |
| 19. I am always informed of the outcome of meetings which address health and safety. | + | | | - | - | | |
| 53. People here are sometimes pressured to work unsafely by their co-workers. | + | + | | - | | | |
| 69. All the people who work in my organization are fully committed to health and safety. | | + | | - | | | |

\+ indicates mean item score was 3.75 of higher.
\- indicates mean item score was 2.95 or lower.

reported the belief that productivity is not more important than safety while foremen and the workforce reported the opposite. Foremen self-reported that management sometimes turns a blind eye to the breaking of health and safety rules but senior managers and managers did not. Senior managers reported they were always informed of the outcome of meetings that address health and safety at the same time foremen and the workforce felt they were not always informed. Foremen self-reported that people are sometimes pressured to work unsafely by co-workers while senior managers and managers did not. Finally, managers self-reported that all people in their organization were fully committed to health and safety while foremen reported that all in their organization were not fully committed.

3. *Are there significant differences in safety climate between those who self-reported an on-the-job injury during the previous 12 months and those who reported no injury among workers of a nuclear D&D employer located in the United States?*

Significant differences ($p<0.05$) in mean safety climate score and mean factor scores were found between those reporting an on-the-job injury or illness resulting in first aid treatment, medical treatment or lost/restricted time and those who reported no injury or illness. The mean item scores were reviewed to identify differences in scores by on-the-job injury or illness. For purposes of this review, items were examined when the mean item scores ranged from 2.95 to 3.75 or greater. There were no items that met the stated criteria for examination.

*First Aid Treatment Injury or Illness Past 12 Months*

Respondents who self-reported an on-the-job injury or illness in the previous 12 months resulting in first aid treatment (n = 126) had a mean safety climate item score of 3.061 compared to those who reported no on-the-job injury or illness (n = 1272) that had a mean safety climate item average of 3.408. See Figure 5. Analysis of variance of mean safety climate score as related to first aid injury or illness resulted in an F statistic of 51.785 ($p<0.05$). See Table 4.20. The negative mean difference (-0.347) in safety mean climate score indicates that those who reported a first aid injury scored lower on safety climate. See data set B.8 in Appendix B for the results of post hoc analysis.

The number of respondents who did not report whether or not they experienced a first aid injury totaled 189 (11.9%). There was no significant difference ($p<0.05$) in mean safety climate scores between those reporting whether or not they experienced a first aid injury and those who did not report.

Multiple analysis of mean factor scores as related to first aid injury or illnesses resulted in significant F statistics ($p<0.002$) except for factor number 9 (permit to work). See Table 4.21. The mean factor scores by first aid injury or illness is shown in data set B.9 in Appendix B. Post hoc analysis of the differences in mean factor scores by first aid injury or illness revealed significant difference ($p<0.05$) for all factors except number 9, permit to work. See data set B.10 in Appendix B.

*Medical Treatment Injury or Illness Past 12 Months*

Respondents who self-reported an on-the-job injury or illness in the previous 12 months resulting in medical treatment (n = 62) had a mean safety climate score of 2.934

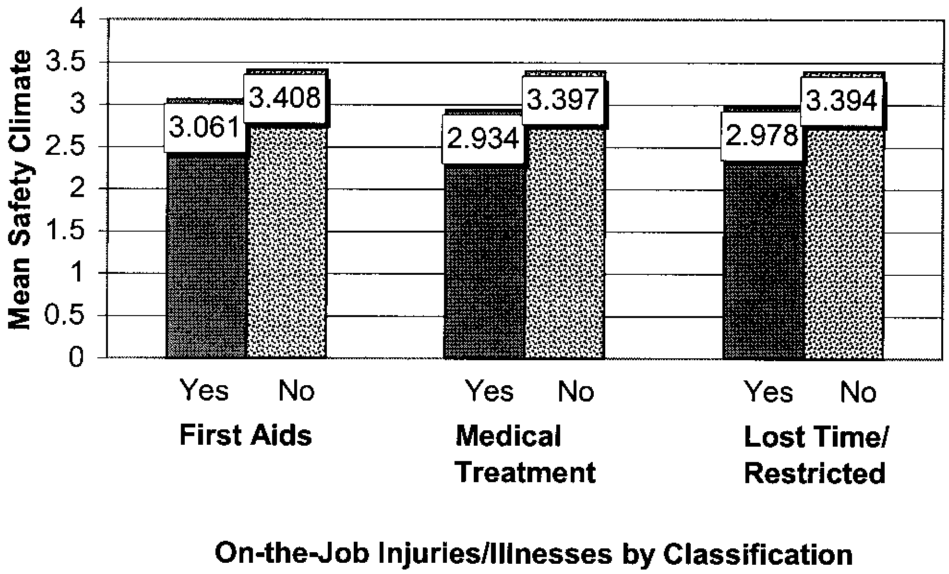


Figure 5. Mean Safety Climate by On-The-Job Injury or Illness.

Table 4.20

Group differences in mean safety climate score between respondents who reported a first aid injury/illness in previous 12 months and those who reported none

| | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|
| Contrast | 13.785 | 1 | 13.785 | 51.785 | .000 | 51.785 | 1.000 |
| Error | 371.612 | 1396 | .266 | | | | |

The F tests the effect of having reported a first aid injury/illness in the previous 12 months. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05

Table 4.21

Group differences in mean factor scores between respondents who reported a first aid injury/illness in the previous 12 months and those who reported none

| Factor | | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|
| 1 | Contrast | 22.294 | 1 | 22.294 | 46.524 | .000 | 46.524 | 1.000 |
| | Error | 657.456 | 1372 | .479 | | | | |
| 2 | Contrast | 12.975 | 1 | 12.975 | 22.048 | .000 | 22.048 | .997 |
| | Error | 807.413 | 1372 | .588 | | | | |
| 3 | Contrast | 26.152 | 1 | 26.152 | 44.904 | .000 | 44.904 | 1.000 |
| | Error | 799.046 | 1372 | .582 | | | | |
| 4 | Contrast | 6.880 | 1 | 6.880 | 19.450 | .000 | 19.450 | .993 |
| | Error | 485.334 | 1372 | .354 | | | | |
| 5 | Contrast | 11.476 | 1 | 11.476 | 21.964 | .000 | 21.964 | .997 |
| | Error | 716.831 | 1372 | .522 | | | | |
| 6 | Contrast | 3.898 | 1 | 3.898 | 10.024 | .002 | 10.024 | .886 |
| | Error | 533.571 | 1372 | .389 | | | | |
| 7 | Contrast | 20.125 | 1 | 20.125 | 47.248 | .000 | 47.248 | 1.000 |
| | Error | 584.393 | 1372 | .426 | | | | |
| 8 | Contrast | 10.667 | 1 | 10.667 | 26.284 | .000 | 26.284 | .999 |
| | Error | 556.791 | 1372 | .406 | | | | |
| 9 | Contrast | 1.174 | 1 | 1.174 | 1.468 | .226 | 1.468 | .228 |
| | Error | 1097.273 | 1372 | .800 | | | | |
| 10 | Contrast | 11.187 | 1 | 11.187 | 13.748 | .000 | 13.748 | .960 |
| | Error | 1116.411 | 1372 | .814 | | | | |

The F tests the effect of having reported a first aid injury/illness in the previous 12 months. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a Computed using alpha = .05

compared to those who reported noon-the-job injury or illness (n = 1337) that had a mean safety climate score of 3.397. See Figure 5. Analysis of variance of mean safety climate score as related to first aid injury or illness resulted in an F statistic of 47.766 ($p<0.05$). See Table 4.22. The negative mean difference (-0.464) in safety climate item score indicates that those who reported a medical treatment injury or illness scored lower on safety climate item. See data set B.11 in Appendix B for the results of post hoc analysis. The number of respondents who did not report whether or not they experienced a medical treatment injury totaled 188 (11.8%). There was no significant difference ($p<0.05$) in mean safety climate scores between those reporting whether or not they experienced a medical treatment injury and those who did not report.

Multiple analysis of mean factor scores as related to medical treatment injury or illnesses resulted in significant F statistics ($p<0.009$) except for factor number 9 (permit to work). See Table 4.23. The mean factor scores by medical treatment injury or illness are shown in data set B.12 in Appendix B. Post hoc analysis of the differences in mean factor scores by medical treatment injury or illness revealed significant difference ($p<0.05$) for all factors except number 9, permit to work. See data set B.13 in Appendix B.

*Lost Time or Restricted Injury or Illness in Past 12 Months*

Respondents who self-reported an on-the-job injury or illness in the previous 12 months resulting in lost time or restricted time (n = 56) had a mean safety climate score of 2.978 compared to those who reported no on-the-job injury or illness (n = 1338) that had a mean safety climate score of 3.394. See Figure 5. Analysis of variance of mean

Table 4.22

Group differences in mean safety climate score between respondents who reported medical treatment injury/illness in the previous 12 months and those who reported none

| | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|
| Contrast | 12.747 | 1 | 12.747 | 47.766 | .000 | 47.766 | 1.000 |
| Error | 372.804 | 1397 | .267 | | | | |

The F tests the effect of having reported a medical treatment injury/illness in the previous 12 months. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05.

Table 4.23

<u>Group differences in mean safety factor scores between respondents who reported medical treatment injury/illness in the previous 12 months and those who reported none</u>

| Factor | | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|
| 1 | Contrast | 18.721 | 1 | 18.721 | 38.896 | .000 | 38.896 | 1.000 |
| | Error | 660.831 | 1373 | .481 | | | | |
| 2 | Contrast | 17.010 | 1 | 17.010 | 28.773 | .000 | 28.773 | 1.000 |
| | Error | 811.689 | 1373 | .591 | | | | |
| 3 | Contrast | 20.129 | 1 | 20.129 | 34.192 | .000 | 34.192 | 1.000 |
| | Error | 808.310 | 1373 | .589 | | | | |
| 4 | Contrast | 8.631 | 1 | 8.631 | 24.450 | .000 | 24.450 | .999 |
| | Error | 484.670 | 1373 | .353 | | | | |
| 5 | Contrast | 9.309 | 1 | 9.309 | 17.791 | .000 | 17.791 | .988 |
| | Error | 718.445 | 1373 | .523 | | | | |
| 6 | Contrast | 11.203 | 1 | 11.203 | 29.254 | .000 | 29.254 | 1.000 |
| | Error | 525.797 | 1373 | .383 | | | | |
| 7 | Contrast | 13.829 | 1 | 13.829 | 32.102 | .000 | 32.102 | 1.000 |
| | Error | 591.441 | 1373 | .431 | | | | |
| 8 | Contrast | 8.714 | 1 | 8.714 | 21.400 | .000 | 21.400 | .996 |
| | Error | 559.080 | 1373 | .407 | | | | |
| 9 | Contrast | .000 | 1 | .000 | .001 | .982 | .001 | .050 |
| | Error | 1101.373 | 1373 | .802 | | | | |
| 10 | Contrast | 5.675 | 1 | 5.675 | 6.934 | .009 | 6.934 | .749 |
| | Error | 1123.613 | 1373 | .818 | | | | |

The F tests the effect of reported medical treatment injury/illness in the previous 12 months. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05

safety climate score as related to first aid injury or illness resulted in an F statistic of 34.726 ($p<0.05$). See Table 4.24. The negative mean difference (-0.416) in safety climate item score indicates that those who reported a lost time or restricted injury or illness scored lower on safety climate item. See data set B.14 in Appendix B for the results of post hoc analysis.

The number of respondents who did not report whether or not they experienced a lost time or restricted injury totaled 193 (12.2%). There was no significant difference ($p<0.05$) in mean safety climate scores between those reporting whether or not they experienced a lost time or restricted injury and those who did not report.

Multiple analysis of variance of factor scores as related to a lost time or restricted injury or illnesses resulted in significant F statistics ($p<0.05$) except for factor number 9 (permit to work). See Table 4.25. The mean factor scores by lost time or restricted injury or illness are shown in data set B.15 in Appendix B. Post hoc analysis of the differences in mean factor scores by lost time or restricted injury or illness revealed significant difference ($p<0.05$) for all factors except number 9, permit to work. See data set B.16 in Appendix B.

*4. Are there significant differences between self-reported safety climate and safety-oriented behavior, as measured by self-reported participation in a behavior-based safety process, among workers of a nuclear D&D employer located in the United States?*

Significant differences ($p<0.05$) in mean safety climate score and mean factor scores were found between those self-reporting participation in safety-oriented behavior and those who self-reported no safety-oriented behavior that included 1) attending a 2-

Table 4.24

Group differences in mean safety climate scores between respondents who reported a lost time/restricted injury/illnesses in the previous 12 months and those who reported none

| | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|
| Contrast | 9.302 | 1 | 9.302 | 34.726 | .000 | 34.726 | 1.000 |
| Error | 372.873 | 1392 | .268 | | | | |

The F tests the effect of having reported a lost time/restricted injury/illness in the previous 12 months. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a Computed using alpha = .05

Table 4.25

Group differences in mean safety climate factor scores between respondents who reported a lost time/restricted injury/illness in the previous 12 months and those who reported none

| Factor | | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|
| 1 | Contrast | 11.481 | 1 | 11.481 | 23.759 | .000 | 23.759 | .998 |
| | Error | 661.528 | 1369 | .483 | | | | |
| 2 | Contrast | 13.090 | 1 | 13.090 | 22.034 | .000 | 22.034 | .997 |
| | Error | 813.313 | 1369 | .594 | | | | |
| 3 | Contrast | 16.398 | 1 | 16.398 | 27.870 | .000 | 27.870 | 1.000 |
| | Error | 805.506 | 1369 | .588 | | | | |
| 4 | Contrast | 4.269 | 1 | 4.269 | 12.051 | .001 | 12.051 | .934 |
| | Error | 484.930 | 1369 | .354 | | | | |
| 5 | Contrast | 7.758 | 1 | 7.758 | 14.844 | .000 | 14.844 | .971 |
| | Error | 715.484 | 1369 | .523 | | | | |
| 6 | Contrast | 5.919 | 1 | 5.919 | 15.315 | .000 | 15.315 | .974 |
| | Error | 529.119 | 1369 | .387 | | | | |
| 7 | Contrast | 11.044 | 1 | 11.044 | 25.560 | .000 | 25.560 | .999 |
| | Error | 591.545 | 1369 | .432 | | | | |
| 8 | Contrast | 5.337 | 1 | 5.337 | 13.058 | .000 | 13.058 | .951 |
| | Error | 559.548 | 1369 | .409 | | | | |
| 9 | Contrast | .052 | 1 | .052 | .065 | .799 | .065 | .057 |
| | Error | 1097.933 | 1369 | .802 | | | | |
| 10 | Contrast | 10.552 | 1 | 10.552 | 13.021 | .000 | 13.021 | .950 |
| | Error | 1109.391 | 1369 | .810 | | | | |

The F tests the effect of a reported lost time/restricted injury/illness in the previous 12 months. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05

hour introductory behavior-based safety training, 2) attending an 8-hour behavior-based safety observation training in the previous 12 months, and 3) conducting behavior-based safety observations in the previous month. The mean item scores were reviewed to identify differences in scores by safety-oriented behavior. For purposes of this review, items were examined when the mean item scores ranged from 2.95 to 3.75 or greater. There were no items that met the stated criteria for examination.

### *Introductory Behavior-Based Safety Training in Past 12 Months*

Respondents who reported attending introductory behavior-based safety training in the previous 12 months (n = 1,046) had a mean safety climate score of 3.420 compared to those who reported no attendance at the introductory training (n = 471) that had a mean safety climate score of 3.255. See Figure 6. Analysis of variance of mean safety climate score as related to introductory behavior-based safety training resulted in an F statistic of 32.781 ($p<0.05$). See Table 4.26. The positive mean difference (0.165) in safety climate score indicates that those who reported having completed an introductory behavior-based safety training class in the previous 12 months scored higher on safety climate item. See data set B.17 in Appendix B for the results of post hoc analysis.

The number of respondents who did not report whether or not they attended introductory behavior-based safety training in the past 12 months totaled 70 (4.4%). There was no significant difference ($p<0.05$) in mean safety climate scores between those reporting whether or not they attended introductory behavior-based safety training and those who did not report.

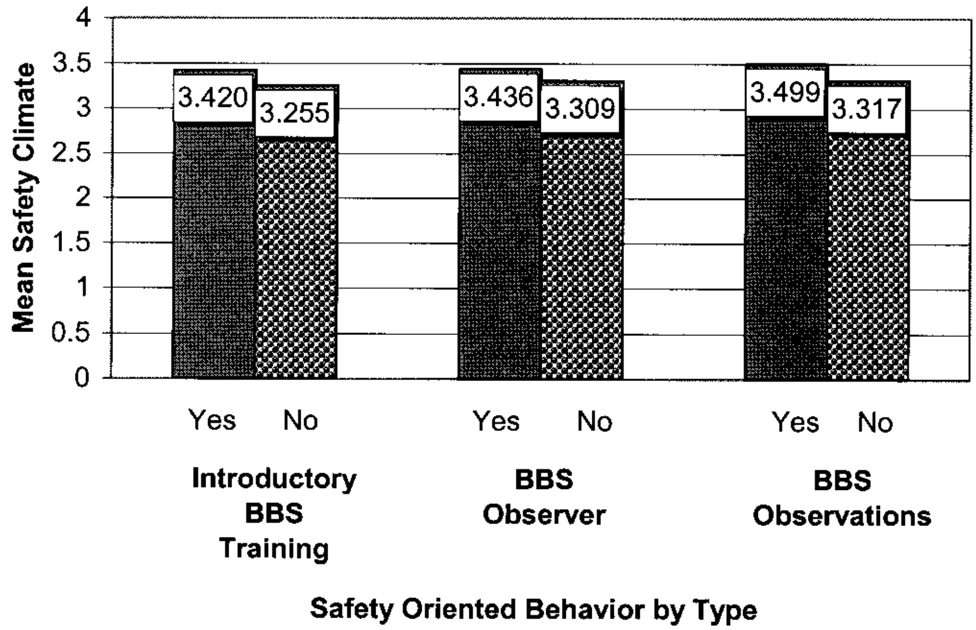


Figure 6. Mean Safety Climate by Safety-Oriented Behavior

Table 4.26

Group differences in mean safety climate scores between respondents who reported behavior-based safety training in the previous 12 months and those who reported none

| | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|
| Contrast | 8.838 | 1 | 8.838 | 32.781 | .000 | 32.781 | 1.000 |
| Error | 408.467 | 1515 | .270 | | | | |

The F tests the effect of reported BBS training in the previous 12 months. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05

Multi-variant analysis of mean factor scores as related to training attendance resulted in significant F statistics ($p<0.05$) except for factor numbers 8 (obstacles to safe behavior) and 10 (reporting of accidents and near misses). See Table 4.27. The mean factor scores for reported attendance at introductory behavior-based safety training are shown in data set B.18 in Appendix B. Post hoc analysis of the differences in mean factor scores by introductory behavior-based safety training revealed significant difference ($p<0.05$) for all factors except number 8, obstacles to safe behavior and number 10, reporting of accidents and near misses. See data set B.19 in Appendix B.

### *Behavior-Based Safety Observer Training Past 12 Months*

Respondents who reported attending an 8-hour behavior-based safety observation training course in the previous 12 months ($n = 686$) had a mean safety climate score of 3.436 compared to those who reported no observer training ($n = 810$) that had a mean safety climate item average of 3.309. See Figure 6. Analysis of variance of mean safety climate score as related to behavior-based safety observation training resulted in an F statistic of 22.117 ($p<0.05$). See Table 4.28. The positive mean difference (0.127) in safety climate item score indicates that those who reported having completed the behavior-based safety observer training class in the previous 12 months scored higher on safety climate item. See data set B.20 in Appendix B for the results of post hoc analysis. The number of respondents who did not report whether or not they attended behavior-based safety observer training in the past 12 months totaled 91 (5.7%). There was no significant difference ($p<0.05$) in mean safety climate scores between those reporting whether or not they attended behavior-based safety observer training and those who did

Table 4.27

Group differences in mean safety climate factor scores between respondents who reported behavior-based safety training in the previous 12 months and those who reported none

| Factor | | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|
| 1 | Contrast | 17.803 | 1 | 17.803 | 36.419 | .000 | 36.419 | 1.000 |
| | Error | 733.733 | 1501 | .489 | | | | |
| 2 | Contrast | 26.539 | 1 | 26.539 | 45.107 | .000 | 45.107 | 1.000 |
| | Error | 883.106 | 1501 | .588 | | | | |
| 3 | Contrast | 15.967 | 1 | 15.967 | 26.681 | .000 | 26.681 | .999 |
| | Error | 898.290 | 1501 | .598 | | | | |
| 4 | Contrast | 1.720 | 1 | 1.720 | 4.820 | .028 | 4.820 | .593 |
| | Error | 535.640 | 1501 | .357 | | | | |
| 5 | Contrast | 9.139 | 1 | 9.139 | 17.438 | .000 | 17.438 | .987 |
| | Error | 786.662 | 1501 | .524 | | | | |
| 6 | Contrast | 11.231 | 1 | 11.231 | 29.106 | .000 | 29.106 | 1.000 |
| | Error | 579.166 | 1501 | .386 | | | | |
| 7 | Contrast | 11.242 | 1 | 11.242 | 25.755 | .000 | 25.755 | .999 |
| | Error | 655.182 | 1501 | .436 | | | | |
| 8 | Contrast | 1.557 | 1 | 1.557 | 3.802 | .051 | 3.802 | .495 |
| | Error | 614.603 | 1501 | .409 | | | | |
| 9 | Contrast | 6.471 | 1 | 6.471 | 8.119 | .004 | 8.119 | .813 |
| | Error | 1196.366 | 1501 | .797 | | | | |
| 10 | Contrast | 2.796 | 1 | 2.796 | 3.381 | .066 | 3.381 | .451 |
| | Error | 1241.150 | 1501 | .827 | | | | |

The F tests the effect of reported behavior-based safety training in the previous 12 months. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Table 4.28

Group differences in mean safety climate scores between respondents who reported behavior-based safety observation training in the previous 12 months and those who reported none

| | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|
| Contrast | 5.990 | 1 | 5.990 | 22.117 | .000 | 22.117 | .997 |
| Error | 404.628 | 1494 | .271 | | | | |

The F tests the effect of behavior-based safety observation training. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a Computed using alpha = .05

not report.

Multiple analysis of variance of mean factor scores as related to behavior-based safety observation training resulted in significant F statistics ($p<0.05$) except for factor numbers 4 (personal role), 8 (obstacles to safe behavior and 10 (reporting of accidents and near misses). See Table 4.29. The mean factor scores by attendance at behavior-based safety observation training are shown in data set B.21 in Appendix B. Post hoc analysis of the differences in mean factor scores by introductory behavior-based safety training revealed significant difference ($p<0.05$) for all factors except number 4, personal role; number 8, obstacles to safe behavior; and number 10, reporting of accidents and near misses. See data set B.22 in Appendix B.

### *Behavior-Based Safety Observation in the Past Month*

Respondents who reported conducting a behavior-based safety observation in the previous month (n = 413) had a mean safety climate score of 3.499 compared to those who reported no observations (n = 1084) and that had a mean safety climate score of 3.317. See Figure 6. Analysis of variance of mean safety climate scores as related to behavior-based safety observations resulted in an F statistic of 36.974 ($p<0.05$). See Table 4.30. The positive mean difference (0.182) in mean safety climate score indicates that those who reported having completed a behavior-based safety observation in the previous month scored higher on safety climate. See data set B.23 in Appendix B for the results of post hoc analysis.

Table 4.29

Group differences in mean safety climate factor scores between respondents who reported behavior-based safety observation training in the previous 12 months and those who reported none

| Factor | | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|
| 1 | Contrast | 17.167 | 1 | 17.167 | 35.273 | .000 | 35.273 | 1.000 |
| | Error | 720.320 | 1480 | .487 | | | | |
| 2 | Contrast | 15.286 | 1 | 15.286 | 25.571 | .000 | 25.571 | .999 |
| | Error | 884.726 | 1480 | .598 | | | | |
| 3 | Contrast | 8.800 | 1 | 8.800 | 14.603 | .000 | 14.603 | .968 |
| | Error | 891.939 | 1480 | .603 | | | | |
| 4 | Contrast | .388 | 1 | .388 | 1.073 | .300 | 1.073 | .179 |
| | Error | 535.347 | 1480 | .362 | | | | |
| 5 | Contrast | 5.007 | 1 | 5.007 | 9.518 | .002 | 9.518 | .869 |
| | Error | 778.561 | 1480 | .526 | | | | |
| 6 | Contrast | 4.658 | 1 | 4.658 | 11.871 | .001 | 11.871 | .931 |
| | Error | 580.770 | 1480 | .392 | | | | |
| 7 | Contrast | 7.427 | 1 | 7.427 | 16.914 | .000 | 16.914 | .984 |
| | Error | 649.859 | 1480 | .439 | | | | |
| 8 | Contrast | 1.501 | 1 | 1.501 | 3.676 | .055 | 3.676 | .483 |
| | Error | 604.239 | 1480 | .408 | | | | |
| 9 | Contrast | 9.658 | 1 | 9.658 | 12.101 | .001 | 12.101 | .935 |
| | Error | 1181.219 | 1480 | .798 | | | | |
| 10 | Contrast | .453 | 1 | .453 | .549 | .459 | .549 | .115 |
| | Error | 1221.044 | 1480 | .825 | | | | |

The F tests the effect of reported behavior-based safety observation training`. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a Computed using alpha = .05

Table 4.30

Group differences in mean safety climate scores between respondents who reported behavior-based safety observation in the previous month and those who reported none

| | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|
| Contrast | 9.898 | 1 | 9.898 | 36.974 | .000 | 36.974 | 1.000 |
| Error | 400.200 | 1495 | .268 | | | | |

The F tests the effect of reported behavior-based safety observation in the previous month. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a Computed using alpha = .05

The number of respondents who did not report whether or not they conducted a behavior-based safety observation in the past month totaled 90 (5.7%). There was no significant difference ($p<0.05$) in mean safety climate scores between those reporting whether or not they conducted a behavior-based safety observation and those who did not.

Multiple analysis of variance of mean factor scores as related to behavior-based safety observations resulted in significant F statistics ($p<0.05$) except for factor numbers 4 (personal role) and 10 (reporting of accidents and near misses). See Table 4.31. The mean factor scores by a reported behavior-based safety observation having been completed in the previous month are shown in data set B.24 in Appendix B. Post hoc analysis of the differences in mean factor scores by introductory behavior-based safety training revealed significant difference ($p<0.05$) for all factors except number 4, personal role and number 10, reporting of accidents and near misses. See data set B.25 in Appendix B.

## Summary

The overall survey response rate of 48.1 percent was sufficiently high to assume the responses were representative of the study population. However, a low response rate of 13.8 percent at the location designated number 2 raises concern over the survey results for that location. The remaining locations had response rates ranging from 40.6 to 78.6 percent and thus, the survey data is assumed to be representative of the study population at these locations.

Table 4.31

Group differences in mean safety climate factor scores between respondents who reported behavior-based safety observation in the previous month and those who reported none

| Factor | | Sum of Squares | df | Mean Square | F | Sig. | Noncent. Parameter | Observed Power(a) |
|---|---|---|---|---|---|---|---|---|
| 1 | Contrast | 25.890 | 1 | 25.890 | 54.153 | .000 | 54.153 | 1.000 |
| | Error | 708.525 | 1482 | .478 | | | | |
| 2 | Contrast | 21.723 | 1 | 21.723 | 37.035 | .000 | 37.035 | 1.000 |
| | Error | 869.259 | 1482 | .587 | | | | |
| 3 | Contrast | 18.519 | 1 | 18.519 | 31.250 | .000 | 31.250 | 1.000 |
| | Error | 878.240 | 1482 | .593 | | | | |
| 4 | Contrast | .933 | 1 | .933 | 2.592 | .108 | 2.592 | .363 |
| | Error | 533.284 | 1482 | .360 | | | | |
| 5 | Contrast | 7.968 | 1 | 7.968 | 15.191 | .000 | 15.191 | .974 |
| | Error | 777.339 | 1482 | .525 | | | | |
| 6 | Contrast | 8.396 | 1 | 8.396 | 21.635 | .000 | 21.635 | .996 |
| | Error | 575.149 | 1482 | .388 | | | | |
| 7 | Contrast | 12.510 | 1 | 12.510 | 28.696 | .000 | 28.696 | 1.000 |
| | Error | 646.069 | 1482 | .436 | | | | |
| 8 | Contrast | 2.853 | 1 | 2.853 | 6.991 | .008 | 6.991 | .753 |
| | Error | 604.832 | 1482 | .408 | | | | |
| 9 | Contrast | 9.160 | 1 | 9.160 | 11.543 | .001 | 11.543 | .924 |
| | Error | 1176.118 | 1482 | .794 | | | | |
| 10 | Contrast | 1.432 | 1 | 1.432 | 1.741 | .187 | 1.741 | .261 |
| | Error | 1219.449 | 1482 | .823 | | | | |

The F tests the effect of reported behavior-based safety observation in the previous month. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
a. Computed using alpha = .05

Based on the results of the self-reported survey the respondents can be characterized as largely employed by one company (66.7%), male (66.9%), white (74.5%) and ranged in age from 36 to 55 years (54.7%). Twenty eight percent of the respondents were exempt (salaried) workers and 65% were non-exempt (hourly). A total of 466 respondents (29.4%) self-reported membership in a union with Laborers (13.6%) being the most frequent union affiliation. The years in current profession and years at their current location were evenly spread across the available ranges. The frequency of reported job positions included: workforce/craft – 667 (42.0%); technical support – 321 (20.2%); not reported 230 (14.5%), 114 (7.2%) administrative; 103 (6.5%) managers; 72 (4.5%) supervisors; 63 (4.0%) foremen; and 17 (1.1%) senior managers. The reported work-shift included 1,177 (74.2%) weekdays, 175 (11%) weekday nights; and 155 (9.8%) weekends.

Respondents' reported on-the-job injury and illness experiences in the previous 12 months included 126 (7.9%) first aids, 62 (3.9%) medical treatments, and 56 (3.5%) lost/restricted.

The respondents' reported participation in safety-oriented behavior included 1,046 (65.9%) who completed introductory behavior-based safety training in the previous 12 months; 686 (43.2%) who completed behavior-based safety observer training in the previous 12 months; and 413 (26.0%) who conducted a behavior-based safety observation in the previous month.

