Development Of A Measure Of Corporate Safety Culture For The Transportation Industry

David Vincent Colarossi
University of Denver

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DEVELOPMENT OF A MEASURE OF CORPORATE SAFETY CULTURE FOR THE
TRANSPORTATION INDUSTRY

A Dissertation

Presented to

the Faculty of the Morgridge College of Education

University of Denver

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

David V. Colarossi

August 2012

Advisor: Patrick Sherry, Ph.D.
Abstract

This project was designed to develop the Corporate Safety Culture Scale, a unique measure of corporate safety culture that is supported by a strong theoretical foundation. Items were developed conceptually, discussed in cognitive interviews, and submitted to expert review. Survey items were administered to employees of a large public transportation organization. Principle components analysis reduced the data and identified an empirical model. The empirical model held two domains identified as: 1) “Values,” and 2) “Behavior.” Confirmatory factor analysis compared the fit of the empirical model with that of a modified empirical model, and the hypothesized model, which held the following three domains: 1) “Behavior,” 2) “Values,” and 3) “Meaning Systems.” Goodness of fit indices (Chi-Squared, RMSEA, CFI, ECVI) identified the modified empirical structure as the model with best fit. The similarities between the hypothesized and modified empirical models suggested that the CSCS carries strong theoretical support.

The measure’s reliability was tested using Cronbach’s Alpha. The full CSCS and each identified domain were shown to have strong Alpha values. One-way between groups analysis of variance, was used to evaluate the relationship between scores on the full measure and a categorical safety behavior item. Findings suggested that high scorers
on the CSCS were safer workers than those with lower scores on the measure. A post hoc analysis using Tukey’s HSD showed that scores on the full CSCS, and the “Behavior” domain were significantly related to safety behavior. The analysis of variance and the post hoc results indicated that a relationship exists between the CSCS and safety behavior. This finding added to the validity of the measure. The CSCS was shown to be a theoretically supported, valid and reliable measure that can be used to evaluate corporate safety culture.
Acknowledgement

Many invaluable people have supported me through the journey of completing this dissertation. I owe great thanks to my dissertation chair, Patrick Sherry, Ph.D. His honest feedback and guidance supported my exploration of organizational psychology. Without his wisdom and confidence, I would have never aspired to study a construct as abstract and conceptual as corporate culture. I also want to thank the other members of my committee: Duan Zhang, Ph.D., Ruth Chao, Ph.D., and Cynthia Fukami, Ph.D. for their interest, challenge, and unending encouragement. In particular, I owe Duan a special debt of gratitude for her patience, insight, and constructive criticism at each stage of my project. Most importantly, this dissertation would not have been possible without the love, confidence, and encouragement of my family. I owe unending gratitude to my wife and best friend, Allison Colarossi. She has been a constant source of hope, encouragement, and love. As I pursued my academic dream, Allison worked tirelessly to support our household. I will never forget her sacrifice, and vow to repay all she has given me through this process. Finally, I want to thank my mother, who continues to motivate and inspire my writing.
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CHAPTER ONE

STUDY OVERVIEW

Purpose

This study was designed to develop and validate the Corporate Safety Culture Scale (CSCS), a measure of corporate safety culture. In an effort to address diverse conceptualizations of corporate culture and corporate safety culture, the measure was built from a theoretical foundation which combined three common conceptual theories of corporate culture. A theoretical factor structure, composed of three domains (Meaning systems, Values, and Behavioral Expectations) was compared to an empirical model, developed through principle components analysis. A one-way between groups analysis of variance was used to assess construct validity.

Introduction

Workplace Accidents

The significance of workplace accidents was first publically identified in 1970, after public officials recognized that the rate of occupational accidents increased by 20% during the 1960’s. With the implementation of the Occupational Safety and Health Act
of 1970, three related organizations were formed: the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Safety and Health Review Commission (OSHRC). Combined, these organizations were used to create, evaluate, and enforce occupational safety (Workplace Safety Tips, 2010).