Reliability analysis demonstrated that all factors except for number 9, permit to work and number 11, general worker satisfaction, possessed acceptable internal consistency. Further analysis of factor number 9 revealed that deleting item number 22, (The work permit/work package/procedure system is always strictly applied and followed.) raised the internal consistency of factor 9 to an acceptable level. Item 22 was deleted from all calculations of factor 9 but was retained in the calculation of the safety climate score. Factor 11 was deleted from the subsequent statistical analysis that addressed the research questions but again the items contained in the factor were included in the calculation of safety climate score.

Significant differences ($p<0.05$) were identified among groups for all four research questions. Mean safety climate scores and mean factor scores differed by location ($p<0.05$), job position ($p<0.05$), on-the-job injury illness ($p<0.05$), and behavior-based safety participation ($p<0.05$). Foreman had the lowest mean safety climate score of all reported job positions. On average those who reported an on-the-job injury or illness scored lower on safety climate while those who reported participation in safety-oriented behavior scored higher on safety climate. Eight (11.3%) mean item scores ranged from 2.95 to 3.75 or greater by job position and these differences among mean item scores were significant ($p<0.05$). Foremen consistently had the lowest mean item scores on these eight items while the higher mean item scores were for senior managers and/or managers.

## Chapter V

## SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

### Summary

The purpose of this study was to evaluate group differences in safety climate among workers in the nuclear decommissioning and demolition (D&D) industry in the United States. Respondents numbering 1,587 out of a total of 3,296 (48.1%) voluntarily and anonymously completed a safety climate survey. The survey instrument, the Climate Survey Tool (CST), was selected based on its appropriateness as a measure of safety climate among workers in high reliability industries. The CST included 71 five point Likert items that elicited respondents' attitudes and perceptions about 11 factors deemed key to a healthy safety climate. The CST also included nineteen demographic questions. The survey was prepared in a tri-fold front and back page format and scored electronically. The scanned survey data was transferred from an EXCEL file into a Statistical Program for Social Sciences (SPSS) database for analysis.

Descriptive and inferential statistical analysis was performed. Factor reliability was established by computation of Cronbach's alphas. Group differences in mean safety climate scores, mean factor scores and mean item scores were identified through analysis of variance (ANOVA) and multiple analysis of variance (MANOVA). Specific differences in safety climate among groups was characterized by post hoc analysis with Tukey's HSD.

## General Findings

1. The overall survey response rate of 48.1 percent is sufficient to assume that the survey respondents are representative of the study population.
2. The overall reliability of factors proved acceptable and was strengthened by the deletion of factor 11, general worker satisfaction, and item number 22 from factor number 9, permit to work.
3. Significant group differences ($p<0.05$) in mean safety climate scores and mean factor scores were detected by location, job position, on-the-job injury and illness, and safety-oriented behavior.
4. Significant differences ($p<0.05$) were found for all factors when grouped by location, job position, on-the-job injury or illness, and safety-oriented behavior except for the following:

   a. The location group means for factor # 4, personal role.

   b. The job position group means for factor #9, permit to work.

   c. The on-the-job injury group means including first aids, medical treatments, and lost time or restricted for factor #9, permit to work.

   d. The safety-oriented behavior group means for factors #4, personal role; #8, obstacles to safe behavior; and #10, reporting of accidents and near misses.

## Findings Related to the Research Questions

*Research question #1: Are there significant differences in safety climate among self-reported geographic work locations among workers of a nuclear D&D employer located in the United States who use the same safety management system?*

1. Significant differences ($p<0.05$) in mean safety climate scores and mean factor scores were identified among locations.
2. The mean difference in safety climate score between the lowest scoring location and the highest scoring location was –0.968.
3. Post hoc analysis revealed that the mean safety climate score for each of the 11 locations significantly differed ($p<0.05$) from at least one other location.

*Research question # 2: Are there significant differences in safety climate among self-reported job positions among workers of a nuclear D&D employer located in the United States?*

1. Significant differences ($p<0.05$) in mean safety climate score and mean factor scores were identified among job positions.
2. Foremen and workforce/craft had the lowest mean safety climate scores (3.155 and 3.244, respectively) and these mean scores were significantly different ($p<0.05$) than senior managers, managers, supervisors, technical support, and administrative.
3. Managers had the highest mean safety climate score (3.729) and this group's mean score was significantly different ($p<0.05$) than the mean safety climate score for supervisors, foremen, workforce/craft, technical support and administrative.
4. Significant differences ($p<0.05$) in mean item scores by job position were identified for eight items. For purposes of this study items were examined if the mean item scores ranged from 2.95 to 3.75 or greater. Foremen consistently had

mean item scores of 2.95 or lower on all eight items while the mean item scores for senior managers and/or managers were 3.75 or higher.

*Research Question #3: Are there significant differences in safety climate between those who self-reported an on-the-job injury during the previous 12 months and those who reported no injury among workers of a nuclear D&D employer located in the United States?*

1. Significant differences ($p<0.05$) in mean safety climate scores and mean factor scores were found between those who reported an on-the-job first aid injury or illness in the previous 12 months and those who did not.
2. The significant difference ($p<0.05$) in mean safety climate score between those who reported an on-the-job first aid injury or illness in the previous 12 months and those who did not was –0.448 and indicates that the mean safety climate is lower for those who reported a first aid injury or illness in the previous 12 months.
3. Significant differences ($p<0.05$) in mean safety climate score and mean factor score were found between those who reported an on-the-job medical treatment injury or illness in the previous 12 months and those who did not.
4. The significant difference ($p<0.05$) in mean safety climate scores between those who reported an on-the-job medical treatment injury or illness in the previous 12 months and those who did not was –0.464 and indicates that the mean safety climate is lower for those who reported a medical treatment injury or illness in the previous 12 months.

5. Significant differences ($p<0.05$) in mean safety climate scores and mean factor scores were found between those who reported an on-the-job lost-time/restricted injury or illness in the previous 12 months and those who did not.
6. The significant difference ($p<0.05$) in mean safety climate score between those who reported an on-the-job lost-time/restricted injury or illness in the previous 12 months and those who did not was –0.464 and indicates that the mean safety climate is lower for those who reported a lost-time/restricted injury or illness in the previous 12 months.

*Research question #4: Are there significant differences between self-reported safety climate and safety-oriented behavior, as measured by self-reported participation in a behavior-based safety process, among workers of a nuclear D&D employer located in the United States?*

1. Significant differences ($p<0.05$) in mean safety climate scores and mean factor scores were found between those who reported attending an introductory behavior-based safety training course in the previous 12 months and those who reported none.
2. The significant difference ($p<0.05$) in mean safety climate scores between those who reported attending an introductory behavior-based safety course in the previous 12 months and those who did not was 0.165 and indicates that the mean safety climate is higher for those who reported attending an introductory behavior-based safety training course.

3. Significant differences ($p<0.05$) in mean safety climate scores and mean factor scores were found between those who reported attending a behavior-based safety observation training course in the previous 12 months and those who did not.
4. The significant difference ($p<0.05$) in mean safety climate scores between those who reported attending the behavior-based safety observation training in the previous 12 months and those who did not was 0.127 and indicates that the mean safety climate is higher for those who reported attending the behavior-based safety observation training in the previous 12 months.
5. Significant differences ($p<0.05$) in mean safety climate scores and mean factor scores were found between those who reported conducting a behavior-based safety observation in the previous month and those who did not.
6. The significant difference ($p<0.05$) in mean safety climate scores between those who reported conducting a behavior-based safety observation in the previous month and those who did not was 0.182 and indicates that the mean safety climate is higher for those who reported conducting a behavior-based safety observation in the previous 12 months.

## Conclusions

Within the limitations of this study, analysis of the data, and the findings presented in the previous section, the following conclusions can be drawn.

*Research question #1: Are there significant differences in safety climate among self-reported geographic work locations among workers of a nuclear D&D employer located in the United States who use the same safety management system?*

Workers at different geographic locations may not have the same self reported attitudes and perceptions about safety (safety climate) even though the safety management systems are the same. Therefore, factors other than the safety management system must be responsible.

*Research question # 2: Are there significant differences in safety climate among self-reported job positions among workers of a nuclear D&D employer located in the United States?*

The self-reported safety attitudes and perceptions of the majority of managers/support staff in the nuclear D&D industry in the United States supports a strong safety climate while the self-reported safety attitudes and perceptions of the majority of the foremen/workforce do not reflect this same strong safety climate.

*Research Question #3: Are there significant differences in safety climate between those who self-reported an on-the-job injury during the previous 12 months and those who reported no injury among workers of a nuclear D&D employer located in the United States?*

The self-reported safety attitudes and perceptions of the majority of workers in the nuclear D&D industry in the United States who self-reported no on-the-job injury or illness supports a strong safety climate while the self-reported safety attitudes and perceptions of the majority of workers who self-reported an on-the-job injury or illness do not reflect this same strong safety climate.

*Research question #4: Are there significant differences between self-reported safety climate and safety-oriented behavior, as measured by self-reported participation in a* *behavior-based safety process, among workers of a nuclear D&D employer located in the United States?*

The self-reported safety attitudes and perceptions of the majority of workers in the nuclear D&D industry in the United States who self-reported participation in safety-oriented behavior support a strong safety climate while the self-reported safety attitudes and perceptions of the majority of workers who self-reported no participation in safety-oriented behavior do reflect the same strong safety climate.

## Recommendations

The following recommendations are based upon the findings and the conclusions of this study as they relate to the four research questions:

*Research question #1: Are there significant differences in safety climate among self-reported geographic work locations among workers of a nuclear D&D employer located in the United States who use the same safety management system?*

Based on the conclusion that differences in self-reported safety climate among geographic locations in the nuclear D&D industry in the United States who use common safety management systems are attributable to factors other than the safety management system, safety process improvements should address social, political and human factors.

*Research question # 2: Are there significant differences in safety climate among self-reported job positions among workers of a nuclear D&D employer located in the United States?*

Given the evidence for the existence of two safety cultures in the nuclear D&D industry in the United States characterized by a strong safety climate among managers/support staff and negative relationship between hands-on work and safety climate, efforts to improve safety climate should focus on workers performing hands-on work.

*Research Question #3: Are there significant differences in safety climate between those who self-reported an on-the-job injury during the previous 12 months and those who reported no injury among workers of a nuclear D&D employer located in the United States?*

Based on the conclusion that worker safety attitudes and perceptions in high reliability industries degrade with the occurrence of on-the-job injuries and illnesses, immediate and long term follow up with workers in high reliability industries who experience on-the-job injuries or illnesses should extend beyond their physical well-being to include social, political, and human factors that bear on the health of their safety attitudes and perceptions.

*Research question #4: Are there significant differences between self-reported safety climate and safety-oriented behavior, as measured by self-reported participation in a behavior-based safety process, among workers of a nuclear D&D employer located in the United States?*

Based on the conclusion that a the positive effect that participation in the safety program has on worker safety attitudes and perceptions, the participation of workers in high reliability industries in safety-oriented behavior should be fostered by all levels of management.

## Recommendations for Further Research

The significant differences in safety climate this research found among locations, job positions, on-the-job injury and illness experience, and safety-oriented behavior suggests that other group differences in safety climate such as age, work shift, length of employment, and years of experience should be explored in future safety climate research. Additional findings of group differences in safety climate can better enable management teams to focus safety process improvements. Group differences in safety climate to be investigated in future research may include:

1. Age, gender, and ethnicity.
2. Length of employment and years of experience.
3. Work shift.
4. Union membership.

## Summary

This study demonstrated the existence of significant group differences in self-reported safety climate among workers in the nuclear D&D industry in the United States. The study findings included significant differences in safety climate among locations, job positions, on-the-job injury and illness experiences, and safety-oriented behavior. Differences in self-reported safety climate among locations in high reliability industries are attributable to elements other than safety management systems. Differences in the self-reported safety climate among job positions in high reliability industries adduce evidence of two safety cultures in high reliability industries characterized by a negative relationship between hands-on work and safety climate. Differences in self-reported safety climate by self-reporting of on-the-job injuries or illness attests that worker safety attitudes and perceptions in high reliability industries degrade with the occurrence of on-the-job injuries and illnesses. Differences in self-reported safety climate by self-reported participation in safety-oriented behavior bespeaks the positive effect that participation in the safety program has on worker safety attitudes and perceptions. Recommended safety improvement strategies include 1) addressing the contributions of elements other than safety management systems such as social, political and human factors to the safety climate across locations; 2) attending to the self reported safety climate of the workers performing hands-on work; 3) implementing immediate and long term follow up with workers experiencing on-the-job injuries or illnesses; and 4) ensuring management support of worker participation in safety-oriented behavior. Based on the study findings and conclusions, further research into group differences in safety climate in high reliability industries is recommended to better enable management teams to focus safety process improvements.

# Chapter VI

# THE STUDY IN RETROSPECT

## Introduction

This chapter presents a retrospective review of the study covering the strengths, weaknesses, and other issues that did not lead themselves to analysis but may have been reflected in the outcomes of the investigation. The purpose of this study was to evaluate group differences in safety climate among workers in the nuclear D&D industry in the United States.

## Strengths

The strengths of the study are many and included the following.

1. The nuclear D&D employer was fully committed to undertaking a safety climate survey at all their locations in the United States and freely provided personnel and financial resources, including support staff, freeing up time for workers to attend the safety meetings and complete the surveys, the hiring of a specialty contractor to develop the survey format and electronically score the surveys and providing permission for the researcher who was employed by the nuclear D&D employer to conduct the survey. In addition, conducting the research in affiliation with the University of Tennessee resulted in the creation and implementation of study control measures to ensure human subjects research guidelines were closely followed. While these control measures resulted in additional effort over and above that the nuclear D&D employer would have expended on its own, the nuclear D&D employer cooperated fully.

2. The study population provided a uniquely homogeneous set of locations and workers that lent its self to the evaluation of group differences in safety climate among workers in the nuclear D&D industry in the United States. Environment, health and safety in the nuclear D&D industry is closely regulated and the implementation of safety management systems is highly standardized. This standardization of programs served to control extraneous bias that could mask true group differences in safety climate attributable only to safety attitudes and perceptions.
3. The availability of a valid and reliable survey instrument that had been successfully employed in the nuclear industry in the United Kingdom and undergone extensive refinement as result of the evaluation of thousands of survey responses enabled the researcher to dedicate research resources principally to the study of group differences.
4. The overall response rate for the survey was excellent and provided sufficient sample sub sets to identify significant group differences in safety climate.
5. The large size of the available study population facilitated the evaluation of group differences that would not have been possible with a smaller study population.
6. The use a specialty contractor to develop the survey format and electronically score the surveys saved immeasurable time and contributed to the accuracy of the inputted data.

## Weaknesses

While the weaknesses of the study were few and successfully managed, they nonetheless are important to the understanding of the study. The study weaknesses included the following.

1. The study locations were geographically dispersed across the United States and thus, the onsite involvement of the researcher at all locations was impractical. With the exception of one location with significant numbers of workers the researcher relied on the support of personnel at each of the locations to properly implement the study procedures and control measures.
2. The length of the survey required up to 20 minutes to complete. Feedback from some participants was that the survey was overly lengthy and this contributed to the numbers of missing item responses.
3. The survey included a number of demographic questions to facilitate the current and future study of group differences. Despite the study controls in place to ensure confidentiality and anonymity, some participants voiced concern that answering certain questions could lead to the their identification.
4. Safety climate surveys measure safety attitudes and perceptions at one point in time. The association of safety climate with other safety performance indicators expressed over time is problematic. For purposes of this study, the timeframe for the interaction between safety climate and, injuries/illness and behavior-based safety training was set at 12 months, while the timeframe for safety climate interaction with behavior-based safety observations was set at one month.

## Other Issues Affecting Safety Climate

Safety climate measurement tools are designed to elicit safety attitudes and perceptions. However, the responses to individual items are subject to other factors such as labor/management disputes, significant organizational changes, and reductions in force. For example, the expressed safety climate of study populations undergoing reduction in force may reflect fears and anxieties related to job security rather than safety attitudes and perceptions. At the same time it follows that concern over job security can contribute to a weakening of safety climate. In this study, one of the locations was undergoing a substantial reduction in force due to the completion of the project. It can be assumed that worker concerns with job security were reflected in lower safety climate scores. How much these fears contributed to erosion of safety climate cannot be quantified. Still it can be assumed that while fears over job security adversely affected safety attitudes and perceptions, safety climate scores were lowered for all groups.

## Concluding Remarks

The undertaking of a safety climate survey is a significant endeavor that requires substantial management and labor support, technical expertise, and expenditure of resources. Safety climate surveys raise worker expectations and thus, employers must be committed to communicate and act on safety climate results. Group differences in safety climate indicate the existence of multiple safety cultures that can negate the effectiveness of safety programs and communication. In the end what the workforce thinks about management's commitment to safety is equally important as how management perceives their commitment. Additional research is needed to develop safety climate models, validate safety climate measurement tools and better understand the impact of group differences in safety climate.

**REFERENCES**

Advisory Committee on the Safety of Nuclear Installations (ACSNI), (1993). Human Factors Study Group, Third Report. Suffolk, UK: Health and Safety Executive Books.

Argyis, C. (1958). Some problems in conceptualizing organizational climate: A case study of a bank. Administrative Science Quarterly, 2, 501-520.

Blau, P. (1955). The Dynamics of Bureaucracy. New York, NY: John Wiley.

Brown, R. & Holmes, H. (1986). The use of factor-analytic procedure for assessing the validity of an worker safety climate model. Accident Analysis and Prevention, 18, 455-470.

Carroll, J. (1998). Safety culture as an ongoing process: Culture surveys as opportunities for inquiry and change. Work & Stress, 12(3), 272-284.

Cheyne, A., Oliver, A., Tomas, J. and Cox, S. (2002). The architecture of employee attitudes to safety in the manufacturing sector. Personnel Review, 31(6), 649-670.

Cheyne, A. Cox. S., Oliver, A. & Tomas, J. (1998). Modeling safety climate in the prediction of levels of safety activity. Work and Stress, 12(3), 255-271.

Clarke, S. (1996). The effect of habit as a behavioral response in risk reduction programmes. Safety Science, 22(1-3), 163-175.

Cleveland, R., Cohen, H., Smith, M. & Cohen, A. (1978). Safety program practices in record-holding plants. Cincinnati, OH: National Institute for Occupational Safety and Health.

Cohen, A. (1977). Factors in successful occupational safety programs. Journal of Safety Research, 9, 168-178.

Cohen, A., Smith, M. & Cohen H. (1975). Safety program practices in high vs. low accident rate companies: An interim report (U. S. Department of Health, Education and Welfare Publication No. 75-185). Cincinnati, OH: National Institute for Occupational Safety and Health.

Collinson, D. (1999). Surviving the rigs: Safety and surveillance on North Sea oil installations. Organization Studies, 20(4), 579-600.

Cox, S. & Cox, T. (1996). Safety Systems and People. Oxford, UK: Butterworth-Heineman.

Cox, S. & Cox, T. (1991). The structure of employee attitudes to safety: A European example. Work and Stress, 5(2), 93-106.

Cox, S & Flin, R. (1998). Safety Culture: Philosopher's stone or man of straw? Work and Stress, 12, 189-201.

Cullen, D. (1990). The public inquiry into the piper alpha disaster. London, U.K.: Department of Energy, Her Majesty's Stationary Office.

Dalton, M. (1959). Men who manage. New York, NY: John Wiley.

Dansereau, F. & Alutto, J. (1990). Level –of-analysis issues in climate and culture research. In Schneider, B (Ed.), Organizational climate and culture (pp. 193-236). San Francisco, CA: Jossey-Bass.

Deal, T. & Kennedy, A. (1983). Culture: A new look through old lenses. Journal of Applied Behavioral Sciences, 19(4), 498-505.

Dedobbeleer, N. & Beland, F. (1998). Is risk perception one of the dimensions of safety climate? In Feyer, A. & Williamson, (Eds.), Occupational Injury: Risk Prevention and Intervention. London, U.K: Taylor & Francis, 73-81.

Dedobbeleer, N. & Beland, F. (1991). A safety climate measure for construction sites. Journal of Safety Research, 22, 97-103.

Denison, D. (1990). Corporate culture and organizational effectiveness. New York, NY: John Wiley.

Donald, I., Canter, D. & Chalk, J. (1991). Measuring safety culture and attitudes. In: Proceedings of the First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production. Society of Petroleum Engineers, The Hague, November 11-14.

Donald, I. & Canter, D. (1994). Employee attitudes and safety in the chemical industry. Journal of Loss Prevention Process Industries,??(??), ??-??.

Drexler, J. (1977). Organizational climate: Its homogeneity within organizations. Journal of Applied Psychology, 62, 38-42.

Flin, R. (2003). Danger-Men at work: Management influence on safety. Human Factors and Ergonomics in Manufacturing, 13(4), 261-268.

Flin, R. (1998). Safety condition monitoring. Lessons from 'Man-made disasters. Journal of Contingencies and Crisis Management, 6, 88-92.

Flin, R. Mearns, K., O'Conner, P., & Bryden, R. (2000). Measuring safety climate: identifying the common features. Safety Science, 34, 177-192.

Geller, S. (1994). Ten principles for achieving a total safety culture. Professional Safety, 38, 18-24.

Gillen, M., Baltz, D. Gassel, M. Kirsch, L. & Vaccaro, D. (2002). Perceived safety climate, job demands, and coworker support among union and nonunion injured construction workers. Journal of Safety Research, 33, 33-51.

Glendon, A. and Litherland, D. (2001). Safety climate factors, group differences and safety behavior in road construction. Safety Science, 39, 157-188.

Glendon, A, Stanton, N. & Harrison, D. (1994). Factor analyzing a performance shaping concepts questionnaire. In: Robertson, S. (Ed). Contemporary Ergonomics 1994: Ergonomics for All. London,UK: Taylor & Francis, 340-345.

Glick, W. (1985). Conceptualizing and measuring organizational and psychological pitfalls in multilevel research. Academy of Management Review, 10, 601-616.

Gonzalez-Roma, V, Peiro, J, Lloret, S & Zornoza (1999). The validity of collective climates. Journal of Occupational and Organizational Psychology, 72, 25-40.

Goulder, A. (1954). Industrial relations and organization of management. Dissertation: University of California, Berkely.

Guldenmund, F. (2000). The nature of safety culture: A review of theory and practice. Safety Science, 34, 215-257.

Hale, R., Kirwan, B. & Guldenmund, F. (1999). Capturing the river: multilevel modeling of safety management, Chapter 11. In: Misumi, J., Wilpert, B., & Miller, R. (Eds.). Nuclear Safety: A Human Factors Perspective. London, UK: Taylor & Francis.

Harvey, J., Bolam, H., Gregory, D. & Erdos, G. (2001). The effectiveness of training to change safety culture and attitudes within a highly regulated environment. Personnel Review, 30(6), 615-636.

Harvey, J., Bolam, H. & Gregory, D. (1999). How many safety cultures are there? The Safety and Health Practitioner, 17(12), 9-12.

Health and Safety Executive (1997a). Software Manual: Health and Safety Climate Survey Tool. Colegate, Norwich: Author.

Health and Safety Executive (1997b). Process Guidelines: Health and Safety Climate Survey Tool. Colegate, Norwich: Author.

Health and Safety Executive (1999). Reducing Error and Influencing Behavior, HSG48, 2nd Edition. Suffolk, UK: Author.

Health and Safety Laboratory (2002). Safety Culture: A Review of the Literature, (HSL/2002/25). Sheffield, U.K.: Health & Safety Laboratory.

Hoffman, D. & Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behaviors and accidents. Personnel Psychology, 49, 307-339.

International Atomic Energy Authority (IAEA), (1997). Examples of safety culture practices: Safety report series no. 1. Vienna, Austria: IAEA.

International Atomic Energy Authority (IAEA), (1991). Safety Culture: Safety Series 75-INSAG-4. Vienna, Austria: IAEA.

International Atomic Energy Authority (IAEA), (1986). Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident: Safety Series 75-INSAG-1. Vienna, Austria: IAEA.

Keil Centre (2002). Evaluating the effectiveness of the Health and Safety Executive's health and safety tool. Research Report No. 042. HSE Books, Edinburgh: United Kingdom.

Lee, T. R. (1998). Assessment of safety culture at a nuclear reprocessing plant. Work and Stress, 12(3), 217-237.

Lewin, K., Lippit, R. & White, R. (1939). Patterns of aggressive behavior in experimentally created "social climate." Journal of Social Psychology, 10, 271-299.

Martin, J. (1991). Culture in organizations: Three perspectives. New York, NY: Oxford University Press.

McDonald, N. Corrigan, S. Day, C. & Cromie, S. (2000). Safety management systems and safety culture in aircraft maintenance organizations. Safety Science, 34(1), 151-176.

McLain, D. (1995). Response to health and safety risk in the work environment. Academy of Management Journal, 38, 1726-1743.

Mearns, K., Flin, R., Gordon, & Fleming, M. (2001) Human and organizational factors in offshore safety. Work and Stress, 15(2), 144-160.

Mearns, K., Flin, R. Gordon, R. & Fleming, M. (1998). Measuring safety climate on offshore installations. Work and Stress, 12, 238-254.

Mearns, K, Whitaker, S. & Flin, R. (2003). Safety climate, safety management practice and safety performance in offshore environments. Safety Science, 41, 641-680.

Mearns, K, Whitaker, S. & Flin, R. (2001). Benchmarking safety climate in hazardous environments: A longitudinal, inter-organizational approach. Risk Analysis, 21(4), 771-786.

Mohamed, S. (2002). Safety climate in construction site environments. Journal of Construction Engineering and Management, September/October, 375-384.

Niskanen, T. (1994). Safety climate in the road administration. Safety Science, 17, 237-255.

Oliver, A., Cheyne, A. Tomas, J. & Cox, S. (2002). The effects of organizational and individual factors on occupational accidents. Journal of Occupational and Organizational Psychology, 75, 473-488.

Organization for Economic Co-operation and Development (OECD) Nuclear Agency (1987). Chernobyl and the safety of nuclear reactors on OECD countries. Paris, France: OECD.

Ostram, L., Wilhelmsen, A., & Kaplan, B. (1993). Assessing safety culture. Nuclear Safety, 34(2).

Ouchi, W. (1981). Theory Z: How American business can meet the Japanese challenge. Reading, MA: Addison-Wesley.

Peters, T. & Waterman, R. (1982). In search of excellence. New York, NY: Harper & Row.

Pidgeon, N. (1998). Safety culture: key theoretical issues. Work and Stress, 12(3), 202-216.

Prussia, G., Brown, K. & Willis, P. (2003). Mental models of safety: Do managers and workers see eye to eye? Journal of Safety Research, 34, 143-156.

Reason, J. (1998). Achieving a safe culture: Theory and practice. Work and Stress, 12(3), 293-306.

Reason, J. (1997). Managing the risks of organizational accidents. Aldershot: Ashgate.

Reichers, A. & Schneider, B. (1990). Climate and culture: An evolution of constructs. In B. Schneider (Ed.) Organizational climate and culture (pp. 5-39). San Francisco, CA: Jossey-Bass.

Roethlisberger, F. & Dickson, W. (1946). Management and the worker. Cambridge, MA: Harvard University Press.

Rousseau, D. (1985). Issues of level in organizational research: Multilevel and cross-level perspectives. In L. Cummings & B Staw (Eds.) Research in organizational behavior (pp. 1-38). Greenwich, CT: JAI Press.

Rycraft, H. (2002). Safety culture self-assessment: Making improvements from assessment results. Paper to be presented at the 2002 IAEA Conference. Rio de Jinero, Spain.

Seppala, A. (1992). Evaluation of safety measures, their importance and connections to occupational accidents. Cited in Niskanen, T. (1994). Safety climate in the road administration. Safety Science, 17, 237-255.

Schein, E. (1984). Coming to a new awareness of organizational culture. Sloan Management Review, 25, 3-16.

Schein, E. (1990). Organizational culture and leadership: A dynamic view (2nd ed.). San Francisco, CA: Jossey-Bass.

Schneider, B. (1990). The climate for service: An application of the climate construct. In Schneider (Ed.), Organizational climate and culture (pp. 383-412). San Francisco, CA: Jossey-Bass.

Schnieder, B. and Gunnarson, S. (1991). Organizational climate and culture: The psychology of the workplace. In Steffy, J. & Bray, D. (Eds.). Applying Psychology in Business. Lexington, MA. 542-551.

Selznick, P. (1949). TVA and the Grassroots . Berkley, CA: University of California Press.

Shafai-Sharai, Y. (1971). An inquiry into factors that might explain differences in occupational accident experience of similar size firms in the same industry. East Lansing, Michigan: Division of research, Graduate School of Business Administration, Michigan State University Press.

Sorensen, J. (2002). Safety culture: A survey of the state of the art. Reliability Engineering and System, 76, 189-204.

Thompson, J. W. (1996). Employee attitudes, organizational performance, and qualitative factors underlying success. Journal of Business and Psychology, 11(2), 171-196.

Turner, B. A. (1994). Causes of disaster: sloppy management. British Journal of Management, 5, 215-219.

Van Mannen, J. & Barley, S. (1985). Cultural organization: Fragments of theory. In Frost, P., Moore, L., Louis, M., Lundberg, C. & Martin, J., (Eds.), Organizational Culture. London: Sage Publications.

Vaugh, D. (1996). The Challenger launch decision: Risky technology, culture and deviance at NASA. Chicago, IL: University of Chicago Press.

Weick, K, Sutcliff, K & Obstfeld, D. (1999). Organizing for reliability: process of collective mindfulness. Research in Organizational Behavior, 21, 81-123.

Williamson, A. M., Feyer, A. M., Cairns, D. & Biancotti, D. (1997). The development of a measure of safety climate: the role of safety perceptions and attitudes. Safety Science, 25(1-3), 15-27.

Zohar, D. (2000). A group-level model of safety climate: Testing the effect of group climate on micro-accidents in manufacturing jobs. Journal of Applied Psychology, 85(4), 587-596.

Zohar, D. (1980). Safety culture in industrial organizations: Theoretical and applied implications. Journal of Applied Psychology, 65, 96-102.

## APPENDICIES

# APPENDIX A: CERTIFICATE OF INSTITUIONAL REVIEW BOARD EXEMPTION, STUDY INFORMATION SHEET AND QUESTIONNAIRE

THE UNIVERSITY OF TENNESSEE

Department of Health and Exercise Science
1914 Andy Holt Avenue
Knoxville, TN 37996-2710
(865) 974-5041
FAX (865) 974-6439

November 10, 2003

HES IRB# 005-A

TITLE: An Evaluation of the Safety Climate at Projects of a Nuclear Decommissioning and Demolition Contractor in the United States

Michael Findley
203 Village Green Parkway
Knoxville, TN 37922

Faculty Advisor: Dr. Susan Smith
367 HPER
Dept of Health and Exercise Science

Your project listed above was reviewed and approved as exempt research.

This approval is for a period ending one year from the date of this letter. Please make timely submission of renewal or prompt notification of project termination.

Responsibilities of the investigator during data collection for this project include the following:

1. To obtain prior approval from the Departmental Review Chair before instituting any changes in the project.
2. To maintain records in a manner that will protect the privacy of those participating in the project.
3. To submit a Form D to report changes in the project or to report termination at 12-month or less intervals.

Best wishes in your research endeavor. This office will send you a renewal notice (Form R) on the anniversary of your approval date.

Sincerely,

Dixie L. Thompson

Dixie L. Thompson, Ph.D.
Chair – Health and Exercise Science Departmental Review Committee

CC: Brenda Lawson, UT IRB Office
Dr. Susan Smith

## FORM A

IRB# 005-A

**Certification for Exemption from IRB Review for Research Involving Human Subjects**

### A. PRINCIPAL INVESTIGATOR:

Michael Findley: Graduate Student
Susan Smith: Faculty Advisor and Committee Chair

### B. DEPARTMENT:

Health and Exercise Science

### C. COMPLETE MAILING ADDRESS AND PHONE NUMBERS OF PI AND CO-PI:

Michael Findley
203 Village Green Parkway
Knoxville, TN 37922
865 966 6863

Susan Smith
Department of Health & Exercise Science
1914 Andy Holt Avenue
Knoxville, TN 37996-2710
865 974 1108

### D. TITLE OF PROJECT:

An Evaluation of the Safety Climate At Projects of a Nuclear Decommissioning and Demolition Contractor in the United States

### E. EXTERNAL FUNDING AGENCY AND ID NUMBER:

N/A

### F. GRANT SUBMISSION DEADLINE:

N/A

### G. STARTING DATE: (NO RESEARCH MAY BE INITIATED UNTIL CERTIFICATION IS GRANTED.)

Upon IRB approval.

### H. ESTIMATED COMPLETION DATE:

August 31, 2004

# I. RESEARCH PROJECT:

## 1. Objectives of Project:

The purpose of this research is to evaluate the safety climate at projects and/or offices of a nuclear D&D contractor in the United States. [redacted] is conducting a safety climate survey at its projects in the United States. The University of Tennessee will participate in this survey in order to study the safety climate at nuclear projects in the United States. [redacted] will use the survey results to improve its safety and health program. The University of Tennessee will use the information to expand the body of knowledge about safety climate within the nuclear industry. Members of the study population will be invited to complete a survey addressing their safety attitudes and beliefs. Individual participation will be voluntary and responses will remain anonymous and confidential.

## 2. Subjects:

The research participants include persons employed at projects and offices of a nuclear decommissioning and demolition contractor in the United States. The study population was selected in order to obtain data on the safety climate within the nuclear decommissioning and demolition industry. All personnel at the study sites will be invited to participate. The participants' will attend a 30-minute safety meeting at which time the survey will be distributed. The survey is expected to take 20 minutes to complete. The study subjects include only persons 18 years of age or older due to work age requirements at nuclear facilities and thus, no study participant will be less than 18 years old.

## 3. Methods or Procedure:

A series of safety meetings will be held at each project and/or office participating in the study. The number and location of the safety meetings will be determined based on the number of employees and their assigned locations. The study information sheet described in the paragraph below and the survey will be distributed to all attending the safety meetings. The surveys will be distributed by persons designated by the researcher and include members of the Safety staff at the respective Project or office. These designated persons also called "Survey Monitors" will be instructed to:

(1) provide the participants the survey packet to include: (a) the study information sheet; (b) the survey; and (c) the envelope to place the survey;

(2) verbally instruct the participants not to write their names or any other personal identifiers on the survey form or envelope;

(3) verbally instruct the participants to (a) place the completed survey inside the envelope; (b) seal the envelop; and (c) then place the sealed envelope into one of the survey drop boxes; and

(4) not leave the drop boxes unattended to ensure no surveys are viewed or removed.

The survey to be used in the study is the Health and Safety Climate Survey Tool (CST) developed by the Health and Safety Executive in the United Kingdom. The Health and Safety Executive is the United Kingdom's counterpart to the Occupational Safety and Health Administration in the United States. The survey packet includes instructions for completing the survey and an envelope for placement of the survey following completion. Drop boxes with slots for placing the survey envelope will be provided at the safety meetings. The study participants will be instructed not to place their name or any personal identifier on the survey form or the envelope. The study participants will be instructed to place the survey form inside the envelope, seal the envelope, and then place the sealed envelope into the box. The designated Survey Monitors will not leave the drop boxes unattended to ensure no surveys are viewed or removed. Following completion of the survey the contents of the boxes will be placed inside a sealed shipping package and mailed to the researcher. The risk of disclosure of individual subject responses to the survey will be minimized by the procedures in place to ensure anonymity.

The researcher will assemble all surveys received from Projects and Offices and then ship the surveys to the company hired to perform optical scanning of the results. Completed surveys will be read by optical scanning, entered into a computerized database and coded with numeric codes so that analysis can be performed using the Statistical Program for Social Sciences (SPSS). Data will be stored securely and be made available only to those persons within [redacted] and the University of Tennessee who are conducting the survey. No names of individuals, employee ID numbers, social security numbers or personal identifiers will be entered or utilized during the data analysis by [redacted] or the University of Tennessee. The University of Tennessee will transpose all names of companies, projects and unions into numeric codes. The University of Tennessee will use and report numeric codes only for any aggregate data at the company, project, office, or Union level and none of the groups will be identifiable. To further ensure confidentiality the analysis of data and generated report will focus only on aggregated and grouped data. Participation is voluntary and confidential. The voluntary completion of the anonymous questionnaire will serve as the individual participants' consent for participation in this research project. The consent of the contractor's Environment, Safety, Health & Quality Assurance Manager and General Manager for the University of Tennessee's participation are attached to this form. See attached letters from [redacted] and [redacted]

A study information sheet will be distributed to all potential participants at the time of the survey. The information sheet will:

(a) announce the survey;
(b) invite all employees to voluntarily participate in the research;
(c) list the procedures which will be employed in the study;
(d) state the amount of time required of the participants and the total duration for the study;

(e) a list of all foreseeable risks and the protective measures used to minimize these risks;
(f) list the benefits of the study;
(g) state the information in the study records will be kept confidential;
(h) address the compensation to be received by participants;
(i) provide a contact name, address and phone number for the researcher;
(j) provide the name and phone number of the University of Tennessee's Office of Research, Research Compliance Services;
(k) state participation is voluntary and the employees may decline to participate without penalty; and
(l) state return of the completed survey constitutes consent to participate.

The study information sheet is attached to this completed form.

**4. CATEGORY(S) FOR EXEMPT RESEARCH PER 45 CFR 46:**

45 CFR 46.101 (b) 2 & 4: This research is based on gathering information from a self-reporting questionnaire. The data will be recorded in such a manner that no participant will be identifiable, directly or through identifiers linked to participants.

**J. CERTIFICATION:** The research described herein is in compliance with 45 CFR 46.101(b) and presents subjects with no more than minimal risk as defined by applicable regulations.

Principal Investigator: Michael Findley — Michael Findley (Signature) — 11/12/03 (Date)

Student Advisor/: Committee Chair — Susan Smith — Susan M. Smith (Signature) — Nov 12, 2003 (Date)

Dept. Review Comm. Chair: Dixie L. Thompson (Name) — Dixie Thompson (Signature) — 11/12/03 (Date)

**APPROVED:**

Dept. Head: Thomas W. George (Name) — Thomas W. George (Signature) — 11/17/03 (Date)

Rev. 01/97

Safety Climate at [redacted] Projects in the United States

**Introduction:** [redacted] is conducting a safety climate survey at our projects in the United States. In addition, the data will be used by the University of Tennessee to study the safety climate at nuclear projects in the United States. [redacted] will use the survey results to improve our safety and health program. The University of Tennessee will use the information to expand the body of knowledge about safety climate within the nuclear industry. You are invited to voluntarily participate in the study. Your responses will be anonymous and confidential.

**Your Involvement in the Study:** A series of safety meetings will be held at which time the survey will be distributed. The survey used in the study is the Health and Safety Climate Survey Tool (CST) developed by the Health and Safety Executive in the United Kingdom. The Health and Safety Executive is the United Kingdom's counterpart to the Occupational Safety and Health Administration in the United States. The survey packet includes instructions for completing the survey and an envelope for placement of the survey following completion. Drop boxes with slots for placing the survey envelope will be provided at the safety meetings. You should not place your name or any personal identifier on the survey form or the envelope. Place the survey form inside the envelope, seal the envelope, and then place the sealed envelope into the drop box. Completion of the survey should take approximately 20 minutes. Persons designated by the researcher will not leave the drop boxes unattended to ensure no surveys are viewed or removed. Once the survey period is complete the surveys will be removed from the drop boxes for packaging and then be shipped to the researcher.

**Risks:** The risk of disclosure of any individual responses to the survey will be minimized by the procedures in place to ensure anonymity.

**Benefits:** Your participation in the study will benefit you, your employer and the nuclear industry by identifying important safety concerns, attitudes and beliefs important to your safety, the safety of co-workers and the safety of others who are employed in the nuclear industry.

**Confidentiality:** The information in the study records will be kept confidential. Data will be stored securely and be made available only to those persons within [redacted] and the University of Tennessee who are conducting the survey. No names of individuals, names of companies, names of Unions, employer or employee ID numbers or any other company, union or personal identifier will be entered or utilized during the data analysis. To further ensure confidentiality the analysis of data and generated report will focus only on aggregated and grouped data. No individual person will be able to be identified from the study.

**Contact:** If you have questions at any time about the study or the procedures, you may contact Michael Findley, at [redacted]. If you have questions about your rights as a participant in the University of Tennessee study, contact The University of Tennessee Office of Research Compliance Services at (865) 974-3466.

**Participation:** Your participation is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at anytime without penalty and without loss of benefits to which you otherwise entitled. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed. Return of the completed survey constitutes your consent to participate.

## Safety Climate Survey

As part of the company's desire to continually improve our safety and health performance we wish to gather your views on some issues relating to our health and safety culture. To do so we propose to use this questionnaire. The survey has the endorsement of senior management who values your opinions. We would therefore appreciate your co-operation by completing the questionnaire. In addition, the data will be used as part of a Tennessee University research project whose purpose is to evaluate safety climate in the nuclear industry in the United States. The questionnaire is anonymous and the results will be analyzed for groups of people. It will not be possible for individuals to be identified. Do not write your name or any other personal identifier on the survey form or envelope.

Instructions for completing the survey. The first 71 questions (1-71) in the attached questionnaire give a series of statements. You are asked simply to indicate the extent to which you agree or disagree with each. The last 19 questions (72-90) ask a series of questions that permit placing your responses into various groups. Indicate your answer by filling in the bubble corresponding to your selection. If you do not understand the question then please leave it blank. Be sure to answer all questions including the ones on the back of the form.

In addition to answering questions 1 through 90, we welcome your views. Please give any suggestions that you feel would improve health and safety in the company. Completion of this section is optional. Please make your suggestions on the comment sheet.

Once you have completed the survey, place the survey form and the comment sheet into the attached envelope. Seal the envelope and then place the sealed envelope into one of the drop boxes. Your responses are confidential and should not be shared with others. Thank you for your participation. Feedback on the results of this survey will be shared at future safety meetings.

1 Some health and safety procedures/instructions/rules do not need to be followed to get the job done safely

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

2 People who work here often take risks when they are at work

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

3 Supervisors are good at detecting unsafe behaviors

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

4 My job is boring and repetitive

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

5 There are good communications here about health and safety issues

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

6 Accidents which happen here are always reported

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

7 Some jobs here are difficult to do safely

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

8 Supervisors here are not very effective at ensuring health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

9 Accident investigations are mainly used to identify who is to blame

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

10 Suggestions to improve health and safety are seldom acted upon

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

11 Near misses are always reported

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

12 Some health and safety procedures/instructions/rules are not really practical

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

13 There is little advantage for me keeping strictly to the health and safety procedures/instructions/rules

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

14 I feel involved when health and safety procedures/instructions/rules are developed or reviewed

. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

15 I fully understand the health and safety risks associated with the work for which I am responsible

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

16 Productivity is usually seen as more important than health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree

4. Agree 5. Strongly agree

17 Management sometimes turns a blind eye to health and safety procedures/instructions/rules being broken

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

18 Management always acts quickly over health and safety concerns

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

19 I am always informed of the outcome of meetings which address health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

20 Management only bothers to look at health and safety after there has been an accident

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

21 People here do not remember much of the health and safety training which applies to their job

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

22 The work permit / work package / procedure system is always strictly applied and followed

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

23 People here always work safely even when they are not being supervised

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

24 Senior management takes health and safety seriously

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

25 Some health and safety procedures/instructions/rules do not reflect how the job is now done

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

26 Some health and safety procedures/instructions/rules are difficult to follow

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

27 The work permit / work package / procedure system is "overkill" given the real risks of some of the jobs it is used for

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

28 People here think health and safety isn't their problem -it's up to management and others

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

29 I am clear about what my responsibilities are for health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

30 Supervisors seldom check that people here are working safely

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

31 The company encourages suggestions on how to improve health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

32 Some in the workforce pay little attention to health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

33 There is nothing I can do to further improve health and safety here

1. Strongly disagree 2. Disagree 3. Neither disagree or agree

4. Agree 5. Strongly agree

34 People here always wear their health and safety protective equipment when they are supposed to

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

35 Action is seldom taken against people who break health and safety procedures/instructions/rules

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

36 Some health and safety procedures/instructions/rules are only there to protect management's back

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

37 People who cause accidents here are not held sufficiently accountable for their actions

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

38 The training I had covered all the health and safety risks associated with the work for which I am responsible

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

39 Management would expect me to break health and safety procedures/instructions/rules to get the job done

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

40 Not all the health and safety procedures/instructions/rules are strictly followed here

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

41 People can always get the equipment which is needed to work to the health and safety procedures/instructions/rules

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

42 There are always enough people available to get the job done according to the health and safety procedures/instructions/rules

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

43 The company really cares about the health and safety of the people who work here

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

44 Sometimes I am uncertain what to do to ensure the health and safety in the work for which I am responsible

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

45 Sometimes it is necessary to take risks to get the job done

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

46 The safety committee makes an important contribution to health and safety here

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

47 Sometimes physical conditions at the workplace restrict people's ability to work safely

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

48 I can trust most people who I work with to work safely

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

49 My immediate supervisor often talks to me about health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

50 There are too many health and safety procedures/instructions/rules given the real risks associated with the jobs for which I am responsible

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

51 Management places a low priority on health and safety training

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

52 I am worried about my job security

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

53 People here are sometimes pressured to work unsafely by their Co-workers

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

54 Sufficient resources are available for health and safety here

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

55 Health and safety meetings are a waste of my time

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

56 Some people here have a poor understanding of the risks associated with their work

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

57 My immediate supervisor would be very helpful if I asked for advice on health and safety issues

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

58 The company shows interest in my views on health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

59 People who work here sometimes take risks at work which I would not take myself
1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

60 People who work here are not recognized for working safely

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

61 The work permit / work package / procedure system causes unnecessary delays in getting the job done

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

62 My immediate supervisor is receptive to ideas on how to improve health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

63 I sometimes turn a blind eye to some less important health and safety procedures/instructions/rules

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

64 I fully understand the health and safety procedures/instructions/rules associated with my job

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

65 Supervisors devote sufficient effort to health and safety here

1. Strongly disagree 2. Disagree 3. Neither disagree or agree 4
. Agree 5. Strongly agree

66 I don't think my immediate supervisor does enough to ensure health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

67 Supervisors sometimes turn a blind eye to people who are not working to the health and safety procedures/instructions/rules

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

68 My Co-workers would react strongly against people who break health and safety procedures/instructions/rules

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

69 All the people who work in my organization are fully committed to health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

70 It is important for me to work safely if I am to keep the respect of the others in my organization

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

71 I trust my Co-workers with my health and safety

1. Strongly disagree 2. Disagree 3. Neither disagree or agree
4. Agree 5. Strongly agree

72 Select the Company or subcontractor that you work for:

1. Number 1 2. Number 2 3. Number 3 4. Number 4 5. Number 5
6. Number 6 7. Other

73 Select the Project or Office that you work at:

1. Number 1 2. Number 2 3. Number 3 4. Number 4 5. Number 5
6. Number 6 7. Number 7 8. Number 8 9. Number 9 10. Number 10
11. Other

74 Have you received behavior-based safety (BBS) Training?
1. Yes 2. No

75 Have you received BBS Observer Training?
1. Yes 2. No

76 Have you conducted a BBS observation during the last month?
1. Yes 2. No

77 What is your employment status?

1. Exempt/salaried employee    2. Nonexempt/hourly employee

78 Are you a member of a Union?
1. Yes    2. No

79 If you answered yes to question 78, of what Union are you a member?

1. Laborer    2. Boilermaker3. Pipe-fitter    4. Electrician    5. Carpenter
6. Sheet-metal    7. Teamster    8. Painter    9. Ironworker
10. Operating Eng.    11. Survey Tech    12. Sprinkler-fitters
13. Millwrights    14. Brick masons    15. Other

80 What shift do you work?
1. Weekday days    2. Weekday nights    3. Weekends

81 Indicate the number of years you have worked in your current profession.

1. 0 to 5 years    2. 6 to 10 years    3. 11 to 15 years
4. 16 to 20 years    5. 20 or more years

82 Indicate the number of years you have worked at the Project or office you are at now.

1. less than 1 year    2. 1 to 2 years
3. 3 to 4 years    4. 5 or more years

83 Indicate your job position.
1. Senior Manager    2. Manager    3. Supervisor
4. Foreman    5. Workforce/craft    6. Technical support
7. Administrative

84 Have you had a job related injury or illness that resulted in first aid treatment in the last year?
1. Yes    2. No

85 Have you had a job related injury or illness that resulted in medical treatment other than first aid treatment in the last year?
1. Yes    2. No

86 Have you had a job related injury or illness that resulted in on the job restrictions or time away from work in the last year?
1. Yes    2. No

87 Are you:
1. Male    2. Female

88 What race are you?

1. White 2. Black, African American 3. Asian
4. other

89. Are you Hispanic or Latino?
1. Yes 2. No

90. What is your age?

| | | |
|---|---|---|
| 1. 18 to 25 yrs | 2. 26 to 30 yrs | 3. 31 to 35 yrs |
| 4. 36 to 40 yrs | 5. 41 to 45 yrs | 6. 46 to 50 yrs |
| 7. 51 to 55 yrs | 8. 56 to 60 yrs | 9. 61 to 65 yrs 7. 66 yrs or older |

Thank you for your participation in this study. You responses are strictly confidential and will remain anonymous. Return of the completed survey constitutes your consent to participate.

Place the completed survey and comment sheet inside the envelope, seal the envelope and then place the sealed envelope into one of the drop boxes. Please DO NOT write your name, badge number or any other personal identifier on this form or the envelope.

# APPENDIX B: DATA SETS

Data Set B.1.

Correlation of factor scores with overall safety climate score

| Factor | N | Pearson correlation |
|---|---|---|
| 1. Organizational commitment and communication | 1568 | 0.922** |
| 2. Line management commitment | 1543 | 0.707** |
| 3. Supervisors' role | 1569 | 0.804** |
| 4. Personal role | 1570 | 0.597** |
| 5. Work-mates' influence | 1532 | 0.732** |
| 6. Competence | 1554 | 0.646** |
| 7. Risk taking behavior | 1571 | 0.873** |
| 8. Obstacles to safe behavior | 1568 | 0.781** |
| 9. Permit to work | 1544 | 0.550** |
| 10. Reporting of accidents and near misses | 1564 | 0.598** |
| 11. Job satisfaction | 1568 | -0.344** |

** Correlation is significant at the 0.01 level (2-tailed).

Data Set B.2.

Mean difference in safety climate scores by locations

| A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| 1 | 2 | -.271(*) | .055 | .000 | -.379 | -.163 |
| | 3 | -.398(*) | .095 | .000 | -.584 | -.211 |
| | 4 | -.325(*) | .031 | .000 | -.385 | -.265 |
| | 5 | -.968(*) | .165 | .000 | -1.292 | -.643 |
| | 6 | -.582(*) | .095 | .000 | -.768 | -.396 |
| | 7 | -.513(*) | .107 | .000 | -.723 | -.304 |
| | 8 | -.607(*) | .129 | .000 | -.859 | -.354 |
| | 9 | -.364(*) | .068 | .000 | -.498 | -.230 |
| | 10 | -.464(*) | .109 | .000 | -.678 | -.250 |
| | 11 | -.298(*) | .048 | .000 | -.392 | -.204 |
| 2 | 1 | .271(*) | .055 | .000 | .163 | .379 |
| | 3 | -.127 | .107 | .235 | -.336 | .082 |
| | 4 | -.054 | .057 | .346 | -.166 | .058 |
| | 5 | -.697(*) | .172 | .000 | -1.034 | -.359 |
| | 6 | -.311(*) | .107 | .004 | -.520 | -.102 |
| | 7 | -.242(*) | .117 | .039 | -.472 | -.012 |
| | 8 | -.335(*) | .137 | .015 | -.605 | -.066 |
| | 9 | -.093 | .084 | .266 | -.257 | .071 |
| | 10 | -.193 | .119 | .106 | -.427 | .041 |
| | 11 | -.027 | .068 | .689 | -.160 | .106 |
| 3 | 1 | .398(*) | .095 | .000 | .211 | .584 |
| | 2 | .127 | .107 | .235 | -.082 | .336 |
| | 4 | .073 | .096 | .450 | -.116 | .262 |
| | 5 | -.570(*) | .189 | .003 | -.940 | -.200 |
| | 6 | -.184 | .132 | .162 | -.443 | .074 |
| | 7 | -.115 | .140 | .411 | -.391 | .160 |
| | 8 | -.209 | .158 | .186 | -.518 | .100 |
| | 9 | .034 | .114 | .769 | -.190 | .257 |
| | 10 | -.066 | .142 | .642 | -.345 | .213 |
| | 11 | .099 | .103 | .335 | -.103 | .302 |
| 4 | 1 | .325(*) | .031 | .000 | .265 | .385 |
| | 2 | .054 | .057 | .346 | -.058 | .166 |
| | 3 | -.073 | .096 | .450 | -.262 | .116 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | -.643(*) | .166 | .000 | -.969 | -.317 |
| | 6 | -.257(*) | .096 | .008 | -.446 | -.068 |
| | 7 | -.188 | .108 | .081 | -.400 | .023 |
| | 8 | -.282(*) | .130 | .030 | -.536 | -.028 |
| | 9 | -.039 | .070 | .577 | -.177 | .099 |
| | 10 | -.139 | .110 | .208 | -.355 | .077 |
| | 11 | .027 | .050 | .597 | -.072 | .125 |
| 5 | 1 | .968(*) | .165 | .000 | .643 | 1.292 |
| | 2 | .697(*) | .172 | .000 | .359 | 1.034 |
| | 3 | .570(*) | .189 | .003 | .200 | .940 |
| | 4 | .643(*) | .166 | .000 | .317 | .969 |
| | 6 | .386(*) | .189 | .041 | .015 | .756 |
| | 7 | .455(*) | .195 | .020 | .072 | .837 |
| | 8 | .361 | .208 | .082 | -.046 | .769 |
| | 9 | .604(*) | .177 | .001 | .256 | .951 |
| | 10 | .504(*) | .196 | .010 | .119 | .889 |
| | 11 | .669(*) | .170 | .000 | .336 | 1.003 |
| 6 | 1 | .582(*) | .095 | .000 | .396 | .768 |
| | 2 | .311(*) | .107 | .004 | .102 | .520 |
| | 3 | .184 | .132 | .162 | -.074 | .443 |
| | 4 | .257(*) | .096 | .008 | .068 | .446 |
| | 5 | -.386(*) | .189 | .041 | -.756 | -.015 |
| | 7 | .069 | .140 | .624 | -.207 | .344 |
| | 8 | -.025 | .158 | .876 | -.334 | .285 |
| | 9 | .218 | .114 | .056 | -.006 | .442 |
| | 10 | .118 | .142 | .406 | -.161 | .397 |
| | 11 | .284(*) | .103 | .006 | .082 | .486 |
| 7 | 1 | .513(*) | .107 | .000 | .304 | .723 |
| | 2 | .242(*) | .117 | .039 | .012 | .472 |
| | 3 | .115 | .140 | .411 | -.160 | .391 |
| | 4 | .188 | .108 | .081 | -.023 | .400 |
| | 5 | -.455(*) | .195 | .020 | -.837 | -.072 |
| | 6 | -.069 | .140 | .624 | -.344 | .207 |
| | 8 | -.093 | .165 | .571 | -.417 | .230 |
| | 9 | .149 | .124 | .230 | -.094 | .392 |
| | 10 | .049 | .150 | .743 | -.246 | .344 |
| | 11 | .215 | .114 | .060 | -.009 | .438 |
| 8 | 1 | .607(*) | .129 | .000 | .354 | .859 |
| | 2 | .335(*) | .137 | .015 | .066 | .605 |
| | 3 | .209 | .158 | .186 | -.100 | .518 |
| | 4 | .282(*) | .130 | .030 | .028 | .536 |
| | 5 | -.361 | .208 | .082 | -.769 | .046 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 6 | .025 | .158 | .876 | -.285 | .334 |
| | 7 | .093 | .165 | .571 | -.230 | .417 |
| | 9 | .242 | .143 | .091 | -.039 | .523 |
| | 10 | .143 | .167 | .392 | -.184 | .470 |
| | 11 | .308(*) | .135 | .022 | .044 | .572 |
| 9 | 1 | .364(*) | .068 | .000 | .230 | .498 |
| | 2 | .093 | .084 | .266 | -.071 | .257 |
| | 3 | -.034 | .114 | .769 | -.257 | .190 |
| | 4 | .039 | .070 | .577 | -.099 | .177 |
| | 5 | -.604(*) | .177 | .001 | -.951 | -.256 |
| | 6 | -.218 | .114 | .056 | -.442 | .006 |
| | 7 | -.149 | .124 | .230 | -.392 | .094 |
| | 8 | -.242 | .143 | .091 | -.523 | .039 |
| | 10 | -.100 | .126 | .429 | -.347 | .148 |
| | 11 | .066 | .079 | .406 | -.090 | .221 |
| 10 | 1 | .464(*) | .109 | .000 | .250 | .678 |
| | 2 | .193 | .119 | .106 | -.041 | .427 |
| | 3 | .066 | .142 | .642 | -.213 | .345 |
| | 4 | .139 | .110 | .208 | -.077 | .355 |
| | 5 | -.504(*) | .196 | .010 | -.889 | -.119 |
| | 6 | -.118 | .142 | .406 | -.397 | .161 |
| | 7 | -.049 | .150 | .743 | -.344 | .246 |
| | 8 | -.143 | .167 | .392 | -.470 | .184 |
| | 9 | .100 | .126 | .429 | -.148 | .347 |
| | 11 | .165 | .116 | .155 | -.062 | .393 |
| 11 | 1 | .298(*) | .048 | .000 | .204 | .392 |
| | 2 | .027 | .068 | .689 | -.106 | .160 |
| | 3 | -.099 | .103 | .335 | -.302 | .103 |
| | 4 | -.027 | .050 | .597 | -.125 | .072 |
| | 5 | -.669(*) | .170 | .000 | -1.003 | -.336 |
| | 6 | -.284(*) | .103 | .006 | -.486 | -.082 |
| | 7 | -.215 | .114 | .060 | -.438 | .009 |
| | 8 | -.308(*) | .135 | .022 | -.572 | -.044 |
| | 9 | -.066 | .079 | .406 | -.221 | .090 |
| | 10 | -.165 | .116 | .155 | -.393 | .062 |

Based on estimated marginal means

* The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Data Set B.3

Mean safety climate factor scores by location

| Factor | Location | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1 | 1 | 3.189 | .025 | 3.139 | 3.239 |
| | 2 | 3.432 | .070 | 3.294 | 3.569 |
| | 3 | 3.679 | .128 | 3.427 | 3.931 |
| | 4 | 3.617 | .033 | 3.552 | 3.682 |
| | 5 | 4.269 | .252 | 3.774 | 4.764 |
| | 6 | 3.896 | .126 | 3.649 | 4.143 |
| | 7 | 3.857 | .142 | 3.578 | 4.136 |
| | 8 | 3.992 | .172 | 3.654 | 4.330 |
| | 9 | 3.696 | .091 | 3.518 | 3.874 |
| | 10 | 3.710 | .146 | 3.425 | 3.996 |
| | 11 | 3.572 | .060 | 3.454 | 3.689 |
| 2 | 1 | 3.438 | .029 | 3.381 | 3.494 |
| | 2 | 3.566 | .079 | 3.410 | 3.722 |
| | 3 | 3.639 | .146 | 3.353 | 3.925 |
| | 4 | 3.858 | .038 | 3.784 | 3.932 |
| | 5 | 4.000 | .286 | 3.438 | 4.562 |
| | 6 | 3.708 | .143 | 3.427 | 3.989 |
| | 7 | 3.682 | .162 | 3.365 | 3.999 |
| | 8 | 3.950 | .196 | 3.566 | 4.334 |
| | 9 | 3.738 | .103 | 3.535 | 3.940 |
| | 10 | 3.893 | .165 | 3.568 | 4.217 |
| | 11 | 3.792 | .068 | 3.659 | 3.926 |
| 3 | 1 | 3.190 | .028 | 3.134 | 3.246 |
| | 2 | 3.527 | .078 | 3.374 | 3.681 |
| | 3 | 3.639 | .144 | 3.357 | 3.921 |
| | 4 | 3.618 | .037 | 3.546 | 3.691 |
| | 5 | 4.357 | .282 | 3.804 | 4.910 |
| | 6 | 3.723 | .141 | 3.447 | 4.000 |
| | 7 | 3.848 | .159 | 3.536 | 4.161 |
| | 8 | 4.033 | .193 | 3.655 | 4.411 |
| | 9 | 3.676 | .102 | 3.477 | 3.875 |
| | 10 | 3.821 | .163 | 3.502 | 4.141 |
| | 11 | 3.571 | .067 | 3.439 | 3.702 |
| 4 | 1 | 3.758 | .023 | 3.714 | 3.803 |

| | | | | | |
|---|---|---|---|---|---|
| | 2 | 3.900 | .063 | 3.777 | 4.023 |
| | 3 | 3.753 | .115 | 3.527 | 3.979 |
| | 4 | 3.835 | .030 | 3.777 | 3.894 |
| | 5 | 4.190 | .226 | 3.747 | 4.634 |
| | 6 | 3.898 | .113 | 3.676 | 4.119 |
| | 7 | 3.941 | .128 | 3.691 | 4.191 |
| | 8 | 3.958 | .155 | 3.655 | 4.261 |
| | 9 | 3.819 | .081 | 3.659 | 3.979 |
| | 10 | 3.921 | .131 | 3.664 | 4.177 |
| | 11 | 3.828 | .054 | 3.722 | 3.933 |
| 5 | 1 | 3.336 | .027 | 3.282 | 3.390 |
| | 2 | 3.629 | .075 | 3.482 | 3.777 |
| | 3 | 3.630 | .138 | 3.359 | 3.901 |
| | 4 | 3.599 | .036 | 3.529 | 3.669 |
| | 5 | 4.179 | .271 | 3.646 | 4.711 |
| | 6 | 3.768 | .136 | 3.502 | 4.034 |
| | 7 | 3.739 | .153 | 3.438 | 4.039 |
| | 8 | 3.783 | .185 | 3.420 | 4.147 |
| | 9 | 3.514 | .098 | 3.322 | 3.706 |
| | 10 | 3.714 | .157 | 3.407 | 4.022 |
| | 11 | 3.569 | .064 | 3.442 | 3.695 |
| 6 | 1 | 3.597 | .023 | 3.552 | 3.643 |
| | 2 | 3.875 | .064 | 3.749 | 4.000 |
| | 3 | 3.767 | .117 | 3.536 | 3.997 |
| | 4 | 3.925 | .030 | 3.865 | 3.984 |
| | 5 | 4.343 | .231 | 3.891 | 4.795 |
| | 6 | 3.979 | .115 | 3.752 | 4.205 |
| | 7 | 3.882 | .130 | 3.627 | 4.137 |
| | 8 | 3.947 | .157 | 3.638 | 4.256 |
| | 9 | 3.844 | .083 | 3.682 | 4.007 |
| | 10 | 4.019 | .133 | 3.758 | 4.280 |
| | 11 | 3.870 | .055 | 3.763 | 3.978 |
| 7 | 1 | 2.925 | .023 | 2.880 | 2.971 |
| | 2 | 3.387 | .064 | 3.261 | 3.513 |
| | 3 | 3.608 | .118 | 3.378 | 3.839 |
| | 4 | 3.402 | .030 | 3.342 | 3.461 |
| | 5 | 4.210 | .231 | 3.757 | 4.664 |
| | 6 | 3.817 | .116 | 3.590 | 4.043 |
| | 7 | 3.614 | .130 | 3.359 | 3.870 |
| | 8 | 3.707 | .158 | 3.397 | 4.016 |
| | 9 | 3.378 | .083 | 3.215 | 3.542 |
| | 10 | 3.578 | .133 | 3.316 | 3.840 |

| | | | | | |
|---|---|---|---|---|---|
| | 11 | 3.399 | .055 | 3.291 | 3.507 |
| 8 | 1 | 3.001 | .024 | 2.955 | 3.047 |
| | 2 | 3.205 | .065 | 3.078 | 3.332 |
| | 3 | 3.499 | .119 | 3.266 | 3.732 |
| | 4 | 3.187 | .031 | 3.127 | 3.247 |
| | 5 | 4.000 | .233 | 3.542 | 4.458 |
| | 6 | 3.802 | .117 | 3.573 | 4.030 |
| | 7 | 3.646 | .132 | 3.388 | 3.905 |
| | 8 | 3.607 | .159 | 3.295 | 3.920 |
| | 9 | 3.301 | .084 | 3.137 | 3.466 |
| | 10 | 3.333 | .135 | 3.069 | 3.598 |
| | 11 | 3.186 | .055 | 3.077 | 3.295 |
| 9 | 1 | 3.301 | .033 | 3.236 | 3.367 |
| | 2 | 3.165 | .092 | 2.985 | 3.345 |
| | 3 | 3.444 | .168 | 3.114 | 3.775 |
| | 4 | 2.990 | .044 | 2.905 | 3.075 |
| | 5 | 4.071 | .331 | 3.423 | 4.720 |
| | 6 | 3.464 | .165 | 3.140 | 3.789 |
| | 7 | 3.432 | .187 | 3.066 | 3.798 |
| | 8 | 3.467 | .226 | 3.024 | 3.910 |
| | 9 | 3.370 | .119 | 3.137 | 3.604 |
| | 10 | 3.381 | .191 | 3.006 | 3.755 |
| | 11 | 2.863 | .079 | 2.709 | 3.017 |
| 10 | 1 | 2.623 | .034 | 2.557 | 2.689 |
| | 2 | 3.165 | .092 | 2.984 | 3.346 |
| | 3 | 3.185 | .169 | 2.853 | 3.517 |
| | 4 | 2.902 | .044 | 2.816 | 2.988 |
| | 5 | 4.000 | .332 | 3.348 | 4.652 |
| | 6 | 3.518 | .166 | 3.192 | 3.844 |
| | 7 | 3.227 | .188 | 2.859 | 3.595 |
| | 8 | 3.500 | .227 | 3.055 | 3.945 |
| | 9 | 3.176 | .120 | 2.941 | 3.411 |
| | 10 | 3.381 | .192 | 3.004 | 3.757 |
| | 11 | 2.968 | .079 | 2.813 | 3.123 |

Data Set B.4.

Mean differences in factor scores by locations

| Factor | A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | -.242(*) | .074 | .001 | -.388 | -.096 |
| | | 3 | -.490(*) | .131 | .000 | -.747 | -.233 |
| | | 4 | -.428(*) | .042 | .000 | -.510 | -.346 |
| | | 5 | -1.080(*) | .253 | .000 | -1.577 | -.583 |
| | | 6 | -.707(*) | .129 | .000 | -.959 | -.455 |
| | | 7 | -.668(*) | .144 | .000 | -.951 | -.384 |
| | | 8 | -.803(*) | .174 | .000 | -1.145 | -.462 |
| | | 9 | -.507(*) | .094 | .000 | -.692 | -.322 |
| | | 10 | -.521(*) | .148 | .000 | -.811 | -.231 |
| | | 11 | -.383(*) | .065 | .000 | -.510 | -.255 |
| | 2 | 1 | .242(*) | .074 | .001 | .096 | .388 |
| | | 3 | -.247 | .146 | .091 | -.534 | .039 |
| | | 4 | -.185(*) | .077 | .017 | -.337 | -.033 |
| | | 5 | -.837(*) | .262 | .001 | -1.351 | -.324 |
| | | 6 | -.465(*) | .144 | .001 | -.747 | -.182 |
| | | 7 | -.425(*) | .158 | .007 | -.736 | -.115 |
| | | 8 | -.561(*) | .186 | .003 | -.925 | -.196 |
| | | 9 | -.264(*) | .115 | .021 | -.489 | -.039 |
| | | 10 | -.279 | .162 | .085 | -.596 | .038 |
| | | 11 | -.140 | .092 | .128 | -.321 | .040 |
| | 3 | 1 | .490(*) | .131 | .000 | .233 | .747 |
| | | 2 | .247 | .146 | .091 | -.039 | .534 |
| | | 4 | .062 | .133 | .640 | -.198 | .322 |
| | | 5 | -.590(*) | .283 | .037 | -1.145 | -.035 |
| | | 6 | -.217 | .180 | .228 | -.570 | .136 |
| | | 7 | -.178 | .192 | .353 | -.554 | .198 |
| | | 8 | -.313 | .215 | .145 | -.735 | .108 |
| | | 9 | -.017 | .157 | .916 | -.325 | .292 |
| | | 10 | -.031 | .194 | .872 | -.412 | .349 |
| | | 11 | .107 | .142 | .450 | -.171 | .385 |
| | 4 | 1 | .428(*) | .042 | .000 | .346 | .510 |
| | | 2 | .185(*) | .077 | .017 | .033 | .337 |
| | | 3 | -.062 | .133 | .640 | -.322 | .198 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | -.652(*) | .254 | .010 | -1.151 | -.153 |
| | 6 | -.279(*) | .130 | .032 | -.535 | -.024 |
| | 7 | -.240 | .146 | .100 | -.527 | .046 |
| | 8 | -.375(*) | .175 | .033 | -.719 | -.031 |
| | 9 | -.079 | .097 | .415 | -.268 | .111 |
| | 10 | -.093 | .149 | .532 | -.386 | .199 |
| | 11 | .045 | .068 | .511 | -.089 | .179 |
| 5 | 1 | 1.080(*) | .253 | .000 | .583 | 1.577 |
| | 2 | .837(*) | .262 | .001 | .324 | 1.351 |
| | 3 | .590(*) | .283 | .037 | .035 | 1.145 |
| | 4 | .652(*) | .254 | .010 | .153 | 1.151 |
| | 6 | .373 | .282 | .186 | -.180 | .926 |
| | 7 | .412 | .289 | .155 | -.156 | .980 |
| | 8 | .277 | .305 | .365 | -.322 | .876 |
| | 9 | .573(*) | .268 | .033 | .048 | 1.099 |
| | 10 | .559 | .291 | .055 | -.012 | 1.130 |
| | 11 | .697(*) | .259 | .007 | .189 | 1.205 |
| 6 | 1 | .707(*) | .129 | .000 | .455 | .959 |
| | 2 | .465(*) | .144 | .001 | .182 | .747 |
| | 3 | .217 | .180 | .228 | -.136 | .570 |
| | 4 | .279(*) | .130 | .032 | .024 | .535 |
| | 5 | -.373 | .282 | .186 | -.926 | .180 |
| | 7 | .039 | .190 | .837 | -.334 | .412 |
| | 8 | -.096 | .213 | .653 | -.515 | .323 |
| | 9 | .201 | .155 | .197 | -.104 | .505 |
| | 10 | .186 | .193 | .335 | -.192 | .564 |
| | 11 | .324(*) | .140 | .020 | .050 | .598 |
| 7 | 1 | .668(*) | .144 | .000 | .384 | .951 |
| | 2 | .425(*) | .158 | .007 | .115 | .736 |
| | 3 | .178 | .192 | .353 | -.198 | .554 |
| | 4 | .240 | .146 | .100 | -.046 | .527 |
| | 5 | -.412 | .289 | .155 | -.980 | .156 |
| | 6 | -.039 | .190 | .837 | -.412 | .334 |
| | 8 | -.135 | .223 | .545 | -.573 | .303 |
| | 9 | .161 | .169 | .339 | -.170 | .492 |
| | 10 | .147 | .204 | .471 | -.253 | .546 |
| | 11 | .285 | .154 | .065 | -.018 | .588 |
| 8 | 1 | .803(*) | .174 | .000 | .462 | 1.145 |
| | 2 | .561(*) | .186 | .003 | .196 | .925 |
| | 3 | .313 | .215 | .145 | -.108 | .735 |
| | 4 | .375(*) | .175 | .033 | .031 | .719 |
| | 5 | -.277 | .305 | .365 | -.876 | .322 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | .096 | .213 | .653 | -.323 | .515 |
| | | 7 | .135 | .223 | .545 | -.303 | .573 |
| | | 9 | .297 | .195 | .128 | -.085 | .678 |
| | | 10 | .282 | .226 | .212 | -.160 | .724 |
| | | 11 | .420(*) | .182 | .021 | .063 | .778 |
| | 9 | 1 | .507(*) | .094 | .000 | .322 | .692 |
| | | 2 | .264(*) | .115 | .021 | .039 | .489 |
| | | 3 | .017 | .157 | .916 | -.292 | .325 |
| | | 4 | .079 | .097 | .415 | -.111 | .268 |
| | | 5 | -.573(*) | .268 | .033 | -1.099 | -.048 |
| | | 6 | -.201 | .155 | .197 | -.505 | .104 |
| | | 7 | -.161 | .169 | .339 | -.492 | .170 |
| | | 8 | -.297 | .195 | .128 | -.678 | .085 |
| | | 10 | -.015 | .172 | .932 | -.351 | .322 |
| | | 11 | .124 | .109 | .255 | -.090 | .337 |
| | 10 | 1 | .521(*) | .148 | .000 | .231 | .811 |
| | | 2 | .279 | .162 | .085 | -.038 | .596 |
| | | 3 | .031 | .194 | .872 | -.349 | .412 |
| | | 4 | .093 | .149 | .532 | -.199 | .386 |
| | | 5 | -.559 | .291 | .055 | -1.130 | .012 |
| | | 6 | -.186 | .193 | .335 | -.564 | .192 |
| | | 7 | -.147 | .204 | .471 | -.546 | .253 |
| | | 8 | -.282 | .226 | .212 | -.724 | .160 |
| | | 9 | .015 | .172 | .932 | -.322 | .351 |
| | | 11 | .138 | .157 | .379 | -.170 | .447 |
| | 11 | 1 | .383(*) | .065 | .000 | .255 | .510 |
| | | 2 | .140 | .092 | .128 | -.040 | .321 |
| | | 3 | -.107 | .142 | .450 | -.385 | .171 |
| | | 4 | -.045 | .068 | .511 | -.179 | .089 |
| | | 5 | -.697(*) | .259 | .007 | -1.205 | -.189 |
| | | 6 | -.324(*) | .140 | .020 | -.598 | -.050 |
| | | 7 | -.285 | .154 | .065 | -.588 | .018 |
| | | 8 | -.420(*) | .182 | .021 | -.778 | -.063 |
| | | 9 | -.124 | .109 | .255 | -.337 | .090 |
| | | 10 | -.138 | .157 | .379 | -.447 | .170 |
| 2 | 1 | 2 | -.128 | .085 | .129 | -.294 | .037 |
| | | 3 | -.201 | .149 | .176 | -.493 | .090 |
| | | 4 | -.420(*) | .048 | .000 | -.514 | -.327 |
| | | 5 | -.562 | .288 | .051 | -1.127 | .002 |
| | | 6 | -.271 | .146 | .064 | -.557 | .016 |
| | | 7 | -.244 | .164 | .137 | -.566 | .078 |
| | | 8 | -.512(*) | .198 | .010 | -.900 | -.125 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 9 | -.300(*) | .107 | .005 | -.510 | -.090 |
| | 10 | -.455(*) | .168 | .007 | -.785 | -.126 |
| | 11 | -.355(*) | .074 | .000 | -.500 | -.210 |
| 2 | 1 | .128 | .085 | .129 | -.037 | .294 |
| | 3 | -.073 | .166 | .660 | -.399 | .253 |
| | 4 | -.292(*) | .088 | .001 | -.464 | -.119 |
| | 5 | -.434 | .297 | .144 | -1.017 | .149 |
| | 6 | -.142 | .164 | .385 | -.464 | .179 |
| | 7 | -.116 | .180 | .520 | -.469 | .237 |
| | 8 | -.384 | .211 | .069 | -.798 | .030 |
| | 9 | -.172 | .130 | .187 | -.427 | .084 |
| | 10 | -.327 | .183 | .075 | -.687 | .033 |
| | 11 | -.226(*) | .105 | .031 | -.432 | -.021 |
| 3 | 1 | .201 | .149 | .176 | -.090 | .493 |
| | 2 | .073 | .166 | .660 | -.253 | .399 |
| | 4 | -.219 | .151 | .146 | -.514 | .076 |
| | 5 | -.361 | .321 | .261 | -.992 | .269 |
| | 6 | -.069 | .204 | .734 | -.470 | .331 |
| | 7 | -.043 | .218 | .844 | -.470 | .384 |
| | 8 | -.311 | .244 | .203 | -.790 | .168 |
| | 9 | -.099 | .179 | .580 | -.449 | .252 |
| | 10 | -.254 | .220 | .250 | -.686 | .179 |
| | 11 | -.153 | .161 | .340 | -.469 | .162 |
| 4 | 1 | .420(*) | .048 | .000 | .327 | .514 |
| | 2 | .292(*) | .088 | .001 | .119 | .464 |
| | 3 | .219 | .151 | .146 | -.076 | .514 |
| | 5 | -.142 | .289 | .623 | -.709 | .425 |
| | 6 | .150 | .148 | .313 | -.141 | .440 |
| | 7 | .176 | .166 | .289 | -.149 | .501 |
| | 8 | -.092 | .199 | .644 | -.483 | .299 |
| | 9 | .120 | .110 | .274 | -.095 | .336 |
| | 10 | -.035 | .170 | .837 | -.368 | .298 |
| | 11 | .066 | .078 | .400 | -.087 | .218 |
| 5 | 1 | .562 | .288 | .051 | -.002 | 1.127 |
| | 2 | .434 | .297 | .144 | -.149 | 1.017 |
| | 3 | .361 | .321 | .261 | -.269 | .992 |
| | 4 | .142 | .289 | .623 | -.425 | .709 |
| | 6 | .292 | .320 | .363 | -.336 | .920 |
| | 7 | .318 | .329 | .333 | -.327 | .963 |
| | 8 | .050 | .347 | .885 | -.630 | .730 |
| | 9 | .262 | .304 | .389 | -.335 | .859 |
| | 10 | .107 | .331 | .746 | -.542 | .756 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 11 | .208 | .294 | .481 | -.370 | .785 |
| 6 | 1 | .271 | .146 | .064 | -.016 | .557 |
| | 2 | .142 | .164 | .385 | -.179 | .464 |
| | 3 | .069 | .204 | .734 | -.331 | .470 |
| | 4 | -.150 | .148 | .313 | -.440 | .141 |
| | 5 | -.292 | .320 | .363 | -.920 | .336 |
| | 7 | .027 | .216 | .902 | -.397 | .450 |
| | 8 | -.242 | .242 | .319 | -.717 | .234 |
| | 9 | -.029 | .176 | .868 | -.375 | .317 |
| | 10 | -.185 | .219 | .399 | -.614 | .245 |
| | 11 | -.084 | .159 | .596 | -.395 | .227 |
| 7 | 1 | .244 | .164 | .137 | -.078 | .566 |
| | 2 | .116 | .180 | .520 | -.237 | .469 |
| | 3 | .043 | .218 | .844 | -.384 | .470 |
| | 4 | -.176 | .166 | .289 | -.501 | .149 |
| | 5 | -.318 | .329 | .333 | -.963 | .327 |
| | 6 | -.027 | .216 | .902 | -.450 | .397 |
| | 8 | -.268 | .254 | .291 | -.766 | .230 |
| | 9 | -.056 | .192 | .771 | -.432 | .320 |
| | 10 | -.211 | .231 | .361 | -.665 | .242 |
| | 11 | -.111 | .175 | .528 | -.454 | .233 |
| 8 | 1 | .512(*) | .198 | .010 | .125 | .900 |
| | 2 | .384 | .211 | .069 | -.030 | .798 |
| | 3 | .311 | .244 | .203 | -.168 | .790 |
| | 4 | .092 | .199 | .644 | -.299 | .483 |
| | 5 | -.050 | .347 | .885 | -.730 | .630 |
| | 6 | .242 | .242 | .319 | -.234 | .717 |
| | 7 | .268 | .254 | .291 | -.230 | .766 |
| | 9 | .212 | .221 | .337 | -.221 | .646 |
| | 10 | .057 | .256 | .824 | -.445 | .560 |
| | 11 | .158 | .207 | .447 | -.249 | .564 |
| 9 | 1 | .300(*) | .107 | .005 | .090 | .510 |
| | 2 | .172 | .130 | .187 | -.084 | .427 |
| | 3 | .099 | .179 | .580 | -.252 | .449 |
| | 4 | -.120 | .110 | .274 | -.336 | .095 |
| | 5 | -.262 | .304 | .389 | -.859 | .335 |
| | 6 | .029 | .176 | .868 | -.317 | .375 |
| | 7 | .056 | .192 | .771 | -.320 | .432 |
| | 8 | -.212 | .221 | .337 | -.646 | .221 |
| | 10 | -.155 | .195 | .426 | -.537 | .227 |
| | 11 | -.055 | .124 | .658 | -.297 | .188 |
| 10 | 1 | .455(*) | .168 | .007 | .126 | .785 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2 | .327 | .183 | .075 | -.033 | .687 |
| | | 3 | .254 | .220 | .250 | -.179 | .686 |
| | | 4 | .035 | .170 | .837 | -.298 | .368 |
| | | 5 | -.107 | .331 | .746 | -.756 | .542 |
| | | 6 | .185 | .219 | .399 | -.245 | .614 |
| | | 7 | .211 | .231 | .361 | -.242 | .665 |
| | | 8 | -.057 | .256 | .824 | -.560 | .445 |
| | | 9 | .155 | .195 | .426 | -.227 | .537 |
| | | 11 | .101 | .179 | .574 | -.250 | .451 |
| | 11 | 1 | .355(*) | .074 | .000 | .210 | .500 |
| | | 2 | .226(*) | .105 | .031 | .021 | .432 |
| | | 3 | .153 | .161 | .340 | -.162 | .469 |
| | | 4 | -.066 | .078 | .400 | -.218 | .087 |
| | | 5 | -.208 | .294 | .481 | -.785 | .370 |
| | | 6 | .084 | .159 | .596 | -.227 | .395 |
| | | 7 | .111 | .175 | .528 | -.233 | .454 |
| | | 8 | -.158 | .207 | .447 | -.564 | .249 |
| | | 9 | .055 | .124 | .658 | -.188 | .297 |
| | | 10 | -.101 | .179 | .574 | -.451 | .250 |
| 3 | 1 | 2 | -.337(*) | .083 | .000 | -.500 | -.174 |
| | | 3 | -.449(*) | .146 | .002 | -.736 | -.161 |
| | | 4 | -.428(*) | .047 | .000 | -.520 | -.336 |
| | | 5 | -1.167(*) | .283 | .000 | -1.723 | -.611 |
| | | 6 | -.533(*) | .144 | .000 | -.815 | -.251 |
| | | 7 | -.658(*) | .162 | .000 | -.975 | -.341 |
| | | 8 | -.843(*) | .195 | .000 | -1.225 | -.461 |
| | | 9 | -.486(*) | .105 | .000 | -.692 | -.279 |
| | | 10 | -.631(*) | .165 | .000 | -.955 | -.307 |
| | | 11 | -.380(*) | .073 | .000 | -.523 | -.237 |
| | 2 | 1 | .337(*) | .083 | .000 | .174 | .500 |
| | | 3 | -.111 | .164 | .496 | -.432 | .209 |
| | | 4 | -.091 | .087 | .294 | -.261 | .079 |
| | | 5 | -.830(*) | .293 | .005 | -1.404 | -.256 |
| | | 6 | -.196 | .161 | .225 | -.512 | .121 |
| | | 7 | -.321 | .177 | .070 | -.669 | .027 |
| | | 8 | -.506(*) | .208 | .015 | -.914 | -.098 |
| | | 9 | -.148 | .128 | .247 | -.400 | .103 |
| | | 10 | -.294 | .181 | .104 | -.648 | .060 |
| | | 11 | -.043 | .103 | .676 | -.245 | .159 |
| | 3 | 1 | .449(*) | .146 | .002 | .161 | .736 |
| | | 2 | .111 | .164 | .496 | -.209 | .432 |
| | | 4 | .020 | .148 | .890 | -.270 | .311 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | -.718(*) | .316 | .023 | -1.339 | -.097 |
| | 6 | -.084 | .201 | .675 | -.479 | .310 |
| | 7 | -.210 | .214 | .328 | -.630 | .211 |
| | 8 | -.394 | .240 | .101 | -.866 | .077 |
| | 9 | -.037 | .176 | .833 | -.382 | .308 |
| | 10 | -.183 | .217 | .401 | -.608 | .243 |
| | 11 | .068 | .158 | .666 | -.243 | .379 |
| 4 | 1 | .428(*) | .047 | .000 | .336 | .520 |
| | 2 | .091 | .087 | .294 | -.079 | .261 |
| | 3 | -.020 | .148 | .890 | -.311 | .270 |
| | 5 | -.739(*) | .284 | .010 | -1.297 | -.181 |
| | 6 | -.105 | .146 | .472 | -.391 | .181 |
| | 7 | -.230 | .163 | .159 | -.551 | .090 |
| | 8 | -.415(*) | .196 | .035 | -.800 | -.030 |
| | 9 | -.058 | .108 | .595 | -.270 | .155 |
| | 10 | -.203 | .167 | .224 | -.531 | .125 |
| | 11 | .048 | .077 | .532 | -.102 | .198 |
| 5 | 1 | 1.167(*) | .283 | .000 | .611 | 1.723 |
| | 2 | .830(*) | .293 | .005 | .256 | 1.404 |
| | 3 | .718(*) | .316 | .023 | .097 | 1.339 |
| | 4 | .739(*) | .284 | .010 | .181 | 1.297 |
| | 6 | .634(*) | .315 | .045 | .015 | 1.252 |
| | 7 | .509 | .324 | .116 | -.127 | 1.144 |
| | 8 | .324 | .342 | .343 | -.346 | .994 |
| | 9 | .681(*) | .300 | .023 | .093 | 1.269 |
| | 10 | .536 | .326 | .100 | -.103 | 1.175 |
| | 11 | .787(*) | .290 | .007 | .218 | 1.355 |
| 6 | 1 | .533(*) | .144 | .000 | .251 | .815 |
| | 2 | .196 | .161 | .225 | -.121 | .512 |
| | 3 | .084 | .201 | .675 | -.310 | .479 |
| | 4 | .105 | .146 | .472 | -.181 | .391 |
| | 5 | -.634(*) | .315 | .045 | -1.252 | -.015 |
| | 7 | -.125 | .213 | .556 | -.542 | .292 |
| | 8 | -.310 | .239 | .194 | -.778 | .158 |
| | 9 | .047 | .174 | .786 | -.294 | .388 |
| | 10 | -.098 | .215 | .649 | -.521 | .324 |
| | 11 | .153 | .156 | .328 | -.154 | .459 |
| 7 | 1 | .658(*) | .162 | .000 | .341 | .975 |
| | 2 | .321 | .177 | .070 | -.027 | .669 |
| | 3 | .210 | .214 | .328 | -.211 | .630 |
| | 4 | .230 | .163 | .159 | -.090 | .551 |
| | 5 | -.509 | .324 | .116 | -1.144 | .127 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 6 | .125 | .213 | .556 | -.292 | .542 |
| | 8 | -.185 | .250 | .460 | -.675 | .305 |
| | 9 | .173 | .189 | .361 | -.198 | .543 |
| | 10 | .027 | .228 | .905 | -.420 | .474 |
| | 11 | .278 | .173 | .108 | -.061 | .617 |
| 8 | 1 | .843(*) | .195 | .000 | .461 | 1.225 |
| | 2 | .506(*) | .208 | .015 | .098 | .914 |
| | 3 | .394 | .240 | .101 | -.077 | .866 |
| | 4 | .415(*) | .196 | .035 | .030 | .800 |
| | 5 | -.324 | .342 | .343 | -.994 | .346 |
| | 6 | .310 | .239 | .194 | -.158 | .778 |
| | 7 | .185 | .250 | .460 | -.305 | .675 |
| | 9 | .357 | .218 | .101 | -.070 | .785 |
| | 10 | .212 | .252 | .401 | -.283 | .707 |
| | 11 | .463(*) | .204 | .023 | .063 | .863 |
| 9 | 1 | .486(*) | .105 | .000 | .279 | .692 |
| | 2 | .148 | .128 | .247 | -.103 | .400 |
| | 3 | .037 | .176 | .833 | -.308 | .382 |
| | 4 | .058 | .108 | .595 | -.155 | .270 |
| | 5 | -.681(*) | .300 | .023 | -1.269 | -.093 |
| | 6 | -.047 | .174 | .786 | -.388 | .294 |
| | 7 | -.173 | .189 | .361 | -.543 | .198 |
| | 8 | -.357 | .218 | .101 | -.785 | .070 |
| | 10 | -.146 | .192 | .448 | -.522 | .231 |
| | 11 | .105 | .122 | .387 | -.133 | .344 |
| 10 | 1 | .631(*) | .165 | .000 | .307 | .955 |
| | 2 | .294 | .181 | .104 | -.060 | .648 |
| | 3 | .183 | .217 | .401 | -.243 | .608 |
| | 4 | .203 | .167 | .224 | -.125 | .531 |
| | 5 | -.536 | .326 | .100 | -1.175 | .103 |
| | 6 | .098 | .215 | .649 | -.324 | .521 |
| | 7 | -.027 | .228 | .905 | -.474 | .420 |
| | 8 | -.212 | .252 | .401 | -.707 | .283 |
| | 9 | .146 | .192 | .448 | -.231 | .522 |
| | 11 | .251 | .176 | .154 | -.095 | .596 |
| 11 | 1 | .380(*) | .073 | .000 | .237 | .523 |
| | 2 | .043 | .103 | .676 | -.159 | .245 |
| | 3 | -.068 | .158 | .666 | -.379 | .243 |
| | 4 | -.048 | .077 | .532 | -.198 | .102 |
| | 5 | -.787(*) | .290 | .007 | -1.355 | -.218 |
| | 6 | -.153 | .156 | .328 | -.459 | .154 |
| | 7 | -.278 | .173 | .108 | -.617 | .061 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 8 | -.463(*) | .204 | .023 | -.863 | -.063 |
| | | 9 | -.105 | .122 | .387 | -.344 | .133 |
| | | 10 | -.251 | .176 | .154 | -.596 | .095 |
| 4 | 1 | 2 | -.141(*) | .067 | .035 | -.272 | -.010 |
| | | 3 | .005 | .117 | .964 | -.225 | .236 |
| | | 4 | -.077(*) | .038 | .040 | -.151 | -.003 |
| | | 5 | -.432 | .227 | .058 | -.878 | .014 |
| | | 6 | -.139 | .115 | .228 | -.365 | .087 |
| | | 7 | -.182 | .130 | .159 | -.437 | .072 |
| | | 8 | -.199 | .156 | .202 | -.506 | .107 |
| | | 9 | -.061 | .085 | .473 | -.227 | .105 |
| | | 10 | -.162 | .133 | .221 | -.422 | .098 |
| | | 11 | -.069 | .058 | .236 | -.184 | .045 |
| | 2 | 1 | .141(*) | .067 | .035 | .010 | .272 |
| | | 3 | .147 | .131 | .264 | -.111 | .404 |
| | | 4 | .064 | .069 | .356 | -.072 | .200 |
| | | 5 | -.291 | .235 | .216 | -.751 | .170 |
| | | 6 | .002 | .129 | .988 | -.252 | .256 |
| | | 7 | -.041 | .142 | .772 | -.320 | .238 |
| | | 8 | -.058 | .167 | .727 | -.385 | .269 |
| | | 9 | .080 | .103 | .434 | -.121 | .282 |
| | | 10 | -.021 | .145 | .885 | -.305 | .263 |
| | | 11 | .072 | .083 | .384 | -.090 | .234 |
| | 3 | 1 | -.005 | .117 | .964 | -.236 | .225 |
| | | 2 | -.147 | .131 | .264 | -.404 | .111 |
| | | 4 | -.082 | .119 | .489 | -.316 | .151 |
| | | 5 | -.437 | .254 | .085 | -.935 | .060 |
| | | 6 | -.145 | .161 | .371 | -.461 | .172 |
| | | 7 | -.188 | .172 | .275 | -.525 | .149 |
| | | 8 | -.205 | .193 | .288 | -.583 | .173 |
| | | 9 | -.066 | .141 | .640 | -.343 | .211 |
| | | 10 | -.168 | .174 | .336 | -.509 | .174 |
| | | 11 | -.075 | .127 | .557 | -.324 | .175 |
| | 4 | 1 | .077(*) | .038 | .040 | .003 | .151 |
| | | 2 | -.064 | .069 | .356 | -.200 | .072 |
| | | 3 | .082 | .119 | .489 | -.151 | .316 |
| | | 5 | -.355 | .228 | .120 | -.802 | .092 |
| | | 6 | -.062 | .117 | .595 | -.292 | .167 |
| | | 7 | -.105 | .131 | .421 | -.362 | .152 |
| | | 8 | -.122 | .157 | .437 | -.431 | .186 |
| | | 9 | .016 | .087 | .851 | -.154 | .186 |
| | | 10 | -.085 | .134 | .525 | -.348 | .178 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 11 | .008 | .061 | .899 | -.113 | .128 |
| 5 | 1 | .432 | .227 | .058 | -.014 | .878 |
| | 2 | .291 | .235 | .216 | -.170 | .751 |
| | 3 | .437 | .254 | .085 | -.060 | .935 |
| | 4 | .355 | .228 | .120 | -.092 | .802 |
| | 6 | .293 | .253 | .247 | -.203 | .789 |
| | 7 | .250 | .260 | .337 | -.260 | .759 |
| | 8 | .233 | .274 | .396 | -.305 | .770 |
| | 9 | .371 | .240 | .123 | -.100 | .843 |
| | 10 | .270 | .261 | .302 | -.242 | .782 |
| | 11 | .363 | .232 | .119 | -.093 | .819 |
| 6 | 1 | .139 | .115 | .228 | -.087 | .365 |
| | 2 | -.002 | .129 | .988 | -.256 | .252 |
| | 3 | .145 | .161 | .371 | -.172 | .461 |
| | 4 | .062 | .117 | .595 | -.167 | .292 |
| | 5 | -.293 | .253 | .247 | -.789 | .203 |
| | 7 | -.043 | .170 | .800 | -.378 | .291 |
| | 8 | -.060 | .191 | .753 | -.436 | .315 |
| | 9 | .078 | .139 | .573 | -.195 | .352 |
| | 10 | -.023 | .173 | .894 | -.362 | .316 |
| | 11 | .070 | .125 | .577 | -.176 | .316 |
| 7 | 1 | .182 | .130 | .159 | -.072 | .437 |
| | 2 | .041 | .142 | .772 | -.238 | .320 |
| | 3 | .188 | .172 | .275 | -.149 | .525 |
| | 4 | .105 | .131 | .421 | -.152 | .362 |
| | 5 | -.250 | .260 | .337 | -.759 | .260 |
| | 6 | .043 | .170 | .800 | -.291 | .378 |
| | 8 | -.017 | .200 | .933 | -.410 | .376 |
| | 9 | .122 | .151 | .421 | -.175 | .419 |
| | 10 | .020 | .183 | .912 | -.338 | .378 |
| | 11 | .113 | .138 | .414 | -.158 | .385 |
| 8 | 1 | .199 | .156 | .202 | -.107 | .506 |
| | 2 | .058 | .167 | .727 | -.269 | .385 |
| | 3 | .205 | .193 | .288 | -.173 | .583 |
| | 4 | .122 | .157 | .437 | -.186 | .431 |
| | 5 | -.233 | .274 | .396 | -.770 | .305 |
| | 6 | .060 | .191 | .753 | -.315 | .436 |
| | 7 | .017 | .200 | .933 | -.376 | .410 |
| | 9 | .139 | .175 | .427 | -.204 | .481 |
| | 10 | .037 | .202 | .854 | -.360 | .434 |
| | 11 | .130 | .164 | .427 | -.191 | .451 |
| 9 | 1 | .061 | .085 | .473 | -.105 | .227 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2 | -.080 | .103 | .434 | -.282 | .121 |
| | | 3 | .066 | .141 | .640 | -.211 | .343 |
| | | 4 | -.016 | .087 | .851 | -.186 | .154 |
| | | 5 | -.371 | .240 | .123 | -.843 | .100 |
| | | 6 | -.078 | .139 | .573 | -.352 | .195 |
| | | 7 | -.122 | .151 | .421 | -.419 | .175 |
| | | 8 | -.139 | .175 | .427 | -.481 | .204 |
| | | 10 | -.101 | .154 | .510 | -.403 | .200 |
| | | 11 | -.009 | .098 | .930 | -.200 | .183 |
| | 10 | 1 | .162 | .133 | .221 | -.098 | .422 |
| | | 2 | .021 | .145 | .885 | -.263 | .305 |
| | | 3 | .168 | .174 | .336 | -.174 | .509 |
| | | 4 | .085 | .134 | .525 | -.178 | .348 |
| | | 5 | -.270 | .261 | .302 | -.782 | .242 |
| | | 6 | .023 | .173 | .894 | -.316 | .362 |
| | | 7 | -.020 | .183 | .912 | -.378 | .338 |
| | | 8 | -.037 | .202 | .854 | -.434 | .360 |
| | | 9 | .101 | .154 | .510 | -.200 | .403 |
| | | 11 | .093 | .141 | .511 | -.184 | .370 |
| | 11 | 1 | .069 | .058 | .236 | -.045 | .184 |
| | | 2 | -.072 | .083 | .384 | -.234 | .090 |
| | | 3 | .075 | .127 | .557 | -.175 | .324 |
| | | 4 | -.008 | .061 | .899 | -.128 | .113 |
| | | 5 | -.363 | .232 | .119 | -.819 | .093 |
| | | 6 | -.070 | .125 | .577 | -.316 | .176 |
| | | 7 | -.113 | .138 | .414 | -.385 | .158 |
| | | 8 | -.130 | .164 | .427 | -.451 | .191 |
| | | 9 | .009 | .098 | .930 | -.183 | .200 |
| | | 10 | -.093 | .141 | .511 | -.370 | .184 |
| 5 | 1 | 2 | -.293(*) | .080 | .000 | -.450 | -.136 |
| | | 3 | -.294(*) | .141 | .037 | -.570 | -.017 |
| | | 4 | -.263(*) | .045 | .000 | -.351 | -.175 |
| | | 5 | -.843(*) | .273 | .002 | -1.378 | -.308 |
| | | 6 | -.432(*) | .138 | .002 | -.703 | -.160 |
| | | 7 | -.403(*) | .155 | .010 | -.708 | -.098 |
| | | 8 | -.447(*) | .187 | .017 | -.815 | -.080 |
| | | 9 | -.178 | .101 | .080 | -.377 | .021 |
| | | 10 | -.378(*) | .159 | .018 | -.690 | -.066 |
| | | 11 | -.233(*) | .070 | .001 | -.370 | -.095 |
| | 2 | 1 | .293(*) | .080 | .000 | .136 | .450 |
| | | 3 | -.001 | .157 | .997 | -.309 | .308 |
| | | 4 | .030 | .083 | .716 | -.133 | .194 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | -.549 | .282 | .051 | -1.102 | .003 |
| | 6 | -.139 | .155 | .371 | -.443 | .166 |
| | 7 | -.110 | .171 | .521 | -.444 | .225 |
| | 8 | -.154 | .200 | .441 | -.547 | .238 |
| | 9 | .115 | .123 | .350 | -.127 | .357 |
| | 10 | -.085 | .174 | .624 | -.426 | .256 |
| | 11 | .061 | .099 | .541 | -.134 | .255 |
| 3 | 1 | .294(*) | .141 | .037 | .017 | .570 |
| | 2 | .001 | .157 | .997 | -.308 | .309 |
| | 4 | .031 | .143 | .829 | -.249 | .311 |
| | 5 | -.549 | .304 | .072 | -1.146 | .048 |
| | 6 | -.138 | .194 | .475 | -.518 | .242 |
| | 7 | -.109 | .206 | .597 | -.513 | .295 |
| | 8 | -.154 | .231 | .506 | -.607 | .300 |
| | 9 | .116 | .169 | .494 | -.216 | .448 |
| | 10 | -.085 | .209 | .685 | -.494 | .325 |
| | 11 | .061 | .152 | .689 | -.238 | .360 |
| 4 | 1 | .263(*) | .045 | .000 | .175 | .351 |
| | 2 | -.030 | .083 | .716 | -.194 | .133 |
| | 3 | -.031 | .143 | .829 | -.311 | .249 |
| | 5 | -.580(*) | .274 | .034 | -1.117 | -.043 |
| | 6 | -.169 | .140 | .228 | -.444 | .106 |
| | 7 | -.140 | .157 | .374 | -.448 | .168 |
| | 8 | -.185 | .189 | .328 | -.555 | .186 |
| | 9 | .085 | .104 | .414 | -.119 | .289 |
| | 10 | -.115 | .161 | .472 | -.431 | .200 |
| | 11 | .030 | .074 | .681 | -.114 | .175 |
| 5 | 1 | .843(*) | .273 | .002 | .308 | 1.378 |
| | 2 | .549 | .282 | .051 | -.003 | 1.102 |
| | 3 | .549 | .304 | .072 | -.048 | 1.146 |
| | 4 | .580(*) | .274 | .034 | .043 | 1.117 |
| | 6 | .411 | .303 | .176 | -.184 | 1.006 |
| | 7 | .440 | .312 | .158 | -.171 | 1.051 |
| | 8 | .395 | .329 | .229 | -.249 | 1.040 |
| | 9 | .665(*) | .288 | .021 | .099 | 1.230 |
| | 10 | .464 | .313 | .139 | -.150 | 1.079 |
| | 11 | .610(*) | .279 | .029 | .063 | 1.157 |
| 6 | 1 | .432(*) | .138 | .002 | .160 | .703 |
| | 2 | .139 | .155 | .371 | -.166 | .443 |
| | 3 | .138 | .194 | .475 | -.242 | .518 |
| | 4 | .169 | .140 | .228 | -.106 | .444 |
| | 5 | -.411 | .303 | .176 | -1.006 | .184 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 7 | .029 | .205 | .886 | -.372 | .430 |
| | 8 | -.015 | .230 | .946 | -.466 | .435 |
| | 9 | .254 | .167 | .129 | -.074 | .582 |
| | 10 | .054 | .207 | .796 | -.353 | .460 |
| | 11 | .199 | .150 | .185 | -.095 | .494 |
| 7 | 1 | .403(*) | .155 | .010 | .098 | .708 |
| | 2 | .110 | .171 | .521 | -.225 | .444 |
| | 3 | .109 | .206 | .597 | -.295 | .513 |
| | 4 | .140 | .157 | .374 | -.168 | .448 |
| | 5 | -.440 | .312 | .158 | -1.051 | .171 |
| | 6 | -.029 | .205 | .886 | -.430 | .372 |
| | 8 | -.045 | .240 | .853 | -.516 | .427 |
| | 9 | .225 | .182 | .216 | -.131 | .581 |
| | 10 | .024 | .219 | .911 | -.405 | .454 |
| | 11 | .170 | .166 | .306 | -.156 | .496 |
| 8 | 1 | .447(*) | .187 | .017 | .080 | .815 |
| | 2 | .154 | .200 | .441 | -.238 | .547 |
| | 3 | .154 | .231 | .506 | -.300 | .607 |
| | 4 | .185 | .189 | .328 | -.186 | .555 |
| | 5 | -.395 | .329 | .229 | -1.040 | .249 |
| | 6 | .015 | .230 | .946 | -.435 | .466 |
| | 7 | .045 | .240 | .853 | -.427 | .516 |
| | 9 | .269 | .210 | .199 | -.142 | .680 |
| | 10 | .069 | .243 | .776 | -.407 | .545 |
| | 11 | .215 | .196 | .274 | -.170 | .600 |
| 9 | 1 | .178 | .101 | .080 | -.021 | .377 |
| | 2 | -.115 | .123 | .350 | -.357 | .127 |
| | 3 | -.116 | .169 | .494 | -.448 | .216 |
| | 4 | -.085 | .104 | .414 | -.289 | .119 |
| | 5 | -.665(*) | .288 | .021 | -1.230 | -.099 |
| | 6 | -.254 | .167 | .129 | -.582 | .074 |
| | 7 | -.225 | .182 | .216 | -.581 | .131 |
| | 8 | -.269 | .210 | .199 | -.680 | .142 |
| | 10 | -.200 | .185 | .278 | -.563 | .162 |
| | 11 | -.055 | .117 | .641 | -.284 | .175 |
| 10 | 1 | .378(*) | .159 | .018 | .066 | .690 |
| | 2 | .085 | .174 | .624 | -.256 | .426 |
| | 3 | .085 | .209 | .685 | -.325 | .494 |
| | 4 | .115 | .161 | .472 | -.200 | .431 |
| | 5 | -.464 | .313 | .139 | -1.079 | .150 |
| | 6 | -.054 | .207 | .796 | -.460 | .353 |
| | 7 | -.024 | .219 | .911 | -.454 | .405 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 8 | -.069 | .243 | .776 | -.545 | .407 |
| | | 9 | .200 | .185 | .278 | -.162 | .563 |
| | | 11 | .146 | .169 | .390 | -.187 | .478 |
| | 11 | 1 | .233(*) | .070 | .001 | .095 | .370 |
| | | 2 | -.061 | .099 | .541 | -.255 | .134 |
| | | 3 | -.061 | .152 | .689 | -.360 | .238 |
| | | 4 | -.030 | .074 | .681 | -.175 | .114 |
| | | 5 | -.610(*) | .279 | .029 | -1.157 | -.063 |
| | | 6 | -.199 | .150 | .185 | -.494 | .095 |
| | | 7 | -.170 | .166 | .306 | -.496 | .156 |
| | | 8 | -.215 | .196 | .274 | -.600 | .170 |
| | | 9 | .055 | .117 | .641 | -.175 | .284 |
| | | 10 | -.146 | .169 | .390 | -.478 | .187 |
| 6 | 1 | 2 | -.277(*) | .068 | .000 | -.411 | -.144 |
| | | 3 | -.169 | .120 | .158 | -.404 | .066 |
| | | 4 | -.327(*) | .038 | .000 | -.402 | -.252 |
| | | 5 | -.745(*) | .232 | .001 | -1.200 | -.291 |
| | | 6 | -.381(*) | .118 | .001 | -.612 | -.150 |
| | | 7 | -.284(*) | .132 | .032 | -.544 | -.025 |
| | | 8 | -.349(*) | .159 | .028 | -.662 | -.037 |
| | | 9 | -.247(*) | .086 | .004 | -.416 | -.078 |
| | | 10 | -.422(*) | .135 | .002 | -.687 | -.157 |
| | | 11 | -.273(*) | .060 | .000 | -.389 | -.156 |
| | 2 | 1 | .277(*) | .068 | .000 | .144 | .411 |
| | | 3 | .108 | .134 | .419 | -.154 | .370 |
| | | 4 | -.050 | .071 | .480 | -.189 | .089 |
| | | 5 | -.468 | .239 | .051 | -.937 | .001 |
| | | 6 | -.104 | .132 | .431 | -.362 | .155 |
| | | 7 | -.007 | .145 | .961 | -.291 | .277 |
| | | 8 | -.072 | .170 | .672 | -.405 | .261 |
| | | 9 | .030 | .105 | .773 | -.175 | .236 |
| | | 10 | -.144 | .148 | .329 | -.434 | .145 |
| | | 11 | .005 | .084 | .957 | -.161 | .170 |
| | 3 | 1 | .169 | .120 | .158 | -.066 | .404 |
| | | 2 | -.108 | .134 | .419 | -.370 | .154 |
| | | 4 | -.158 | .121 | .193 | -.396 | .080 |
| | | 5 | -.576(*) | .259 | .026 | -1.084 | -.069 |
| | | 6 | -.212 | .165 | .198 | -.535 | .111 |
| | | 7 | -.115 | .175 | .511 | -.459 | .229 |
| | | 8 | -.180 | .196 | .360 | -.565 | .205 |
| | | 9 | -.078 | .144 | .589 | -.360 | .204 |
| | | 10 | -.252 | .177 | .155 | -.601 | .096 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 11 | -.103 | .130 | .424 | -.358 | .151 |
| 4 | 1 | .327(*) | .038 | .000 | .252 | .402 |
| | 2 | .050 | .071 | .480 | -.089 | .189 |
| | 3 | .158 | .121 | .193 | -.080 | .396 |
| | 5 | -.418 | .233 | .072 | -.874 | .038 |
| | 6 | -.054 | .119 | .652 | -.288 | .180 |
| | 7 | .043 | .134 | .748 | -.219 | .305 |
| | 8 | -.022 | .160 | .891 | -.337 | .293 |
| | 9 | .080 | .088 | .364 | -.093 | .254 |
| | 10 | -.094 | .137 | .490 | -.362 | .174 |
| | 11 | .055 | .063 | .383 | -.068 | .177 |
| 5 | 1 | .745(*) | .232 | .001 | .291 | 1.200 |
| | 2 | .468 | .239 | .051 | -.001 | .937 |
| | 3 | .576(*) | .259 | .026 | .069 | 1.084 |
| | 4 | .418 | .233 | .072 | -.038 | .874 |
| | 6 | .364 | .258 | .158 | -.141 | .870 |
| | 7 | .461 | .265 | .082 | -.058 | .980 |
| | 8 | .396 | .279 | .156 | -.151 | .944 |
| | 9 | .498(*) | .245 | .042 | .018 | .979 |
| | 10 | .324 | .266 | .224 | -.198 | .846 |
| | 11 | .473(*) | .237 | .046 | .008 | .938 |
| 6 | 1 | .381(*) | .118 | .001 | .150 | .612 |
| | 2 | .104 | .132 | .431 | -.155 | .362 |
| | 3 | .212 | .165 | .198 | -.111 | .535 |
| | 4 | .054 | .119 | .652 | -.180 | .288 |
| | 5 | -.364 | .258 | .158 | -.870 | .141 |
| | 7 | .097 | .174 | .578 | -.244 | .438 |
| | 8 | .032 | .195 | .870 | -.351 | .415 |
| | 9 | .134 | .142 | .345 | -.145 | .413 |
| | 10 | -.040 | .176 | .818 | -.386 | .305 |
| | 11 | .108 | .128 | .396 | -.142 | .359 |
| 7 | 1 | .284(*) | .132 | .032 | .025 | .544 |
| | 2 | .007 | .145 | .961 | -.277 | .291 |
| | 3 | .115 | .175 | .511 | -.229 | .459 |
| | 4 | -.043 | .134 | .748 | -.305 | .219 |
| | 5 | -.461 | .265 | .082 | -.980 | .058 |
| | 6 | -.097 | .174 | .578 | -.438 | .244 |
| | 8 | -.065 | .204 | .751 | -.465 | .336 |
| | 9 | .037 | .154 | .809 | -.265 | .340 |
| | 10 | -.137 | .186 | .461 | -.502 | .228 |
| | 11 | .012 | .141 | .934 | -.265 | .288 |
| 8 | 1 | .349(*) | .159 | .028 | .037 | .662 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2 | .072 | .170 | .672 | -.261 | .405 |
| | | 3 | .180 | .196 | .360 | -.205 | .565 |
| | | 4 | .022 | .160 | .891 | -.293 | .337 |
| | | 5 | -.396 | .279 | .156 | -.944 | .151 |
| | | 6 | -.032 | .195 | .870 | -.415 | .351 |
| | | 7 | .065 | .204 | .751 | -.336 | .465 |
| | | 9 | .102 | .178 | .566 | -.247 | .451 |
| | | 10 | -.072 | .206 | .726 | -.477 | .332 |
| | | 11 | .077 | .167 | .646 | -.251 | .404 |
| | 9 | 1 | .247(*) | .086 | .004 | .078 | .416 |
| | | 2 | -.030 | .105 | .773 | -.236 | .175 |
| | | 3 | .078 | .144 | .589 | -.204 | .360 |
| | | 4 | -.080 | .088 | .364 | -.254 | .093 |
| | | 5 | -.498(*) | .245 | .042 | -.979 | -.018 |
| | | 6 | -.134 | .142 | .345 | -.413 | .145 |
| | | 7 | -.037 | .154 | .809 | -.340 | .265 |
| | | 8 | -.102 | .178 | .566 | -.451 | .247 |
| | | 10 | -.175 | .157 | .266 | -.482 | .133 |
| | | 11 | -.026 | .099 | .796 | -.221 | .169 |
| | 10 | 1 | .422(*) | .135 | .002 | .157 | .687 |
| | | 2 | .144 | .148 | .329 | -.145 | .434 |
| | | 3 | .252 | .177 | .155 | -.096 | .601 |
| | | 4 | .094 | .137 | .490 | -.174 | .362 |
| | | 5 | -.324 | .266 | .224 | -.846 | .198 |
| | | 6 | .040 | .176 | .818 | -.305 | .386 |
| | | 7 | .137 | .186 | .461 | -.228 | .502 |
| | | 8 | .072 | .206 | .726 | -.332 | .477 |
| | | 9 | .175 | .157 | .266 | -.133 | .482 |
| | | 11 | .149 | .144 | .301 | -.133 | .431 |
| | 11 | 1 | .273(*) | .060 | .000 | .156 | .389 |
| | | 2 | -.005 | .084 | .957 | -.170 | .161 |
| | | 3 | .103 | .130 | .424 | -.151 | .358 |
| | | 4 | -.055 | .063 | .383 | -.177 | .068 |
| | | 5 | -.473(*) | .237 | .046 | -.938 | -.008 |
| | | 6 | -.108 | .128 | .396 | -.359 | .142 |
| | | 7 | -.012 | .141 | .934 | -.288 | .265 |
| | | 8 | -.077 | .167 | .646 | -.404 | .251 |
| | | 9 | .026 | .099 | .796 | -.169 | .221 |
| | | 10 | -.149 | .144 | .301 | -.431 | .133 |
| 7 | 1 | 2 | -.461(*) | .068 | .000 | -.595 | -.328 |
| | | 3 | -.683(*) | .120 | .000 | -.918 | -.448 |
| | | 4 | -.476(*) | .038 | .000 | -.551 | -.401 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | -1.285(*) | .232 | .000 | -1.741 | -.829 |
| | 6 | -.891(*) | .118 | .000 | -1.123 | -.660 |
| | 7 | -.689(*) | .132 | .000 | -.949 | -.429 |
| | 8 | -.781(*) | .160 | .000 | -1.094 | -.468 |
| | 9 | -.453(*) | .086 | .000 | -.622 | -.283 |
| | 10 | -.652(*) | .135 | .000 | -.918 | -.387 |
| | 11 | -.473(*) | .060 | .000 | -.591 | -.356 |
| 2 | 1 | .461(*) | .068 | .000 | .328 | .595 |
| | 3 | -.222 | .134 | .098 | -.485 | .041 |
| | 4 | -.015 | .071 | .834 | -.154 | .124 |
| | 5 | -.823(*) | .240 | .001 | -1.294 | -.353 |
| | 6 | -.430(*) | .132 | .001 | -.689 | -.171 |
| | 7 | -.227 | .145 | .118 | -.512 | .058 |
| | 8 | -.320 | .170 | .061 | -.654 | .014 |
| | 9 | .009 | .105 | .935 | -.198 | .215 |
| | 10 | -.191 | .148 | .197 | -.481 | .099 |
| | 11 | -.012 | .084 | .887 | -.178 | .154 |
| 3 | 1 | .683(*) | .120 | .000 | .448 | .918 |
| | 2 | .222 | .134 | .098 | -.041 | .485 |
| | 4 | .207 | .122 | .089 | -.032 | .445 |
| | 5 | -.602(*) | .259 | .020 | -1.111 | -.093 |
| | 6 | -.208 | .165 | .207 | -.532 | .115 |
| | 7 | -.006 | .176 | .974 | -.350 | .339 |
| | 8 | -.098 | .197 | .618 | -.485 | .288 |
| | 9 | .230 | .144 | .111 | -.053 | .513 |
| | 10 | .031 | .178 | .863 | -.318 | .380 |
| | 11 | .210 | .130 | .107 | -.045 | .464 |
| 4 | 1 | .476(*) | .038 | .000 | .401 | .551 |
| | 2 | .015 | .071 | .834 | -.124 | .154 |
| | 3 | -.207 | .122 | .089 | -.445 | .032 |
| | 5 | -.809(*) | .233 | .001 | -1.266 | -.351 |
| | 6 | -.415(*) | .120 | .001 | -.649 | -.181 |
| | 7 | -.213 | .134 | .112 | -.475 | .050 |
| | 8 | -.305 | .161 | .058 | -.620 | .010 |
| | 9 | .023 | .089 | .792 | -.150 | .197 |
| | 10 | -.176 | .137 | .198 | -.445 | .092 |
| | 11 | .003 | .063 | .964 | -.120 | .126 |
| 5 | 1 | 1.285(*) | .232 | .000 | .829 | 1.741 |
| | 2 | .823(*) | .240 | .001 | .353 | 1.294 |
| | 3 | .602(*) | .259 | .020 | .093 | 1.111 |
| | 4 | .809(*) | .233 | .001 | .351 | 1.266 |
| | 6 | .394 | .258 | .128 | -.113 | .900 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 7 | .596(*) | .265 | .025 | .075 | 1.116 |
| | 8 | .504 | .280 | .072 | -.046 | 1.053 |
| | 9 | .832(*) | .246 | .001 | .350 | 1.314 |
| | 10 | .632(*) | .267 | .018 | .109 | 1.156 |
| | 11 | .811(*) | .238 | .001 | .345 | 1.277 |
| 6 | 1 | .891(*) | .118 | .000 | .660 | 1.123 |
| | 2 | .430(*) | .132 | .001 | .171 | .689 |
| | 3 | .208 | .165 | .207 | -.115 | .532 |
| | 4 | .415(*) | .120 | .001 | .181 | .649 |
| | 5 | -.394 | .258 | .128 | -.900 | .113 |
| | 7 | .202 | .174 | .246 | -.139 | .544 |
| | 8 | .110 | .196 | .574 | -.274 | .494 |
| | 9 | .438(*) | .142 | .002 | .159 | .718 |
| | 10 | .239 | .177 | .176 | -.107 | .585 |
| | 11 | .418(*) | .128 | .001 | .167 | .669 |
| 7 | 1 | .689(*) | .132 | .000 | .429 | .949 |
| | 2 | .227 | .145 | .118 | -.058 | .512 |
| | 3 | .006 | .176 | .974 | -.339 | .350 |
| | 4 | .213 | .134 | .112 | -.050 | .475 |
| | 5 | -.596(*) | .265 | .025 | -1.116 | -.075 |
| | 6 | -.202 | .174 | .246 | -.544 | .139 |
| | 8 | -.092 | .205 | .652 | -.494 | .309 |
| | 9 | .236 | .155 | .127 | -.067 | .539 |
| | 10 | .037 | .187 | .845 | -.329 | .402 |
| | 11 | .215 | .141 | .128 | -.062 | .493 |
| 8 | 1 | .781(*) | .160 | .000 | .468 | 1.094 |
| | 2 | .320 | .170 | .061 | -.014 | .654 |
| | 3 | .098 | .197 | .618 | -.288 | .485 |
| | 4 | .305 | .161 | .058 | -.010 | .620 |
| | 5 | -.504 | .280 | .072 | -1.053 | .046 |
| | 6 | -.110 | .196 | .574 | -.494 | .274 |
| | 7 | .092 | .205 | .652 | -.309 | .494 |
| | 9 | .328 | .178 | .066 | -.022 | .678 |
| | 10 | .129 | .207 | .533 | -.277 | .534 |
| | 11 | .308 | .167 | .066 | -.020 | .636 |
| 9 | 1 | .453(*) | .086 | .000 | .283 | .622 |
| | 2 | -.009 | .105 | .935 | -.215 | .198 |
| | 3 | -.230 | .144 | .111 | -.513 | .053 |
| | 4 | -.023 | .089 | .792 | -.197 | .150 |
| | 5 | -.832(*) | .246 | .001 | -1.314 | -.350 |
| | 6 | -.438(*) | .142 | .002 | -.718 | -.159 |
| | 7 | -.236 | .155 | .127 | -.539 | .067 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 8 | -.328 | .178 | .066 | -.678 | .022 |
| | | 10 | -.199 | .157 | .205 | -.508 | .109 |
| | | 11 | -.021 | .100 | .837 | -.216 | .175 |
| | 10 | 1 | .652(*) | .135 | .000 | .387 | .918 |
| | | 2 | .191 | .148 | .197 | -.099 | .481 |
| | | 3 | -.031 | .178 | .863 | -.380 | .318 |
| | | 4 | .176 | .137 | .198 | -.092 | .445 |
| | | 5 | -.632(*) | .267 | .018 | -1.156 | -.109 |
| | | 6 | -.239 | .177 | .176 | -.585 | .107 |
| | | 7 | -.037 | .187 | .845 | -.402 | .329 |
| | | 8 | -.129 | .207 | .533 | -.534 | .277 |
| | | 9 | .199 | .157 | .205 | -.109 | .508 |
| | | 11 | .179 | .144 | .215 | -.104 | .462 |
| | 11 | 1 | .473(*) | .060 | .000 | .356 | .591 |
| | | 2 | .012 | .084 | .887 | -.154 | .178 |
| | | 3 | -.210 | .130 | .107 | -.464 | .045 |
| | | 4 | -.003 | .063 | .964 | -.126 | .120 |
| | | 5 | -.811(*) | .238 | .001 | -1.277 | -.345 |
| | | 6 | -.418(*) | .128 | .001 | -.669 | -.167 |
| | | 7 | -.215 | .141 | .128 | -.493 | .062 |
| | | 8 | -.308 | .167 | .066 | -.636 | .020 |
| | | 9 | .021 | .100 | .837 | -.175 | .216 |
| | | 10 | -.179 | .144 | .215 | -.462 | .104 |
| 8 | 1 | 2 | -.204(*) | .069 | .003 | -.339 | -.069 |
| | | 3 | -.498(*) | .121 | .000 | -.736 | -.260 |
| | | 4 | -.186(*) | .039 | .000 | -.262 | -.110 |
| | | 5 | -.999(*) | .235 | .000 | -1.459 | -.539 |
| | | 6 | -.801(*) | .119 | .000 | -1.034 | -.567 |
| | | 7 | -.645(*) | .134 | .000 | -.908 | -.383 |
| | | 8 | -.606(*) | .161 | .000 | -.922 | -.290 |
| | | 9 | -.300(*) | .087 | .001 | -.472 | -.129 |
| | | 10 | -.332(*) | .137 | .015 | -.601 | -.064 |
| | | 11 | -.185(*) | .060 | .002 | -.303 | -.067 |
| | 2 | 1 | .204(*) | .069 | .003 | .069 | .339 |
| | | 3 | -.294(*) | .135 | .030 | -.560 | -.029 |
| | | 4 | .018 | .072 | .805 | -.123 | .158 |
| | | 5 | -.795(*) | .242 | .001 | -1.270 | -.320 |
| | | 6 | -.597(*) | .133 | .000 | -.859 | -.335 |
| | | 7 | -.442(*) | .147 | .003 | -.730 | -.154 |
| | | 8 | -.403(*) | .172 | .019 | -.740 | -.065 |
| | | 9 | -.097 | .106 | .362 | -.305 | .111 |
| | | 10 | -.129 | .149 | .390 | -.422 | .165 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 11 | .019 | .085 | .826 | -.148 | .186 |
| 3 | 1 | .498(*) | .121 | .000 | .260 | .736 |
| | 2 | .294(*) | .135 | .030 | .029 | .560 |
| | 4 | .312(*) | .123 | .011 | .071 | .553 |
| | 5 | -.501 | .262 | .056 | -1.015 | .013 |
| | 6 | -.303 | .167 | .069 | -.629 | .024 |
| | 7 | -.147 | .177 | .406 | -.495 | .200 |
| | 8 | -.108 | .199 | .586 | -.498 | .282 |
| | 9 | .198 | .146 | .175 | -.088 | .483 |
| | 10 | .166 | .180 | .357 | -.187 | .518 |
| | 11 | .313(*) | .131 | .017 | .056 | .570 |
| 4 | 1 | .186(*) | .039 | .000 | .110 | .262 |
| | 2 | -.018 | .072 | .805 | -.158 | .123 |
| | 3 | -.312(*) | .123 | .011 | -.553 | -.071 |
| | 5 | -.813(*) | .235 | .001 | -1.275 | -.351 |
| | 6 | -.615(*) | .121 | .000 | -.851 | -.378 |
| | 7 | -.460(*) | .135 | .001 | -.725 | -.194 |
| | 8 | -.420(*) | .162 | .010 | -.739 | -.102 |
| | 9 | -.114 | .089 | .201 | -.290 | .061 |
| | 10 | -.146 | .138 | .290 | -.417 | .125 |
| | 11 | .001 | .063 | .987 | -.123 | .125 |
| 5 | 1 | .999(*) | .235 | .000 | .539 | 1.459 |
| | 2 | .795(*) | .242 | .001 | .320 | 1.270 |
| | 3 | .501 | .262 | .056 | -.013 | 1.015 |
| | 4 | .813(*) | .235 | .001 | .351 | 1.275 |
| | 6 | .198 | .261 | .447 | -.313 | .710 |
| | 7 | .354 | .268 | .187 | -.172 | .879 |
| | 8 | .393 | .283 | .165 | -.162 | .947 |
| | 9 | .699(*) | .248 | .005 | .212 | 1.185 |
| | 10 | .667(*) | .269 | .013 | .138 | 1.195 |
| | 11 | .814(*) | .240 | .001 | .344 | 1.285 |
| 6 | 1 | .801(*) | .119 | .000 | .567 | 1.034 |
| | 2 | .597(*) | .133 | .000 | .335 | .859 |
| | 3 | .303 | .167 | .069 | -.024 | .629 |
| | 4 | .615(*) | .121 | .000 | .378 | .851 |
| | 5 | -.198 | .261 | .447 | -.710 | .313 |
| | 7 | .155 | .176 | .378 | -.190 | .500 |
| | 8 | .194 | .198 | .326 | -.193 | .582 |
| | 9 | .500(*) | .144 | .001 | .218 | .782 |
| | 10 | .468(*) | .178 | .009 | .119 | .818 |
| | 11 | .616(*) | .129 | .000 | .362 | .869 |
| 7 | 1 | .645(*) | .134 | .000 | .383 | .908 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2 | .442(*) | .147 | .003 | .154 | .730 |
| | 3 | .147 | .177 | .406 | -.200 | .495 |
| | 4 | .460(*) | .135 | .001 | .194 | .725 |
| | 5 | -.354 | .268 | .187 | -.879 | .172 |
| | 6 | -.155 | .176 | .378 | -.500 | .190 |
| | 8 | .039 | .207 | .850 | -.366 | .445 |
| | 9 | .345(*) | .156 | .027 | .039 | .651 |
| | 10 | .313 | .188 | .097 | -.056 | .683 |
| | 11 | .461(*) | .143 | .001 | .180 | .741 |
| 8 | 1 | .606(*) | .161 | .000 | .290 | .922 |
| | 2 | .403(*) | .172 | .019 | .065 | .740 |
| | 3 | .108 | .199 | .586 | -.282 | .498 |
| | 4 | .420(*) | .162 | .010 | .102 | .739 |
| | 5 | -.393 | .283 | .165 | -.947 | .162 |
| | 6 | -.194 | .198 | .326 | -.582 | .193 |
| | 7 | -.039 | .207 | .850 | -.445 | .366 |
| | 9 | .306 | .180 | .090 | -.048 | .659 |
| | 10 | .274 | .209 | .189 | -.135 | .684 |
| | 11 | .421(*) | .169 | .013 | .090 | .753 |
| 9 | 1 | .300(*) | .087 | .001 | .129 | .472 |
| | 2 | .097 | .106 | .362 | -.111 | .305 |
| | 3 | -.198 | .146 | .175 | -.483 | .088 |
| | 4 | .114 | .089 | .201 | -.061 | .290 |
| | 5 | -.699(*) | .248 | .005 | -1.185 | -.212 |
| | 6 | -.500(*) | .144 | .001 | -.782 | -.218 |
| | 7 | -.345(*) | .156 | .027 | -.651 | -.039 |
| | 8 | -.306 | .180 | .090 | -.659 | .048 |
| | 10 | -.032 | .159 | .841 | -.343 | .280 |
| | 11 | .115 | .101 | .251 | -.082 | .313 |
| 10 | 1 | .332(*) | .137 | .015 | .064 | .601 |
| | 2 | .129 | .149 | .390 | -.165 | .422 |
| | 3 | -.166 | .180 | .357 | -.518 | .187 |
| | 4 | .146 | .138 | .290 | -.125 | .417 |
| | 5 | -.667(*) | .269 | .013 | -1.195 | -.138 |
| | 6 | -.468(*) | .178 | .009 | -.818 | -.119 |
| | 7 | -.313 | .188 | .097 | -.683 | .056 |
| | 8 | -.274 | .209 | .189 | -.684 | .135 |
| | 9 | .032 | .159 | .841 | -.280 | .343 |
| | 11 | .147 | .146 | .312 | -.138 | .433 |
| 11 | 1 | .185(*) | .060 | .002 | .067 | .303 |
| | 2 | -.019 | .085 | .826 | -.186 | .148 |
| | 3 | -.313(*) | .131 | .017 | -.570 | -.056 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | -.001 | .063 | .987 | -.125 | .123 |
| | | 5 | -.814(*) | .240 | .001 | -1.285 | -.344 |
| | | 6 | -.616(*) | .129 | .000 | -.869 | -.362 |
| | | 7 | -.461(*) | .143 | .001 | -.741 | -.180 |
| | | 8 | -.421(*) | .169 | .013 | -.753 | -.090 |
| | | 9 | -.115 | .101 | .251 | -.313 | .082 |
| | | 10 | -.147 | .146 | .312 | -.433 | .138 |
| 9 | 1 | 2 | .136 | .098 | .162 | -.055 | .328 |
| | | 3 | -.143 | .172 | .405 | -.480 | .194 |
| | | 4 | .311(*) | .055 | .000 | .204 | .419 |
| | | 5 | -.770(*) | .332 | .021 | -1.422 | -.118 |
| | | 6 | -.163 | .169 | .334 | -.494 | .168 |
| | | 7 | -.131 | .190 | .491 | -.502 | .241 |
| | | 8 | -.165 | .228 | .469 | -.613 | .283 |
| | | 9 | -.069 | .124 | .577 | -.312 | .174 |
| | | 10 | -.080 | .194 | .681 | -.460 | .301 |
| | | 11 | .438(*) | .085 | .000 | .271 | .606 |
| | 2 | 1 | -.136 | .098 | .162 | -.328 | .055 |
| | | 3 | -.280 | .192 | .145 | -.656 | .097 |
| | | 4 | .175 | .102 | .085 | -.024 | .374 |
| | | 5 | -.907(*) | .343 | .008 | -1.580 | -.233 |
| | | 6 | -.299 | .189 | .113 | -.670 | .071 |
| | | 7 | -.267 | .208 | .199 | -.675 | .141 |
| | | 8 | -.302 | .244 | .216 | -.780 | .176 |
| | | 9 | -.206 | .150 | .172 | -.500 | .089 |
| | | 10 | -.216 | .212 | .308 | -.632 | .199 |
| | | 11 | .302(*) | .121 | .013 | .065 | .539 |
| | 3 | 1 | .143 | .172 | .405 | -.194 | .480 |
| | | 2 | .280 | .192 | .145 | -.097 | .656 |
| | | 4 | .454(*) | .174 | .009 | .113 | .796 |
| | | 5 | -.627 | .371 | .091 | -1.355 | .101 |
| | | 6 | -.020 | .236 | .933 | -.483 | .443 |
| | | 7 | .013 | .251 | .960 | -.480 | .506 |
| | | 8 | -.022 | .282 | .937 | -.575 | .530 |
| | | 9 | .074 | .206 | .720 | -.330 | .479 |
| | | 10 | .063 | .255 | .803 | -.436 | .563 |
| | | 11 | .582(*) | .186 | .002 | .217 | .946 |
| | 4 | 1 | -.311(*) | .055 | .000 | -.419 | -.204 |
| | | 2 | -.175 | .102 | .085 | -.374 | .024 |
| | | 3 | -.454(*) | .174 | .009 | -.796 | -.113 |
| | | 5 | -1.081(*) | .334 | .001 | -1.736 | -.427 |
| | | 6 | -.474(*) | .171 | .006 | -.810 | -.139 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 7 | -.442(*) | .192 | .021 | -.817 | -.066 |
| | 8 | -.477(*) | .230 | .038 | -.928 | -.025 |
| | 9 | -.380(*) | .127 | .003 | -.629 | -.132 |
| | 10 | -.391(*) | .196 | .046 | -.775 | -.007 |
| | 11 | .127 | .090 | .157 | -.049 | .303 |
| 5 | 1 | .770(*) | .332 | .021 | .118 | 1.422 |
| | 2 | .907(*) | .343 | .008 | .233 | 1.580 |
| | 3 | .627 | .371 | .091 | -.101 | 1.355 |
| | 4 | 1.081(*) | .334 | .001 | .427 | 1.736 |
| | 6 | .607 | .370 | .101 | -.118 | 1.332 |
| | 7 | .640 | .380 | .092 | -.105 | 1.384 |
| | 8 | .605 | .400 | .131 | -.181 | 1.390 |
| | 9 | .701(*) | .351 | .046 | .012 | 1.391 |
| | 10 | .690 | .382 | .071 | -.059 | 1.440 |
| | 11 | 1.209(*) | .340 | .000 | .542 | 1.875 |
| 6 | 1 | .163 | .169 | .334 | -.168 | .494 |
| | 2 | .299 | .189 | .113 | -.071 | .670 |
| | 3 | .020 | .236 | .933 | -.443 | .483 |
| | 4 | .474(*) | .171 | .006 | .139 | .810 |
| | 5 | -.607 | .370 | .101 | -1.332 | .118 |
| | 7 | .032 | .249 | .896 | -.457 | .521 |
| | 8 | -.002 | .280 | .993 | -.552 | .547 |
| | 9 | .094 | .204 | .645 | -.306 | .494 |
| | 10 | .083 | .253 | .741 | -.412 | .579 |
| | 11 | .601(*) | .183 | .001 | .242 | .960 |
| 7 | 1 | .131 | .190 | .491 | -.241 | .502 |
| | 2 | .267 | .208 | .199 | -.141 | .675 |
| | 3 | -.013 | .251 | .960 | -.506 | .480 |
| | 4 | .442(*) | .192 | .021 | .066 | .817 |
| | 5 | -.640 | .380 | .092 | -1.384 | .105 |
| | 6 | -.032 | .249 | .896 | -.521 | .457 |
| | 8 | -.035 | .293 | .905 | -.610 | .540 |
| | 9 | .061 | .221 | .781 | -.373 | .496 |
| | 10 | .051 | .267 | .849 | -.473 | .574 |
| | 11 | .569(*) | .202 | .005 | .172 | .966 |
| 8 | 1 | .165 | .228 | .469 | -.283 | .613 |
| | 2 | .302 | .244 | .216 | -.176 | .780 |
| | 3 | .022 | .282 | .937 | -.530 | .575 |
| | 4 | .477(*) | .230 | .038 | .025 | .928 |
| | 5 | -.605 | .400 | .131 | -1.390 | .181 |
| | 6 | .002 | .280 | .993 | -.547 | .552 |
| | 7 | .035 | .293 | .905 | -.540 | .610 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 9 | .096 | .255 | .706 | -.405 | .597 |
| | | 10 | .086 | .296 | .772 | -.494 | .666 |
| | | 11 | .604(*) | .239 | .012 | .135 | 1.073 |
| | 9 | 1 | .069 | .124 | .577 | -.174 | .312 |
| | | 2 | .206 | .150 | .172 | -.089 | .500 |
| | | 3 | -.074 | .206 | .720 | -.479 | .330 |
| | | 4 | .380(*) | .127 | .003 | .132 | .629 |
| | | 5 | -.701(*) | .351 | .046 | -1.391 | -.012 |
| | | 6 | -.094 | .204 | .645 | -.494 | .306 |
| | | 7 | -.061 | .221 | .781 | -.496 | .373 |
| | | 8 | -.096 | .255 | .706 | -.597 | .405 |
| | | 10 | -.011 | .225 | .962 | -.452 | .431 |
| | | 11 | .507(*) | .143 | .000 | .228 | .787 |
| | 10 | 1 | .080 | .194 | .681 | -.301 | .460 |
| | | 2 | .216 | .212 | .308 | -.199 | .632 |
| | | 3 | -.063 | .255 | .803 | -.563 | .436 |
| | | 4 | .391(*) | .196 | .046 | .007 | .775 |
| | | 5 | -.690 | .382 | .071 | -1.440 | .059 |
| | | 6 | -.083 | .253 | .741 | -.579 | .412 |
| | | 7 | -.051 | .267 | .849 | -.574 | .473 |
| | | 8 | -.086 | .296 | .772 | -.666 | .494 |
| | | 9 | .011 | .225 | .962 | -.431 | .452 |
| | | 11 | .518(*) | .206 | .012 | .113 | .923 |
| | 11 | 1 | -.438(*) | .085 | .000 | -.606 | -.271 |
| | | 2 | -.302(*) | .121 | .013 | -.539 | -.065 |
| | | 3 | -.582(*) | .186 | .002 | -.946 | -.217 |
| | | 4 | -.127 | .090 | .157 | -.303 | .049 |
| | | 5 | -1.209(*) | .340 | .000 | -1.875 | -.542 |
| | | 6 | -.601(*) | .183 | .001 | -.960 | -.242 |
| | | 7 | -.569(*) | .202 | .005 | -.966 | -.172 |
| | | 8 | -.604(*) | .239 | .012 | -1.073 | -.135 |
| | | 9 | -.507(*) | .143 | .000 | -.787 | -.228 |
| | | 10 | -.518(*) | .206 | .012 | -.923 | -.113 |
| 10 | 1 | 2 | -.542(*) | .098 | .000 | -.734 | -.349 |
| | | 3 | -.562(*) | .173 | .001 | -.901 | -.224 |
| | | 4 | -.279(*) | .055 | .000 | -.387 | -.171 |
| | | 5 | -1.377(*) | .334 | .000 | -2.032 | -.722 |
| | | 6 | -.895(*) | .170 | .000 | -1.227 | -.562 |
| | | 7 | -.604(*) | .190 | .002 | -.978 | -.231 |
| | | 8 | -.877(*) | .230 | .000 | -1.327 | -.427 |
| | | 9 | -.553(*) | .124 | .000 | -.797 | -.309 |
| | | 10 | -.758(*) | .195 | .000 | -1.140 | -.376 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 11 | -.345(*) | .086 | .000 | -.513 | -.176 |
| 2 | 1 | .542(*) | .098 | .000 | .349 | .734 |
| | 3 | -.020 | .193 | .916 | -.398 | .358 |
| | 4 | .263(*) | .102 | .010 | .062 | .463 |
| | 5 | -.835(*) | .345 | .016 | -1.512 | -.158 |
| | 6 | -.353 | .190 | .063 | -.726 | .020 |
| | 7 | -.062 | .209 | .765 | -.472 | .347 |
| | 8 | -.335 | .245 | .172 | -.816 | .146 |
| | 9 | -.011 | .151 | .941 | -.307 | .285 |
| | 10 | -.216 | .213 | .310 | -.634 | .202 |
| | 11 | .197 | .121 | .105 | -.041 | .435 |
| 3 | 1 | .562(*) | .173 | .001 | .224 | .901 |
| | 2 | .020 | .193 | .916 | -.358 | .398 |
| | 4 | .283 | .175 | .106 | -.060 | .626 |
| | 5 | -.815(*) | .373 | .029 | -1.547 | -.083 |
| | 6 | -.333 | .237 | .161 | -.798 | .133 |
| | 7 | -.042 | .253 | .868 | -.538 | .453 |
| | 8 | -.315 | .283 | .267 | -.870 | .241 |
| | 9 | .009 | .207 | .964 | -.397 | .416 |
| | 10 | -.196 | .256 | .444 | -.698 | .306 |
| | 11 | .217 | .187 | .245 | -.149 | .584 |
| 4 | 1 | .279(*) | .055 | .000 | .171 | .387 |
| | 2 | -.263(*) | .102 | .010 | -.463 | -.062 |
| | 3 | -.283 | .175 | .106 | -.626 | .060 |
| | 5 | -1.098(*) | .335 | .001 | -1.755 | -.440 |
| | 6 | -.616(*) | .172 | .000 | -.953 | -.278 |
| | 7 | -.325 | .193 | .092 | -.703 | .053 |
| | 8 | -.598(*) | .231 | .010 | -1.051 | -.144 |
| | 9 | -.274(*) | .127 | .032 | -.524 | -.024 |
| | 10 | -.479(*) | .197 | .015 | -.865 | -.093 |
| | 11 | -.066 | .090 | .468 | -.243 | .112 |
| 5 | 1 | 1.377(*) | .334 | .000 | .722 | 2.032 |
| | 2 | .835(*) | .345 | .016 | .158 | 1.512 |
| | 3 | .815(*) | .373 | .029 | .083 | 1.547 |
| | 4 | 1.098(*) | .335 | .001 | .440 | 1.755 |
| | 6 | .482 | .372 | .195 | -.247 | 1.211 |
| | 7 | .773(*) | .382 | .043 | .024 | 1.521 |
| | 8 | .500 | .403 | .214 | -.290 | 1.290 |
| | 9 | .824(*) | .353 | .020 | .131 | 1.517 |
| | 10 | .619 | .384 | .107 | -.134 | 1.372 |
| | 11 | 1.032(*) | .342 | .003 | .362 | 1.702 |
| 6 | 1 | .895(*) | .170 | .000 | .562 | 1.227 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2 | .353 | .190 | .063 | -.020 | .726 |
| | 3 | .333 | .237 | .161 | -.133 | .798 |
| | 4 | .616(*) | .172 | .000 | .278 | .953 |
| | 5 | -.482 | .372 | .195 | -1.211 | .247 |
| | 7 | .291 | .251 | .246 | -.201 | .782 |
| | 8 | .018 | .281 | .949 | -.534 | .570 |
| | 9 | .342 | .205 | .095 | -.060 | .744 |
| | 10 | .137 | .254 | .590 | -.361 | .635 |
| | 11 | .550(*) | .184 | .003 | .189 | .911 |
| 7 | 1 | .604(*) | .190 | .002 | .231 | .978 |
| | 2 | .062 | .209 | .765 | -.347 | .472 |
| | 3 | .042 | .253 | .868 | -.453 | .538 |
| | 4 | .325 | .193 | .092 | -.053 | .703 |
| | 5 | -.773(*) | .382 | .043 | -1.521 | -.024 |
| | 6 | -.291 | .251 | .246 | -.782 | .201 |
| | 8 | -.273 | .295 | .355 | -.850 | .305 |
| | 9 | .051 | .222 | .817 | -.385 | .488 |
| | 10 | -.154 | .268 | .567 | -.680 | .373 |
| | 11 | .260 | .203 | .202 | -.140 | .659 |
| 8 | 1 | .877(*) | .230 | .000 | .427 | 1.327 |
| | 2 | .335 | .245 | .172 | -.146 | .816 |
| | 3 | .315 | .283 | .267 | -.241 | .870 |
| | 4 | .598(*) | .231 | .010 | .144 | 1.051 |
| | 5 | -.500 | .403 | .214 | -1.290 | .290 |
| | 6 | -.018 | .281 | .949 | -.570 | .534 |
| | 7 | .273 | .295 | .355 | -.305 | .850 |
| | 9 | .324 | .257 | .207 | -.179 | .828 |
| | 10 | .119 | .297 | .689 | -.464 | .702 |
| | 11 | .532(*) | .240 | .027 | .061 | 1.004 |
| 9 | 1 | .553(*) | .124 | .000 | .309 | .797 |
| | 2 | .011 | .151 | .941 | -.285 | .307 |
| | 3 | -.009 | .207 | .964 | -.416 | .397 |
| | 4 | .274(*) | .127 | .032 | .024 | .524 |
| | 5 | -.824(*) | .353 | .020 | -1.517 | -.131 |
| | 6 | -.342 | .205 | .095 | -.744 | .060 |
| | 7 | -.051 | .222 | .817 | -.488 | .385 |
| | 8 | -.324 | .257 | .207 | -.828 | .179 |
| | 10 | -.205 | .226 | .365 | -.649 | .239 |
| | 11 | .208 | .143 | .147 | -.073 | .489 |
| 10 | 1 | .758(*) | .195 | .000 | .376 | 1.140 |
| | 2 | .216 | .213 | .310 | -.202 | .634 |
| | 3 | .196 | .256 | .444 | -.306 | .698 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 4 | .479(*) | .197 | .015 | .093 | .865 |
| | 5 | -.619 | .384 | .107 | -1.372 | .134 |
| | 6 | -.137 | .254 | .590 | -.635 | .361 |
| | 7 | .154 | .268 | .567 | -.373 | .680 |
| | 8 | -.119 | .297 | .689 | -.702 | .464 |
| | 9 | .205 | .226 | .365 | -.239 | .649 |
| | 11 | .413(*) | .208 | .047 | .006 | .820 |
| 11 | 1 | .345(*) | .086 | .000 | .176 | .513 |
| | 2 | -.197 | .121 | .105 | -.435 | .041 |
| | 3 | -.217 | .187 | .245 | -.584 | .149 |
| | 4 | .066 | .090 | .468 | -.112 | .243 |
| | 5 | -1.032(*) | .342 | .003 | -1.702 | -.362 |
| | 6 | -.550(*) | .184 | .003 | -.911 | -.189 |
| | 7 | -.260 | .203 | .202 | -.659 | .140 |
| | 8 | -.532(*) | .240 | .027 | -1.004 | -.061 |
| | 9 | -.208 | .143 | .147 | -.489 | .073 |
| | 10 | -.413(*) | .208 | .047 | -.820 | -.006 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. Codes for factors:

1. Organizational commitment and communication.
2. Line management commitment.
3. Supervisor's role.
4. Personal role.
5. Coworkers' influence.
6. Competence.
7. Risk taking behavior.
8. Obstacles to safe behavior.
9. Permit to work.
10. Reporting of accidents and near misses.

Data Set B.5

Mean difference in safety climate scores by job position(b)

| | | | | | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| | 2 | -.101 | .131 | .439 | -.358 | .155 |
| | 3 | .071 | .135 | .598 | -.193 | .336 |
| | 4 | .473(*) | .137 | .001 | .205 | .741 |
| | 5 | .384(*) | .123 | .002 | .143 | .625 |
| | 6 | .179 | .124 | .151 | -.065 | .423 |
| | 7 | .040 | .130 | .756 | -.215 | .295 |
| 2 | 1 | .101 | .131 | .439 | -.155 | .358 |
| | 3 | .172(*) | .077 | .025 | .022 | .323 |
| | 4 | .574(*) | .080 | .000 | .417 | .731 |
| | 5 | .486(*) | .053 | .000 | .382 | .589 |
| | 6 | .280(*) | .057 | .000 | .169 | .391 |
| | 7 | .142(*) | .068 | .037 | .008 | .275 |
| 3 | 1 | -.071 | .135 | .598 | -.336 | .193 |
| | 2 | -.172(*) | .077 | .025 | -.323 | -.022 |
| | 4 | .402(*) | .086 | .000 | .233 | .571 |
| | 5 | .313(*) | .062 | .000 | .192 | .435 |
| | 6 | .108 | .065 | .099 | -.020 | .236 |
| | 7 | -.031 | .075 | .683 | -.178 | .117 |
| 4 | 1 | -.473(*) | .137 | .001 | -.741 | -.205 |
| | 2 | -.574(*) | .080 | .000 | -.731 | -.417 |
| | 3 | -.402(*) | .086 | .000 | -.571 | -.233 |
| | 5 | -.089 | .066 | .179 | -.218 | .041 |
| | 6 | -.294(*) | .069 | .000 | -.429 | -.159 |
| | 7 | -.433(*) | .078 | .000 | -.587 | -.279 |
| 5 | 1 | -.384(*) | .123 | .002 | -.625 | -.143 |
| | 2 | -.486(*) | .053 | .000 | -.589 | -.382 |
| | 3 | -.313(*) | .062 | .000 | -.435 | -.192 |
| | 4 | .089 | .066 | .179 | -.041 | .218 |
| | 6 | -.206(*) | .034 | .000 | -.272 | -.139 |
| | 7 | -.344(*) | .051 | .000 | -.443 | -.244 |
| 6 | 1 | -.179 | .124 | .151 | -.423 | .065 |
| | 2 | -.280(*) | .057 | .000 | -.391 | -.169 |
| | 3 | -.108 | .065 | .099 | -.236 | .020 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 4 | .294(*) | .069 | .000 | .159 | .429 |
| | 5 | .206(*) | .034 | .000 | .139 | .272 |
| | 7 | -.138(*) | .055 | .011 | -.245 | -.031 |
| 7 | 1 | -.040 | .130 | .756 | -.295 | .215 |
| | 2 | -.142(*) | .068 | .037 | -.275 | -.008 |
| | 3 | .031 | .075 | .683 | -.117 | .178 |
| | 4 | .433(*) | .078 | .000 | .279 | .587 |
| | 5 | .344(*) | .051 | .000 | .244 | .443 |
| | 6 | .138(*) | .055 | .011 | .031 | .245 |

Based on estimated marginal means

* The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

b. Codes for job positions:

1. Senior manager
2. Manager
3. Supervisor
4. Foremen
5. Workforce/craft
6. Technical support
7. Administrative

Data Set B.6

Mean safety climate factor scores by job position

| Factor | Job position | Mean | Std. Error | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|
| 1. Organizational commitment and communication | Senior manager | 3.798 | .166 | 3.471 | 4.124 |
| | Manager | 3.965 | .066 | 3.836 | 4.094 |
| | Supervisor | 3.711 | .078 | 3.557 | 3.865 |
| | Foreman | 3.232 | .084 | 3.067 | 3.398 |
| | Workforce/craft | 3.244 | .026 | 3.193 | 3.295 |
| | Technical support | 3.534 | .037 | 3.460 | 3.607 |
| | Administrative | 3.702 | .063 | 3.578 | 3.825 |
| 2. Line management commitment | Senior manager | 3.734 | .191 | 3.360 | 4.109 |
| | Manager | 3.949 | .076 | 3.801 | 4.098 |
| | Supervisor | 3.847 | .090 | 3.671 | 4.024 |
| | Foreman | 3.532 | .097 | 3.342 | 3.722 |
| | Workforce/craft | 3.500 | .030 | 3.442 | 3.559 |
| | Technical support | 3.744 | .043 | 3.660 | 3.829 |
| | Administrative | 3.821 | .072 | 3.678 | 3.963 |
| 3. Supervisors' role | Senior manager | 3.703 | .187 | 3.337 | 4.070 |
| | Manager | 3.816 | .074 | 3.671 | 3.961 |
| | Supervisor | 3.817 | .088 | 3.644 | 3.990 |
| | Foreman | 3.243 | .095 | 3.057 | 3.429 |
| | Workforce/craft | 3.275 | .029 | 3.218 | 3.332 |
| | Technical support | 3.505 | .042 | 3.423 | 3.588 |
| | Administrative | 3.690 | .071 | 3.551 | 3.829 |
| 4. Personal role | Senior manager | 3.813 | .148 | 3.523 | 4.102 |
| | Manager | 4.032 | .058 | 3.918 | 4.147 |
| | Supervisor | 3.898 | .070 | 3.762 | 4.035 |
| | Foreman | 3.755 | .075 | 3.608 | 3.902 |
| | Workforce/craft | 3.722 | .023 | 3.677 | 3.767 |
| | Technical support | 3.884 | .033 | 3.819 | 3.949 |
| | Administrative | 3.866 | .056 | 3.756 | 3.976 |
| 5. Coworkers' role | Senior manager | 3.693 | .178 | 3.344 | 4.042 |
| | Manager | 3.816 | .070 | 3.678 | 3.954 |
| | Supervisor | 3.726 | .084 | 3.561 | 3.890 |
| | Foreman | 3.238 | .090 | 3.061 | 3.415 |
| | Workforce/craft | 3.367 | .028 | 3.312 | 3.421 |
| | Technical support | 3.546 | .040 | 3.468 | 3.624 |

| | | | | | |
|---|---|---|---|---|---|
| | Administrative | 3.709 | .068 | 3.577 | 3.842 |
| 6. Competence | Senior manager | 3.975 | .154 | 3.673 | 4.277 |
| | Manager | 4.030 | .061 | 3.911 | 4.150 |
| | Supervisor | 3.906 | .072 | 3.763 | 4.048 |
| | Foreman | 3.539 | .078 | 3.385 | 3.692 |
| | Workforce/craft | 3.663 | .024 | 3.616 | 3.710 |
| | Technical support | 3.863 | .035 | 3.795 | 3.930 |
| | Administrative | 3.872 | .058 | 3.757 | 3.986 |
| 7. Risk taking behavior | Senior manager | 3.475 | .160 | 3.161 | 3.789 |
| | Manager | 3.611 | .063 | 3.487 | 3.736 |
| | Supervisor | 3.390 | .075 | 3.242 | 3.538 |
| | Foreman | 2.807 | .081 | 2.647 | 2.966 |
| | Workforce/craft | 3.102 | .025 | 3.053 | 3.151 |
| | Technical support | 3.272 | .036 | 3.201 | 3.342 |
| | Administrative | 3.441 | .061 | 3.322 | 3.560 |
| 8. Obstacles to safe behavior | Senior manager | 3.276 | .156 | 2.970 | 3.582 |
| | Manager | 3.476 | .062 | 3.355 | 3.597 |
| | Supervisor | 3.271 | .073 | 3.127 | 3.416 |
| | Foreman | 2.891 | .079 | 2.736 | 3.046 |
| | Workforce/craft | 3.024 | .024 | 2.977 | 3.072 |
| | Technical support | 3.223 | .035 | 3.155 | 3.292 |
| | Administrative | 3.369 | .059 | 3.253 | 3.485 |
| 9. Permit to work | Senior manager | 3.250 | .224 | 2.811 | 3.689 |
| | Manager | 3.240 | .089 | 3.066 | 3.414 |
| | Supervisor | 3.090 | .105 | 2.883 | 3.297 |
| | Foreman | 3.194 | .114 | 2.971 | 3.416 |
| | Workforce/craft | 3.157 | .035 | 3.088 | 3.225 |
| | Technical support | 3.259 | .050 | 3.160 | 3.357 |
| | Administrative | 3.194 | .085 | 3.027 | 3.360 |
| 10. Reporting of accidents and near misses | Senior manager | 3.531 | .222 | 3.095 | 3.968 |
| | Manager | 3.103 | .088 | 2.930 | 3.276 |
| | Supervisor | 2.896 | .105 | 2.690 | 3.102 |
| | Foreman | 2.468 | .113 | 2.246 | 2.689 |
| | Workforce/craft | 2.736 | .035 | 2.668 | 2.804 |
| | Technical support | 2.885 | .050 | 2.787 | 2.983 |
| | Administrative | 3.113 | .084 | 2.947 | 3.278 |

Data Set B.7

Mean differences in factor scores by job position(c)

| Factor(b) | A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | -.168 | .179 | .349 | -.518 | .183 |
| | | 3 | .087 | .184 | .637 | -.274 | .447 |
| | | 4 | .565(*) | .186 | .002 | .199 | .931 |
| | | 5 | .553(*) | .168 | .001 | .223 | .883 |
| | | 6 | .264 | .170 | .122 | -.070 | .598 |
| | | 7 | .096 | .178 | .590 | -.253 | .445 |
| | 2 | 1 | .168 | .179 | .349 | -.183 | .518 |
| | | 3 | .254(*) | .102 | .013 | .053 | .455 |
| | | 4 | .733(*) | .107 | .000 | .523 | .943 |
| | | 5 | .721(*) | .071 | .000 | .582 | .860 |
| | | 6 | .431(*) | .076 | .000 | .283 | .580 |
| | | 7 | .263(*) | .091 | .004 | .085 | .442 |
| | 3 | 1 | -.087 | .184 | .637 | -.447 | .274 |
| | | 2 | -.254(*) | .102 | .013 | -.455 | -.053 |
| | | 4 | .478(*) | .115 | .000 | .252 | .705 |
| | | 5 | .467(*) | .083 | .000 | .305 | .629 |
| | | 6 | .177(*) | .087 | .041 | .007 | .347 |
| | | 7 | .009 | .101 | .927 | -.188 | .207 |
| | 4 | 1 | -.565(*) | .186 | .002 | -.931 | -.199 |
| | | 2 | -.733(*) | .107 | .000 | -.943 | -.523 |
| | | 3 | -.478(*) | .115 | .000 | -.705 | -.252 |
| | | 5 | -.012 | .088 | .894 | -.185 | .162 |
| | | 6 | -.301(*) | .092 | .001 | -.482 | -.120 |
| | | 7 | -.469(*) | .105 | .000 | -.676 | -.262 |
| | 5 | 1 | -.553(*) | .168 | .001 | -.883 | -.223 |
| | | 2 | -.721(*) | .071 | .000 | -.860 | -.582 |
| | | 3 | -.467(*) | .083 | .000 | -.629 | -.305 |
| | | 4 | .012 | .088 | .894 | -.162 | .185 |
| | | 6 | -.290(*) | .045 | .000 | -.379 | -.200 |
| | | 7 | -.457(*) | .068 | .000 | -.591 | -.324 |
| | 6 | 1 | -.264 | .170 | .122 | -.598 | .070 |
| | | 2 | -.431(*) | .076 | .000 | -.580 | -.283 |
| | | 3 | -.177(*) | .087 | .041 | -.347 | -.007 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .301(*) | .092 | .001 | .120 | .482 |
| | | 5 | .290(*) | .045 | .000 | .200 | .379 |
| | | 7 | -.168(*) | .073 | .022 | -.312 | -.024 |
| | 7 | 1 | -.096 | .178 | .590 | -.445 | .253 |
| | | 2 | -.263(*) | .091 | .004 | -.442 | -.085 |
| | | 3 | -.009 | .101 | .927 | -.207 | .188 |
| | | 4 | .469(*) | .105 | .000 | .262 | .676 |
| | | 5 | .457(*) | .068 | .000 | .324 | .591 |
| | | 6 | .168(*) | .073 | .022 | .024 | .312 |
| 2 | 1 | 2 | -.215 | .205 | .295 | -.618 | .188 |
| | | 3 | -.113 | .211 | .593 | -.527 | .301 |
| | | 4 | .202 | .214 | .345 | -.218 | .622 |
| | | 5 | .234 | .193 | .226 | -.145 | .613 |
| | | 6 | -.010 | .196 | .959 | -.394 | .374 |
| | | 7 | -.086 | .204 | .673 | -.487 | .314 |
| | 2 | 1 | .215 | .205 | .295 | -.188 | .618 |
| | | 3 | .102 | .118 | .385 | -.128 | .333 |
| | | 4 | .417(*) | .123 | .001 | .176 | .658 |
| | | 5 | .449(*) | .081 | .000 | .290 | .608 |
| | | 6 | .205(*) | .087 | .019 | .034 | .375 |
| | | 7 | .129 | .105 | .219 | -.077 | .334 |
| | 3 | 1 | .113 | .211 | .593 | -.301 | .527 |
| | | 2 | -.102 | .118 | .385 | -.333 | .128 |
| | | 4 | .315(*) | .132 | .017 | .055 | .574 |
| | | 5 | .347(*) | .095 | .000 | .161 | .533 |
| | | 6 | .103 | .100 | .303 | -.093 | .298 |
| | | 7 | .027 | .116 | .818 | -.200 | .253 |
| | 4 | 1 | -.202 | .214 | .345 | -.622 | .218 |
| | | 2 | -.417(*) | .123 | .001 | -.658 | -.176 |
| | | 3 | -.315(*) | .132 | .017 | -.574 | -.055 |
| | | 5 | .032 | .101 | .753 | -.167 | .231 |
| | | 6 | -.212(*) | .106 | .046 | -.420 | -.004 |
| | | 7 | -.288(*) | .121 | .017 | -.526 | -.051 |
| | 5 | 1 | -.234 | .193 | .226 | -.613 | .145 |
| | | 2 | -.449(*) | .081 | .000 | -.608 | -.290 |
| | | 3 | -.347(*) | .095 | .000 | -.533 | -.161 |
| | | 4 | -.032 | .101 | .753 | -.231 | .167 |
| | | 6 | -.244(*) | .052 | .000 | -.347 | -.142 |
| | | 7 | -.320(*) | .078 | .000 | -.474 | -.167 |
| | 6 | 1 | .010 | .196 | .959 | -.374 | .394 |
| | | 2 | -.205(*) | .087 | .019 | -.375 | -.034 |
| | | 3 | -.103 | .100 | .303 | -.298 | .093 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .212(*) | .106 | .046 | .004 | .420 |
| | | 5 | .244(*) | .052 | .000 | .142 | .347 |
| | | 7 | -.076 | .084 | .366 | -.241 | .089 |
| | 7 | 1 | .086 | .204 | .673 | -.314 | .487 |
| | | 2 | -.129 | .105 | .219 | -.334 | .077 |
| | | 3 | -.027 | .116 | .818 | -.253 | .200 |
| | | 4 | .288(*) | .121 | .017 | .051 | .526 |
| | | 5 | .320(*) | .078 | .000 | .167 | .474 |
| | | 6 | .076 | .084 | .366 | -.089 | .241 |
| 3 | 1 | 2 | -.113 | .201 | .574 | -.507 | .281 |
| | | 3 | -.114 | .207 | .581 | -.519 | .291 |
| | | 4 | .460(*) | .210 | .028 | .049 | .871 |
| | | 5 | .428(*) | .189 | .024 | .057 | .799 |
| | | 6 | .198 | .191 | .302 | -.178 | .573 |
| | | 7 | .013 | .200 | .947 | -.379 | .405 |
| | 2 | 1 | .113 | .201 | .574 | -.281 | .507 |
| | | 3 | -.001 | .115 | .993 | -.227 | .225 |
| | | 4 | .573(*) | .120 | .000 | .337 | .809 |
| | | 5 | .541(*) | .080 | .000 | .385 | .697 |
| | | 6 | .311(*) | .085 | .000 | .144 | .478 |
| | | 7 | .126 | .102 | .218 | -.075 | .327 |
| | 3 | 1 | .114 | .207 | .581 | -.291 | .519 |
| | | 2 | .001 | .115 | .993 | -.225 | .227 |
| | | 4 | .574(*) | .129 | .000 | .320 | .828 |
| | | 5 | .542(*) | .093 | .000 | .360 | .724 |
| | | 6 | .312(*) | .098 | .001 | .121 | .503 |
| | | 7 | .127 | .113 | .261 | -.095 | .349 |
| | 4 | 1 | -.460(*) | .210 | .028 | -.871 | -.049 |
| | | 2 | -.573(*) | .120 | .000 | -.809 | -.337 |
| | | 3 | -.574(*) | .129 | .000 | -.828 | -.320 |
| | | 5 | -.032 | .099 | .748 | -.227 | .163 |
| | | 6 | -.262(*) | .104 | .012 | -.466 | -.058 |
| | | 7 | -.447(*) | .118 | .000 | -.679 | -.214 |
| | 5 | 1 | -.428(*) | .189 | .024 | -.799 | -.057 |
| | | 2 | -.541(*) | .080 | .000 | -.697 | -.385 |
| | | 3 | -.542(*) | .093 | .000 | -.724 | -.360 |
| | | 4 | .032 | .099 | .748 | -.163 | .227 |
| | | 6 | -.230(*) | .051 | .000 | -.330 | -.130 |
| | | 7 | -.415(*) | .077 | .000 | -.565 | -.264 |
| | 6 | 1 | -.198 | .191 | .302 | -.573 | .178 |
| | | 2 | -.311(*) | .085 | .000 | -.478 | -.144 |
| | | 3 | -.312(*) | .098 | .001 | -.503 | -.121 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .262(*) | .104 | .012 | .058 | .466 |
| | | 5 | .230(*) | .051 | .000 | .130 | .330 |
| | | 7 | -.185(*) | .082 | .025 | -.346 | -.023 |
| | 7 | 1 | -.013 | .200 | .947 | -.405 | .379 |
| | | 2 | -.126 | .102 | .218 | -.327 | .075 |
| | | 3 | -.127 | .113 | .261 | -.349 | .095 |
| | | 4 | .447(*) | .118 | .000 | .214 | .679 |
| | | 5 | .415(*) | .077 | .000 | .264 | .565 |
| | | 6 | .185(*) | .082 | .025 | .023 | .346 |
| 4 | 1 | 2 | -.220 | .159 | .166 | -.531 | .092 |
| | | 3 | -.086 | .163 | .600 | -.406 | .235 |
| | | 4 | .058 | .166 | .728 | -.267 | .382 |
| | | 5 | .091 | .149 | .545 | -.203 | .384 |
| | | 6 | -.071 | .151 | .638 | -.368 | .226 |
| | | 7 | -.053 | .158 | .736 | -.363 | .256 |
| | 2 | 1 | .220 | .159 | .166 | -.092 | .531 |
| | | 3 | .134 | .091 | .140 | -.044 | .313 |
| | | 4 | .278(*) | .095 | .004 | .091 | .464 |
| | | 5 | .310(*) | .063 | .000 | .187 | .434 |
| | | 6 | .149(*) | .067 | .027 | .017 | .280 |
| | | 7 | .167(*) | .081 | .040 | .008 | .325 |
| | 3 | 1 | .086 | .163 | .600 | -.235 | .406 |
| | | 2 | -.134 | .091 | .140 | -.313 | .044 |
| | | 4 | .143 | .102 | .161 | -.057 | .344 |
| | | 5 | .176(*) | .073 | .016 | .032 | .320 |
| | | 6 | .014 | .077 | .852 | -.137 | .166 |
| | | 7 | .032 | .089 | .717 | -.143 | .208 |
| | 4 | 1 | -.058 | .166 | .728 | -.382 | .267 |
| | | 2 | -.278(*) | .095 | .004 | -.464 | -.091 |
| | | 3 | -.143 | .102 | .161 | -.344 | .057 |
| | | 5 | .033 | .078 | .675 | -.121 | .187 |
| | | 6 | -.129 | .082 | .116 | -.290 | .032 |
| | | 7 | -.111 | .094 | .236 | -.295 | .073 |
| | 5 | 1 | -.091 | .149 | .545 | -.384 | .203 |
| | | 2 | -.310(*) | .063 | .000 | -.434 | -.187 |
| | | 3 | -.176(*) | .073 | .016 | -.320 | -.032 |
| | | 4 | -.033 | .078 | .675 | -.187 | .121 |
| | | 6 | -.162(*) | .040 | .000 | -.241 | -.083 |
| | | 7 | -.144(*) | .061 | .018 | -.263 | -.025 |
| | 6 | 1 | .071 | .151 | .638 | -.226 | .368 |
| | | 2 | -.149(*) | .067 | .027 | -.280 | -.017 |
| | | 3 | -.014 | .077 | .852 | -.166 | .137 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .129 | .082 | .116 | -.032 | .290 |
| | | 5 | .162(*) | .040 | .000 | .083 | .241 |
| | | 7 | .018 | .065 | .782 | -.110 | .146 |
| | 7 | 1 | .053 | .158 | .736 | -.256 | .363 |
| | | 2 | -.167(*) | .081 | .040 | -.325 | -.008 |
| | | 3 | -.032 | .089 | .717 | -.208 | .143 |
| | | 4 | .111 | .094 | .236 | -.073 | .295 |
| | | 5 | .144(*) | .061 | .018 | .025 | .263 |
| | | 6 | -.018 | .065 | .782 | -.146 | .110 |
| 5 | 1 | 2 | -.123 | .191 | .519 | -.499 | .252 |
| | | 3 | -.033 | .197 | .867 | -.419 | .353 |
| | | 4 | .455(*) | .200 | .023 | .063 | .846 |
| | | 5 | .326 | .180 | .071 | -.027 | .679 |
| | | 6 | .147 | .182 | .421 | -.211 | .504 |
| | | 7 | -.017 | .190 | .930 | -.390 | .357 |
| | 2 | 1 | .123 | .191 | .519 | -.252 | .499 |
| | | 3 | .090 | .110 | .409 | -.124 | .305 |
| | | 4 | .578(*) | .115 | .000 | .353 | .803 |
| | | 5 | .449(*) | .076 | .000 | .301 | .598 |
| | | 6 | .270(*) | .081 | .001 | .111 | .429 |
| | | 7 | .107 | .098 | .274 | -.085 | .298 |
| | 3 | 1 | .033 | .197 | .867 | -.353 | .419 |
| | | 2 | -.090 | .110 | .409 | -.305 | .124 |
| | | 4 | .488(*) | .123 | .000 | .246 | .730 |
| | | 5 | .359(*) | .088 | .000 | .185 | .532 |
| | | 6 | .180 | .093 | .053 | -.003 | .362 |
| | | 7 | .016 | .108 | .880 | -.195 | .227 |
| | 4 | 1 | -.455(*) | .200 | .023 | -.846 | -.063 |
| | | 2 | -.578(*) | .115 | .000 | -.803 | -.353 |
| | | 3 | -.488(*) | .123 | .000 | -.730 | -.246 |
| | | 5 | -.129 | .095 | .173 | -.315 | .056 |
| | | 6 | -.308(*) | .099 | .002 | -.502 | -.114 |
| | | 7 | -.472(*) | .113 | .000 | -.693 | -.250 |
| | 5 | 1 | -.326 | .180 | .071 | -.679 | .027 |
| | | 2 | -.449(*) | .076 | .000 | -.598 | -.301 |
| | | 3 | -.359(*) | .088 | .000 | -.532 | -.185 |
| | | 4 | .129 | .095 | .173 | -.056 | .315 |
| | | 6 | -.179(*) | .049 | .000 | -.275 | -.084 |
| | | 7 | -.343(*) | .073 | .000 | -.486 | -.199 |
| | 6 | 1 | -.147 | .182 | .421 | -.504 | .211 |
| | | 2 | -.270(*) | .081 | .001 | -.429 | -.111 |
| | | 3 | -.180 | .093 | .053 | -.362 | .003 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .308(*) | .099 | .002 | .114 | .502 |
| | | 5 | .179(*) | .049 | .000 | .084 | .275 |
| | | 7 | -.163(*) | .078 | .037 | -.317 | -.009 |
| | 7 | 1 | .017 | .190 | .930 | -.357 | .390 |
| | | 2 | -.107 | .098 | .274 | -.298 | .085 |
| | | 3 | -.016 | .108 | .880 | -.227 | .195 |
| | | 4 | .472(*) | .113 | .000 | .250 | .693 |
| | | 5 | .343(*) | .073 | .000 | .199 | .486 |
| | | 6 | .163(*) | .078 | .037 | .009 | .317 |
| 6 | 1 | 2 | -.055 | .165 | .738 | -.380 | .269 |
| | | 3 | .069 | .170 | .683 | -.264 | .403 |
| | | 4 | .436(*) | .172 | .012 | .098 | .775 |
| | | 5 | .312(*) | .156 | .045 | .007 | .618 |
| | | 6 | .112 | .158 | .476 | -.197 | .422 |
| | | 7 | .103 | .164 | .530 | -.219 | .426 |
| | 2 | 1 | .055 | .165 | .738 | -.269 | .380 |
| | | 3 | .125 | .095 | .188 | -.061 | .311 |
| | | 4 | .492(*) | .099 | .000 | .297 | .686 |
| | | 5 | .368(*) | .065 | .000 | .239 | .496 |
| | | 6 | .168(*) | .070 | .017 | .030 | .305 |
| | | 7 | .159 | .084 | .060 | -.007 | .324 |
| | 3 | 1 | -.069 | .170 | .683 | -.403 | .264 |
| | | 2 | -.125 | .095 | .188 | -.311 | .061 |
| | | 4 | .367(*) | .107 | .001 | .158 | .576 |
| | | 5 | .243(*) | .076 | .002 | .093 | .393 |
| | | 6 | .043 | .080 | .593 | -.115 | .201 |
| | | 7 | .034 | .093 | .716 | -.149 | .217 |
| | 4 | 1 | -.436(*) | .172 | .012 | -.775 | -.098 |
| | | 2 | -.492(*) | .099 | .000 | -.686 | -.297 |
| | | 3 | -.367(*) | .107 | .001 | -.576 | -.158 |
| | | 5 | -.124 | .082 | .130 | -.284 | .036 |
| | | 6 | -.324(*) | .085 | .000 | -.491 | -.156 |
| | | 7 | -.333(*) | .098 | .001 | -.524 | -.142 |
| | 5 | 1 | -.312(*) | .156 | .045 | -.618 | -.007 |
| | | 2 | -.368(*) | .065 | .000 | -.496 | -.239 |
| | | 3 | -.243(*) | .076 | .002 | -.393 | -.093 |
| | | 4 | .124 | .082 | .130 | -.036 | .284 |
| | | 6 | -.200(*) | .042 | .000 | -.282 | -.117 |
| | | 7 | -.209(*) | .063 | .001 | -.333 | -.085 |
| | 6 | 1 | -.112 | .158 | .476 | -.422 | .197 |
| | | 2 | -.168(*) | .070 | .017 | -.305 | -.030 |
| | | 3 | -.043 | .080 | .593 | -.201 | .115 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .324(*) | .085 | .000 | .156 | .491 |
| | | 5 | .200(*) | .042 | .000 | .117 | .282 |
| | | 7 | -.009 | .068 | .894 | -.142 | .124 |
| | 7 | 1 | -.103 | .164 | .530 | -.426 | .219 |
| | | 2 | -.159 | .084 | .060 | -.324 | .007 |
| | | 3 | -.034 | .093 | .716 | -.217 | .149 |
| | | 4 | .333(*) | .098 | .001 | .142 | .524 |
| | | 5 | .209(*) | .063 | .001 | .085 | .333 |
| | | 6 | .009 | .068 | .894 | -.124 | .142 |
| 7 | 1 | 2 | -.136 | .172 | .428 | -.474 | .201 |
| | | 3 | .085 | .177 | .630 | -.261 | .432 |
| | | 4 | .668(*) | .179 | .000 | .317 | 1.020 |
| | | 5 | .373(*) | .162 | .021 | .056 | .691 |
| | | 6 | .203 | .164 | .214 | -.118 | .525 |
| | | 7 | .034 | .171 | .843 | -.302 | .369 |
| | 2 | 1 | .136 | .172 | .428 | -.201 | .474 |
| | | 3 | .222(*) | .098 | .024 | .029 | .415 |
| | | 4 | .805(*) | .103 | .000 | .603 | 1.007 |
| | | 5 | .510(*) | .068 | .000 | .376 | .643 |
| | | 6 | .340(*) | .073 | .000 | .197 | .483 |
| | | 7 | .170 | .088 | .052 | -.002 | .342 |
| | 3 | 1 | -.085 | .177 | .630 | -.432 | .261 |
| | | 2 | -.222(*) | .098 | .024 | -.415 | -.029 |
| | | 4 | .583(*) | .111 | .000 | .366 | .801 |
| | | 5 | .288(*) | .079 | .000 | .132 | .444 |
| | | 6 | .118 | .083 | .157 | -.045 | .282 |
| | | 7 | -.051 | .097 | .595 | -.241 | .138 |
| | 4 | 1 | -.668(*) | .179 | .000 | -1.020 | -.317 |
| | | 2 | -.805(*) | .103 | .000 | -1.007 | -.603 |
| | | 3 | -.583(*) | .111 | .000 | -.801 | -.366 |
| | | 5 | -.295(*) | .085 | .001 | -.462 | -.128 |
| | | 6 | -.465(*) | .089 | .000 | -.639 | -.291 |
| | | 7 | -.635(*) | .101 | .000 | -.833 | -.436 |
| | 5 | 1 | -.373(*) | .162 | .021 | -.691 | -.056 |
| | | 2 | -.510(*) | .068 | .000 | -.643 | -.376 |
| | | 3 | -.288(*) | .079 | .000 | -.444 | -.132 |
| | | 4 | .295(*) | .085 | .001 | .128 | .462 |
| | | 6 | -.170(*) | .044 | .000 | -.256 | -.084 |
| | | 7 | -.340(*) | .066 | .000 | -.468 | -.211 |
| | 6 | 1 | -.203 | .164 | .214 | -.525 | .118 |
| | | 2 | -.340(*) | .073 | .000 | -.483 | -.197 |
| | | 3 | -.118 | .083 | .157 | -.282 | .045 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .465(*) | .089 | .000 | .291 | .639 |
| | | 5 | .170(*) | .044 | .000 | .084 | .256 |
| | | 7 | -.170(*) | .071 | .016 | -.308 | -.031 |
| | 7 | 1 | -.034 | .171 | .843 | -.369 | .302 |
| | | 2 | -.170 | .088 | .052 | -.342 | .002 |
| | | 3 | .051 | .097 | .595 | -.138 | .241 |
| | | 4 | .635(*) | .101 | .000 | .436 | .833 |
| | | 5 | .340(*) | .066 | .000 | .211 | .468 |
| | | 6 | .170(*) | .071 | .016 | .031 | .308 |
| 8 | 1 | 2 | -.200 | .168 | .233 | -.529 | .129 |
| | | 3 | .005 | .172 | .979 | -.333 | .343 |
| | | 4 | .385(*) | .175 | .028 | .042 | .728 |
| | | 5 | .252 | .158 | .111 | -.058 | .561 |
| | | 6 | .053 | .160 | .742 | -.261 | .366 |
| | | 7 | -.093 | .167 | .576 | -.420 | .234 |
| | 2 | 1 | .200 | .168 | .233 | -.129 | .529 |
| | | 3 | .204(*) | .096 | .033 | .016 | .393 |
| | | 4 | .585(*) | .100 | .000 | .388 | .782 |
| | | 5 | .451(*) | .066 | .000 | .321 | .582 |
| | | 6 | .252(*) | .071 | .000 | .113 | .392 |
| | | 7 | .107 | .086 | .213 | -.061 | .274 |
| | 3 | 1 | -.005 | .172 | .979 | -.343 | .333 |
| | | 2 | -.204(*) | .096 | .033 | -.393 | -.016 |
| | | 4 | .381(*) | .108 | .000 | .169 | .592 |
| | | 5 | .247(*) | .077 | .001 | .095 | .399 |
| | | 6 | .048 | .081 | .556 | -.112 | .208 |
| | | 7 | -.098 | .094 | .299 | -.283 | .087 |
| | 4 | 1 | -.385(*) | .175 | .028 | -.728 | -.042 |
| | | 2 | -.585(*) | .100 | .000 | -.782 | -.388 |
| | | 3 | -.381(*) | .108 | .000 | -.592 | -.169 |
| | | 5 | -.134 | .083 | .107 | -.296 | .029 |
| | | 6 | -.333(*) | .087 | .000 | -.502 | -.163 |
| | | 7 | -.478(*) | .099 | .000 | -.672 | -.285 |
| | 5 | 1 | -.252 | .158 | .111 | -.561 | .058 |
| | | 2 | -.451(*) | .066 | .000 | -.582 | -.321 |
| | | 3 | -.247(*) | .077 | .001 | -.399 | -.095 |
| | | 4 | .134 | .083 | .107 | -.029 | .296 |
| | | 6 | -.199(*) | .043 | .000 | -.283 | -.115 |
| | | 7 | -.345(*) | .064 | .000 | -.470 | -.219 |
| | 6 | 1 | -.053 | .160 | .742 | -.366 | .261 |
| | | 2 | -.252(*) | .071 | .000 | -.392 | -.113 |
| | | 3 | -.048 | .081 | .556 | -.208 | .112 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .333(*) | .087 | .000 | .163 | .502 |
| | | 5 | .199(*) | .043 | .000 | .115 | .283 |
| | | 7 | -.146(*) | .069 | .034 | -.281 | -.011 |
| | 7 | 1 | .093 | .167 | .576 | -.234 | .420 |
| | | 2 | -.107 | .086 | .213 | -.274 | .061 |
| | | 3 | .098 | .094 | .299 | -.087 | .283 |
| | | 4 | .478(*) | .099 | .000 | .285 | .672 |
| | | 5 | .345(*) | .064 | .000 | .219 | .470 |
| | | 6 | .146(*) | .069 | .034 | .011 | .281 |
| 9 | 1 | 2 | .010 | .241 | .967 | -.462 | .482 |
| | | 3 | .160 | .247 | .518 | -.325 | .645 |
| | | 4 | .056 | .251 | .822 | -.436 | .549 |
| | | 5 | .093 | .226 | .681 | -.351 | .537 |
| | | 6 | -.009 | .229 | .970 | -.458 | .441 |
| | | 7 | .056 | .239 | .814 | -.413 | .526 |
| | 2 | 1 | -.010 | .241 | .967 | -.482 | .462 |
| | | 3 | .150 | .138 | .276 | -.120 | .420 |
| | | 4 | .047 | .144 | .746 | -.236 | .329 |
| | | 5 | .083 | .095 | .381 | -.103 | .270 |
| | | 6 | -.018 | .102 | .856 | -.218 | .181 |
| | | 7 | .047 | .123 | .705 | -.194 | .287 |
| | 3 | 1 | -.160 | .247 | .518 | -.645 | .325 |
| | | 2 | -.150 | .138 | .276 | -.420 | .120 |
| | | 4 | -.103 | .155 | .505 | -.407 | .201 |
| | | 5 | -.066 | .111 | .549 | -.284 | .151 |
| | | 6 | -.168 | .117 | .150 | -.398 | .061 |
| | | 7 | -.103 | .135 | .445 | -.369 | .162 |
| | 4 | 1 | -.056 | .251 | .822 | -.549 | .436 |
| | | 2 | -.047 | .144 | .746 | -.329 | .236 |
| | | 3 | .103 | .155 | .505 | -.201 | .407 |
| | | 5 | .037 | .119 | .757 | -.196 | .270 |
| | | 6 | -.065 | .124 | .600 | -.309 | .179 |
| | | 7 | .000 | .142 | .999 | -.278 | .278 |
| | 5 | 1 | -.093 | .226 | .681 | -.537 | .351 |
| | | 2 | -.083 | .095 | .381 | -.270 | .103 |
| | | 3 | .066 | .111 | .549 | -.151 | .284 |
| | | 4 | -.037 | .119 | .757 | -.270 | .196 |
| | | 6 | -.102 | .061 | .096 | -.222 | .018 |
| | | 7 | -.037 | .092 | .688 | -.217 | .143 |
| | 6 | 1 | .009 | .229 | .970 | -.441 | .458 |
| | | 2 | .018 | .102 | .856 | -.181 | .218 |
| | | 3 | .168 | .117 | .150 | -.061 | .398 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4 | .065 | .124 | .600 | -.179 | .309 |
| | | 5 | .102 | .061 | .096 | -.018 | .222 |
| | | 7 | .065 | .099 | .510 | -.129 | .259 |
| | 7 | 1 | -.056 | .239 | .814 | -.526 | .413 |
| | | 2 | -.047 | .123 | .705 | -.287 | .194 |
| | | 3 | .103 | .135 | .445 | -.162 | .369 |
| | | 4 | .000 | .142 | .999 | -.278 | .278 |
| | | 5 | .037 | .092 | .688 | -.143 | .217 |
| | | 6 | -.065 | .099 | .510 | -.259 | .129 |
| 10 | 1 | 2 | .428 | .239 | .074 | -.041 | .898 |
| | | 3 | .635(*) | .246 | .010 | .153 | 1.118 |
| | | 4 | 1.064(*) | .250 | .000 | .574 | 1.553 |
| | | 5 | .795(*) | .225 | .000 | .354 | 1.237 |
| | | 6 | .646(*) | .228 | .005 | .199 | 1.094 |
| | | 7 | .419 | .238 | .079 | -.048 | .885 |
| | 2 | 1 | -.428 | .239 | .074 | -.898 | .041 |
| | | 3 | .207 | .137 | .131 | -.062 | .476 |
| | | 4 | .635(*) | .143 | .000 | .354 | .916 |
| | | 5 | .367(*) | .095 | .000 | .181 | .553 |
| | | 6 | .218(*) | .101 | .032 | .019 | .417 |
| | | 7 | -.010 | .122 | .937 | -.249 | .230 |
| | 3 | 1 | -.635(*) | .246 | .010 | -1.118 | -.153 |
| | | 2 | -.207 | .137 | .131 | -.476 | .062 |
| | | 4 | .428(*) | .154 | .006 | .126 | .731 |
| | | 5 | .160 | .110 | .148 | -.057 | .377 |
| | | 6 | .011 | .116 | .925 | -.217 | .239 |
| | | 7 | -.217 | .135 | .108 | -.481 | .047 |
| | 4 | 1 | -1.064(*) | .250 | .000 | -1.553 | -.574 |
| | | 2 | -.635(*) | .143 | .000 | -.916 | -.354 |
| | | 3 | -.428(*) | .154 | .006 | -.731 | -.126 |
| | | 5 | -.268(*) | .118 | .023 | -.500 | -.036 |
| | | 6 | -.417(*) | .124 | .001 | -.660 | -.175 |
| | | 7 | -.645(*) | .141 | .000 | -.922 | -.368 |
| | 5 | 1 | -.795(*) | .225 | .000 | -1.237 | -.354 |
| | | 2 | -.367(*) | .095 | .000 | -.553 | -.181 |
| | | 3 | -.160 | .110 | .148 | -.377 | .057 |
| | | 4 | .268(*) | .118 | .023 | .036 | .500 |
| | | 6 | -.149(*) | .061 | .015 | -.268 | -.030 |
| | | 7 | -.377(*) | .091 | .000 | -.556 | -.198 |
| | 6 | 1 | -.646(*) | .228 | .005 | -1.094 | -.199 |
| | | 2 | -.218(*) | .101 | .032 | -.417 | -.019 |
| | | 3 | -.011 | .116 | .925 | -.239 | .217 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 4 | .417(*) | .124 | .001 | .175 | .660 |
| | 5 | .149(*) | .061 | .015 | .030 | .268 |
| | 7 | -.228(*) | .098 | .020 | -.420 | -.035 |
| 7 | 1 | -.419 | .238 | .079 | -.885 | .048 |
| | 2 | .010 | .122 | .937 | -.230 | .249 |
| | 3 | .217 | .135 | .108 | -.047 | .481 |
| | 4 | .645(*) | .141 | .000 | .368 | .922 |
| | 5 | .377(*) | .091 | .000 | .198 | .556 |
| | 6 | .228(*) | .098 | .020 | .035 | .420 |

Based on estimated marginal means

* The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

b. Codes for factors:

1. Organizational commitment and communication.
2. Line management commitment.
3. Supervisor's role.
4. Personal role.
5. Coworkers' influence.
6. Competence.
7. Risk taking behavior.
8. Obstacles to safe behavior.
9. Permit to work.
10. Reporting of accidents and near misses.

c. Codes for job positions:

1. Senior manager
2. Manager
3. Supervisor
4. Foremen
5. Workforce/craft
6. Technical support
7. Administrative

Data Set B.8

Mean differences in safety climate scores by first aid injury or illness

| A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| | No | -.347(*) | .048 | .000 | -.441 | -.252 |
| No | Yes | .347(*) | .048 | .000 | .252 | .441 |

Based on estimated marginal means

* The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Data Set B.9

Mean safety climate factor scores by reported first aid injury/illness in the previous 12 months

| Factor | First aid injury/illness | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1. Organizational commitment and communication | Yes | 3.030 | .063 | 2.907 | 3.153 |
| | No | 3.478 | .020 | 3.440 | 3.516 |
| 2. Line management commitment | Yes | 3.334 | .069 | 3.198 | 3.470 |
| | No | 3.676 | .022 | 3.633 | 3.718 |
| 3. Supervisors' role | Yes | 3.000 | .069 | 2.864 | 3.136 |
| | No | 3.485 | .022 | 3.443 | 3.527 |
| 4. Personal role | Yes | 3.584 | .054 | 3.478 | 3.689 |
| | No | 3.832 | .017 | 3.799 | 3.865 |
| 5. Coworkers' influence | Yes | 3.203 | .065 | 3.074 | 3.331 |
| | No | 3.524 | .020 | 3.484 | 3.564 |
| 6. Competence | Yes | 3.601 | .056 | 3.490 | 3.712 |
| | No | 3.788 | .018 | 3.754 | 3.823 |
| 7. Risk taking behavior | Yes | 2.831 | .059 | 2.715 | 2.947 |
| | No | 3.256 | .018 | 3.220 | 3.292 |
| 8. Obstacles to safe behavior | Yes | 2.865 | .058 | 2.751 | 2.978 |
| | No | 3.174 | .018 | 3.139 | 3.210 |
| 9. Permit to work | Yes | 3.287 | .081 | 3.128 | 3.446 |
| | No | 3.184 | .025 | 3.135 | 3.234 |
| 10. Reporting of accidents and near misses | Yes | 2.557 | .082 | 2.397 | 2.718 |
| | No | 2.875 | .025 | 2.825 | 2.925 |

Data Set B.10

<u>Mean differences in factor scores by first aid injury</u>

| | | | | | | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|---|
| Factor(b) | A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | Lower Bound | Upper Bound |
| 1 | | 2 | -.448(*) | .066 | .000 | -.577 | -.319 |
| | 2 | 1 | .448(*) | .066 | .000 | .319 | .577 |
| 2 | 1 | 2 | -.342(*) | .073 | .000 | -.484 | -.199 |
| | 2 | 1 | .342(*) | .073 | .000 | .199 | .484 |
| 3 | 1 | 2 | -.485(*) | .072 | .000 | -.627 | -.343 |
| | 2 | 1 | .485(*) | .072 | .000 | .343 | .627 |
| 4 | 1 | 2 | -.249(*) | .056 | .000 | -.359 | -.138 |
| | 2 | 1 | .249(*) | .056 | .000 | .138 | .359 |
| 5 | 1 | 2 | -.321(*) | .069 | .000 | -.456 | -.187 |
| | 2 | 1 | .321(*) | .069 | .000 | .187 | .456 |
| 6 | 1 | 2 | -.187(*) | .059 | .002 | -.303 | -.071 |
| | 2 | 1 | .187(*) | .059 | .002 | .071 | .303 |
| 7 | 1 | 2 | -.425(*) | .062 | .000 | -.547 | -.304 |
| | 2 | 1 | .425(*) | .062 | .000 | .304 | .547 |
| 8 | 1 | 2 | -.310(*) | .060 | .000 | -.428 | -.191 |
| | 2 | 1 | .310(*) | .060 | .000 | .191 | .428 |
| 9 | 1 | 2 | .103 | .085 | .226 | -.064 | .269 |
| | 2 | 1 | -.103 | .085 | .226 | -.269 | .064 |
| 10 | 1 | 2 | -.317(*) | .086 | .000 | -.485 | -.149 |
| | 2 | 1 | .317(*) | .086 | .000 | .149 | .485 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. Codes for factors:

1. Organizational commitment and communication.
2. Line management commitment.
3. Supervisor's role.
4. Personal role.
5. Coworkers' influence.
6. Competence.
7. Risk taking behavior.
8. Obstacles to safe behavior.
9. Permit to work.
10. Reporting of accidents and near misses.

Data Set B.11

Mean differences in safety climate score by medical treatment injury or illness

| A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| | 2 | -.464(*) | .067 | .000 | -.595 | -.332 |
| 2 | 1 | .464(*) | .067 | .000 | .332 | .595 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. 1 = Yes; 2 = N

Data Set B.12

Mean safety climate factor scores by reported medical treatment injury/illness in the previous 12 months

| Factor | Medical treatment | Mean | Std. Error | 95% Confidence Interval Lower Bound | Upper Bound |
|---|---|---|---|---|---|
| 1 | Yes | 2.877 | .092 | 2.697 | 3.058 |
| | No | 3.463 | .019 | 3.425 | 3.500 |
| 2 | Yes | 3.110 | .102 | 2.910 | 3.309 |
| | No | 3.668 | .021 | 3.626 | 3.709 |
| 3 | Yes | 2.858 | .102 | 2.659 | 3.058 |
| | No | 3.465 | .021 | 3.424 | 3.507 |
| 4 | Yes | 3.430 | .079 | 3.275 | 3.584 |
| | No | 3.827 | .016 | 3.795 | 3.859 |
| 5 | Yes | 3.101 | .096 | 2.913 | 3.289 |
| | No | 3.514 | .020 | 3.475 | 3.553 |
| 6 | Yes | 3.339 | .082 | 3.178 | 3.499 |
| | No | 3.791 | .017 | 3.758 | 3.825 |
| 7 | Yes | 2.735 | .087 | 2.565 | 2.906 |
| | No | 3.238 | .018 | 3.203 | 3.274 |
| 8 | Yes | 2.763 | .085 | 2.598 | 2.929 |
| | No | 3.163 | .018 | 3.128 | 3.197 |
| 9 | Yes | 3.193 | .119 | 2.960 | 3.426 |
| | No | 3.196 | .025 | 3.147 | 3.244 |
| 10 | Yes | 2.535 | .120 | 2.300 | 2.770 |
| | No | 2.857 | .025 | 2.808 | 2.906 |

Data Set B.13

Mean differences in factor scores by medical treatment injury or illness

| Factor(b) | A | B | Mean Difference | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| 1 | | 2 | -.585(*) | .094 | .000 | -.769 | -.401 |
| | 2 | 1 | .585(*) | .094 | .000 | .401 | .769 |
| 2 | 1 | 2 | -.558(*) | .104 | .000 | -.762 | -.354 |
| | 2 | 1 | .558(*) | .104 | .000 | .354 | .762 |
| 3 | 1 | 2 | -.607(*) | .104 | .000 | -.811 | -.403 |
| | 2 | 1 | .607(*) | .104 | .000 | .403 | .811 |
| 4 | 1 | 2 | -.397(*) | .080 | .000 | -.555 | -.240 |
| | 2 | 1 | .397(*) | .080 | .000 | .240 | .555 |
| 5 | 1 | 2 | -.413(*) | .098 | .000 | -.605 | -.221 |
| | 2 | 1 | .413(*) | .098 | .000 | .221 | .605 |
| 6 | 1 | 2 | -.453(*) | .084 | .000 | -.617 | -.289 |
| | 2 | 1 | .453(*) | .084 | .000 | .289 | .617 |
| 7 | 1 | 2 | -.503(*) | .089 | .000 | -.677 | -.329 |
| | 2 | 1 | .503(*) | .089 | .000 | .329 | .677 |
| 8 | 1 | 2 | -.399(*) | .086 | .000 | -.569 | -.230 |
| | 2 | 1 | .399(*) | .086 | .000 | .230 | .569 |
| 9 | 1 | 2 | -.003 | .121 | .982 | -.240 | .235 |
| | 2 | 1 | .003 | .121 | .982 | -.235 | .240 |
| 10 | 1 | 2 | -.322(*) | .122 | .009 | -.562 | -.082 |
| | 2 | 1 | .322(*) | .122 | .009 | .082 | .562 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. Codes for factors:

1. Organizational commitment and communication.
2. Line management commitment.
3. Supervisor's role.
4. Personal role.
5. Coworkers' influence.
6. Competence.
7. Risk taking behavior.
8. Obstacles to safe behavior.
9. Permit to work.
10. Reporting of accidents and near misses.

Data Set B.14

Mean difference in safety climate score by lost/restricted injury or illness

| | | | | | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|
| A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | Lower Bound | Upper Bound |
| | 2 | -.416(*) | .071 | .000 | -.554 | -.278 |
| 2 | 1 | .416(*) | .071 | .000 | .278 | .554 |

Based on estimated marginal means

* The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

b. 1 = Yes; 2 = No

Data Set B.15

Mean safety climate factor scores by reported lost time/restricted injury/illness in the previous 12 months

| Factor | Lost time/ restricted | Mean | Std. Error | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|
| 1 | Yes | 2.974 | .097 | 2.783 | 3.165 |
| | No | 3.458 | .019 | 3.420 | 3.495 |
| 2 | Yes | 3.147 | .108 | 2.935 | 3.359 |
| | No | 3.663 | .021 | 3.622 | 3.705 |
| 3 | Yes | 2.886 | .107 | 2.675 | 3.096 |
| | No | 3.464 | .021 | 3.422 | 3.505 |
| 4 | Yes | 3.529 | .083 | 3.366 | 3.693 |
| | No | 3.824 | .016 | 3.792 | 3.856 |
| 5 | Yes | 3.113 | .101 | 2.914 | 3.311 |
| | No | 3.510 | .020 | 3.471 | 3.549 |
| 6 | Yes | 3.437 | .087 | 3.266 | 3.608 |
| | No | 3.784 | .017 | 3.751 | 3.818 |
| 7 | Yes | 2.761 | .092 | 2.581 | 2.942 |
| | No | 3.236 | .018 | 3.200 | 3.271 |
| 8 | Yes | 2.829 | .090 | 2.653 | 3.004 |
| | No | 3.158 | .018 | 3.124 | 3.193 |
| 9 | Yes | 3.167 | .125 | 2.921 | 3.413 |
| | No | 3.199 | .025 | 3.151 | 3.248 |
| 10 | Yes | 2.402 | .126 | 2.155 | 2.649 |
| | No | 2.866 | .025 | 2.817 | 2.914 |

Data Set B.16

<u>Mean difference in factor scores by lost time/restricted injury</u>

| Factor(b) | A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| 1 | | 2 | -.484(*) | .099 | .000 | -.678 | -.289 |
| | 2 | 1 | .484(*) | .099 | .000 | .289 | .678 |
| 2 | 1 | 2 | -.516(*) | .110 | .000 | -.732 | -.301 |
| | 2 | 1 | .516(*) | .110 | .000 | .301 | .732 |
| 3 | 1 | 2 | -.578(*) | .109 | .000 | -.793 | -.363 |
| | 2 | 1 | .578(*) | .109 | .000 | .363 | .793 |
| 4 | 1 | 2 | -.295(*) | .085 | .001 | -.461 | -.128 |
| | 2 | 1 | .295(*) | .085 | .001 | .128 | .461 |
| 5 | 1 | 2 | -.397(*) | .103 | .000 | -.600 | -.195 |
| | 2 | 1 | .397(*) | .103 | .000 | .195 | .600 |
| 6 | 1 | 2 | -.347(*) | .089 | .000 | -.521 | -.173 |
| | 2 | 1 | .347(*) | .089 | .000 | .173 | .521 |
| 7 | 1 | 2 | -.474(*) | .094 | .000 | -.658 | -.290 |
| | 2 | 1 | .474(*) | .094 | .000 | .290 | .658 |
| 8 | 1 | 2 | -.330(*) | .091 | .000 | -.509 | -.151 |
| | 2 | 1 | .330(*) | .091 | .000 | .151 | .509 |
| 9 | 1 | 2 | -.033 | .128 | .799 | -.283 | .218 |
| | 2 | 1 | .033 | .128 | .799 | -.218 | .283 |
| 10 | 1 | 2 | -.464(*) | .128 | .000 | -.716 | -.212 |
| | 2 | 1 | .464(*) | .128 | .000 | .212 | .716 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. Codes for factors:

1. Organizational commitment and communication.
2. Line management commitment.
3. Supervisor's role.
4. Personal role.
5. Coworkers' influence.
6. Competence.
7. Risk taking behavior.
8. Obstacles to safe behavior.
9. Permit to work.
10. Reporting of accidents and near misses.

Data Set B.17

Mean differences in safety climate score by introductory behavior-based safety training in the past 12 months

| A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| | 2 | .165(*) | .029 | .000 | .108 | .221 |
| 2 | 1 | -.165(*) | .029 | .000 | -.221 | -.108 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. 1 = Yes; 2 = No

Data Set B.18

<u>Mean safety climate factor scores by reported introductory behavior-based safety training in the previous 12 months</u>

| | | | | 95% Confidence Interval | |
|---|---|---|---|---|---|
| Factor | BBS training | Mean | Std. Error | Lower Bound | Upper Bound |
| 1 | Yes | 3.496 | .022 | 3.454 | 3.539 |
| | No | 3.261 | .032 | 3.197 | 3.324 |
| 2 | Yes | 3.722 | .024 | 3.675 | 3.769 |
| | No | 3.434 | .036 | 3.365 | 3.504 |
| 3 | Yes | 3.499 | .024 | 3.452 | 3.546 |
| | No | 3.276 | .036 | 3.205 | 3.346 |
| 4 | Yes | 3.829 | .019 | 3.793 | 3.866 |
| | No | 3.756 | .028 | 3.702 | 3.811 |
| 5 | Yes | 3.537 | .022 | 3.493 | 3.581 |
| | No | 3.368 | .034 | 3.302 | 3.434 |
| 6 | Yes | 3.821 | .019 | 3.783 | 3.859 |
| | No | 3.634 | .029 | 3.577 | 3.690 |
| 7 | Yes | 3.264 | .020 | 3.224 | 3.304 |
| | No | 3.077 | .031 | 3.017 | 3.137 |
| 8 | Yes | 3.163 | .020 | 3.124 | 3.202 |
| | No | 3.093 | .030 | 3.035 | 3.152 |
| 9 | Yes | 3.142 | .028 | 3.088 | 3.197 |
| | No | 3.284 | .041 | 3.203 | 3.366 |
| 10 | Yes | 2.868 | .028 | 2.813 | 2.923 |
| | No | 2.775 | .042 | 2.692 | 2.858 |

Data Set B.19

Mean differences in factor scores by introductory behavior-based safety training in the past 12 months

| | | | | | | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|---|
| Factor(b) | A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | Lower Bound | Upper Bound |
| 1 | | 2 | .236(*) | .039 | .000 | .159 | .312 |
| | 2 | 1 | -.236(*) | .039 | .000 | -.312 | -.159 |
| 2 | 1 | 2 | .288(*) | .043 | .000 | .204 | .372 |
| | 2 | 1 | -.288(*) | .043 | .000 | -.372 | -.204 |
| 3 | 1 | 2 | .223(*) | .043 | .000 | .138 | .308 |
| | 2 | 1 | -.223(*) | .043 | .000 | -.308 | -.138 |
| 4 | 1 | 2 | .073(*) | .033 | .028 | .008 | .139 |
| | 2 | 1 | -.073(*) | .033 | .028 | -.139 | -.008 |
| 5 | 1 | 2 | .169(*) | .040 | .000 | .090 | .248 |
| | 2 | 1 | -.169(*) | .040 | .000 | -.248 | -.090 |
| 6 | 1 | 2 | .187(*) | .035 | .000 | .119 | .255 |
| | 2 | 1 | -.187(*) | .035 | .000 | -.255 | -.119 |
| 7 | 1 | 2 | .187(*) | .037 | .000 | .115 | .260 |
| | 2 | 1 | -.187(*) | .037 | .000 | -.260 | -.115 |
| 8 | 1 | 2 | .070 | .036 | .051 | .000 | .140 |
| | 2 | 1 | -.070 | .036 | .051 | -.140 | .000 |
| 9 | 1 | 2 | -.142(*) | .050 | .004 | -.240 | -.044 |
| | 2 | 1 | .142(*) | .050 | .004 | .044 | .240 |
| 10 | 1 | 2 | .093 | .051 | .066 | -.006 | .193 |
| | 2 | 1 | -.093 | .051 | .066 | -.193 | .006 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. Codes for factors:

1. Organizational commitment and communication.
2. Line management commitment.
3. Supervisor's role.
4. Personal role.
5. Coworkers' influence.
6. Competence.
7. Risk taking behavior.
8. Obstacles to safe behavior.

9. Permit to work.

10. Reporting of accidents and near misses.

c. 1 = Yes; 2 = No

Data Set B.20

<u>Mean differences in safety climate score by behavior-based safety observation training</u>

| | | | | | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|
| A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | Lower Bound | Upper Bound |
| | 2 | .127(*) | .027 | .000 | .074 | .180 |
| 2 | 1 | -.127(*) | .027 | .000 | -.180 | -.074 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. 1 = Yes; 2 = No

Data Set B.21

Mean safety climate factor scores by reported behavior-based safety observation training in the previous 12 months

| Factor | BBS Observer Training | Mean | Std. Error | 95% Confidence Interval Lower Bound | Upper Bound |
|---|---|---|---|---|---|
| 1 | Yes | 3.538 | .027 | 3.486 | 3.591 |
| | No | 3.322 | .025 | 3.274 | 3.371 |
| 2 | Yes | 3.740 | .030 | 3.682 | 3.798 |
| | No | 3.536 | .027 | 3.483 | 3.590 |
| 3 | Yes | 3.513 | .030 | 3.454 | 3.571 |
| | No | 3.358 | .027 | 3.304 | 3.412 |
| 4 | Yes | 3.823 | .023 | 3.777 | 3.868 |
| | No | 3.790 | .021 | 3.749 | 3.832 |
| 5 | Yes | 3.549 | .028 | 3.494 | 3.603 |
| | No | 3.432 | .026 | 3.382 | 3.482 |
| 6 | Yes | 3.826 | .024 | 3.779 | 3.873 |
| | No | 3.713 | .022 | 3.670 | 3.757 |
| 7 | Yes | 3.281 | .025 | 3.231 | 3.331 |
| | No | 3.139 | .023 | 3.093 | 3.185 |
| 8 | Yes | 3.173 | .025 | 3.125 | 3.221 |
| | No | 3.109 | .023 | 3.064 | 3.153 |
| 9 | Yes | 3.095 | .034 | 3.028 | 3.162 |
| | No | 3.257 | .032 | 3.195 | 3.319 |
| 10 | Yes | 2.854 | .035 | 2.785 | 2.922 |
| | No | 2.819 | .032 | 2.756 | 2.881 |

Data Set B.22

Mean differences in factor scores by behavior-based safety observation training

| Factor(b) | A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| 1 | | 2 | .216(*) | .036 | .000 | .145 | .287 |
| | 2 | 1 | -.216(*) | .036 | .000 | -.287 | -.145 |
| 2 | 1 | 2 | .204(*) | .040 | .000 | .125 | .283 |
| | 2 | 1 | -.204(*) | .040 | .000 | -.283 | -.125 |
| 3 | 1 | 2 | .155(*) | .040 | .000 | .075 | .234 |
| | 2 | 1 | -.155(*) | .040 | .000 | -.234 | -.075 |
| 4 | 1 | 2 | .032 | .031 | .300 | -.029 | .094 |
| | 2 | 1 | -.032 | .031 | .300 | -.094 | .029 |
| 5 | 1 | 2 | .117(*) | .038 | .002 | .042 | .191 |
| | 2 | 1 | -.117(*) | .038 | .002 | -.191 | -.042 |
| 6 | 1 | 2 | .113(*) | .033 | .001 | .048 | .177 |
| | 2 | 1 | -.113(*) | .033 | .001 | -.177 | -.048 |
| 7 | 1 | 2 | .142(*) | .035 | .000 | .074 | .210 |
| | 2 | 1 | -.142(*) | .035 | .000 | -.210 | -.074 |
| 8 | 1 | 2 | .064 | .033 | .055 | -.001 | .129 |
| | 2 | 1 | -.064 | .033 | .055 | -.129 | .001 |
| 9 | 1 | 2 | -.162(*) | .047 | .001 | -.253 | -.071 |
| | 2 | 1 | .162(*) | .047 | .001 | .071 | .253 |
| 10 | 1 | 2 | .035 | .047 | .459 | -.058 | .128 |
| | 2 | 1 | -.035 | .047 | .459 | -.128 | .058 |

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
b. Codes for factors:

1. Organizational commitment and communication.
2. Line management commitment.
3. Supervisor's role.
4. Personal role.
5. Coworkers' influence.
6. Competence.
7. Risk taking behavior.
8. Obstacles to safe behavior.
9. Permit to work.
10. Reporting of accidents and near misses.

Data Set B.23

<u>Mean differences in safety climate scores by behavior-based safety observation</u>

| A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| | 2 | .182(*) | .030 | .000 | .123 | .241 |
| 2 | 1 | -.182(*) | .030 | .000 | -.241 | -.123 |

Based on estimated marginal means

* The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

b. 1 = Yes; 2 = No

Data Set B.24

Mean safety climate factor scores by reported behavior-based safety observation in the previous month

| Factor | BBS observation | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1 | Yes | 3.639 | .034 | 3.572 | 3.706 |
| | No | 3.343 | .021 | 3.302 | 3.384 |
| 2 | Yes | 3.829 | .038 | 3.755 | 3.904 |
| | No | 3.558 | .023 | 3.513 | 3.604 |
| 3 | Yes | 3.612 | .038 | 3.537 | 3.686 |
| | No | 3.362 | .023 | 3.315 | 3.408 |
| 4 | Yes | 3.847 | .030 | 3.789 | 3.906 |
| | No | 3.791 | .018 | 3.755 | 3.827 |
| 5 | Yes | 3.601 | .036 | 3.531 | 3.672 |
| | No | 3.437 | .022 | 3.394 | 3.480 |
| 6 | Yes | 3.886 | .031 | 3.825 | 3.946 |
| | No | 3.717 | .019 | 3.680 | 3.755 |
| 7 | Yes | 3.352 | .033 | 3.288 | 3.416 |
| | No | 3.146 | .020 | 3.107 | 3.186 |
| 8 | Yes | 3.210 | .032 | 3.148 | 3.272 |
| | No | 3.112 | .019 | 3.073 | 3.150 |
| 9 | Yes | 3.056 | .044 | 2.970 | 3.143 |
| | No | 3.232 | .027 | 3.179 | 3.286 |
| 10 | Yes | 2.886 | .045 | 2.798 | 2.974 |
| | No | 2.816 | .028 | 2.762 | 2.871 |

Data Set B.25

Mean differences in factor scores by behavior-based safety observations

| Factor(b) | A | B | Mean Difference (A-B) | Std. Error | Sig.(a) | 95% Confidence Interval for Difference(a) Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|---|
| 1 | | 2 | .296(*) | .040 | .000 | .217 | .375 |
| | 2 | 1 | -.296(*) | .040 | .000 | -.375 | -.217 |
| 2 | 1 | 2 | .271(*) | .045 | .000 | .184 | .358 |
| | 2 | 1 | -.271(*) | .045 | .000 | -.358 | -.184 |
| 3 | 1 | 2 | .250(*) | .045 | .000 | .162 | .338 |
| | 2 | 1 | -.250(*) | .045 | .000 | -.338 | -.162 |
| 4 | 1 | 2 | .056 | .035 | .108 | -.012 | .125 |
| | 2 | 1 | -.056 | .035 | .108 | -.125 | .012 |
| 5 | 1 | 2 | .164(*) | .042 | .000 | .082 | .247 |
| | 2 | 1 | -.164(*) | .042 | .000 | -.247 | -.082 |
| 6 | 1 | 2 | .168(*) | .036 | .000 | .097 | .240 |
| | 2 | 1 | -.168(*) | .036 | .000 | -.240 | -.097 |
| 7 | 1 | 2 | .206(*) | .038 | .000 | .130 | .281 |
| | 2 | 1 | -.206(*) | .038 | .000 | -.281 | -.130 |
| 8 | 1 | 2 | .098(*) | .037 | .008 | .025 | .171 |
| | 2 | 1 | -.098(*) | .037 | .008 | -.171 | -.025 |
| 9 | 1 | 2 | -.176(*) | .052 | .001 | -.278 | -.074 |
| | 2 | 1 | .176(*) | .052 | .001 | .074 | .278 |
| 10 | 1 | 2 | .070 | .053 | .187 | -.034 | .173 |
| | 2 | 1 | -.070 | .053 | .187 | -.173 | .034 |

Based on estimated marginal means

* The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

b. Codes for factors:

1. Organizational commitment and communication.
2. Line management commitment.
3. Supervisor's role.
4. Personal role.
5. Coworkers' influence.
6. Competence.
7. Risk taking behavior.
8. Obstacles to safe behavior.
9. Permit to work.
10. Reporting of accidents and near misses.

# VITA

Michael Everett Findley was born in Castleberry, Alabama on December 20, 1950. He attended Woodham High School in Pensacola, Florida, before earning a B.S. in Biology from the University of Montevallo in Montevallo, Alabama. He then earned an M.S.P.H. in Industrial Hygiene from the University of Alabama in Birmingham before completing his Ph.D. in Human Ecology at the University of Tennessee in Knoxville. He is a Certified Industrial Hygienist and Certified Safety Professional.

Michael is now employed in the nuclear decommissioning and demolition industry as a Health and Safety Manager.