With the creation of OSHA, the value of workplace safety was enforced in companies across the United States. However, it was not until the 1980’s that organizations operating in high risk industries began to emphasize and self regulate safety (International Atomic Energy Agency, 1986). Workplace accidents, defined as unanticipated occurrences that are preceded by unsafe behaviors or conditions (DiBerardinis, 1999) have significantly impacted organizations operating within the mining, agriculture, construction and transportation industries. In 2007 alone, these industries recorded a combined total of 2,768 employee fatalities (U.S. Department of Labor, 2010). In the transportation sector, safety has garnered particular interest as greater than 41% of workplace accidents, across all industries, occur during periods of transportation (U.S. Department of Labor, 2010). The high rate of accidents in transportation is alarming because it limits productivity, and negatively influences the physical and psychological health of employees.

Physical Psychological and Financial

The most observable consequences of workplace accidents are often physical. As a result of unexpected events, employees may suffer from bodily injuries, illnesses or even death. The U.S. department of labor (2010) reported that in 2008 alone, 5,214
individuals were killed as a result of workplace accidents. In the same year, state and
local employees experienced workplace injuries and illness at a rate of 6.3 cases per 100
equivalent full-time employees. In the private sector, occupational illnesses and injuries
were recorded at a rate of 3.9 cases per 100 full-time workers (U.S. Department of Labor,
(2009).

In addition to the physical setbacks caused by the occurrence of workplace
accidents, workers have been shown to experience psychological distress. If an employee
perceives the endangerment of their personal safety or the safety of significant others as a
result of a specific event, he/she may experience symptoms of anxiety. These indicators
of anxiety might include: fear, helplessness or horror, recurrent distressing images or
thoughts of the event, intense psychological distress at exposure to cues that remind the
individual of the event, persistent avoidance of feelings or situations that prompt thoughts
of the experience, and persistent symptoms of increased arousal (Mitchell & Everly,
2001). The presence of these symptoms may lead to the psychological diagnosis of
Posttraumatic Stress Disorder (PTSD) or Acute Stress Disorder (American Psychiatric
Association, 2000).

Additionally, exposure to traumatic events may also lead employees to experience
the following symptoms nearly everyday: a depressed mood, markedly diminished
interest or pleasure in all, or almost all, activities, significant weight loss or gain,
insomnia or hyper-somnia, psychomotor agitation or retardation, fatigue or loss of
energy, feelings of worthlessness or inappropriate guilt, diminished ability to think or
concentrate, indecisiveness, and recurrent thoughts of death (Norris, Kaniasty, &
Thompson, 1997). The occurrence of these symptoms may signify the presence of Major Depressive Disorder (American Psychiatric Association, 2000).

It is important to note that damage caused by workplace accidents goes beyond the psychological and physical setbacks experienced by employees. As a workforce copes with the aftermath of an accident, a corporation often suffers a financial loss as a result of reduced productivity. Research shows that psychological difficulties, including depression (Simon, Ludman, Unutzer, Operskalski, & Bauer, 2008), and stress (Marciniak, Lage, Landbloom, Dunayevich, & Bowman, 2004) account for significant productivity costs. Kessler and Frank (1997) reported that affective disorders including both depression and anxiety account for a total of 25 lost work days each month per 100 workers. This statistical finding is equivalent to an annualized national projection of over 4 million work lost days. The damaging effect of workplace accidents on productivity is clearly shown within the transportation industry. As a result of illness or injury, the United States department of labor documented an incidence rate of 2.5 days away from work per every 100 transportation employees in 2008. The incident rate increased to 3.9 when the department of labor included cases with job transfers and job restrictions (U.S. Department of Labor, 2009).

Origin of Accidents

In the aftermath of a workplace accident, investigators focus on identifying culpability for the unplanned incidents. Avoidable occupational incidents are typically the result of human error. The unsafe blunders may be systemic or personal. (Reason, 2000). Personal errors refer to individual acts of danger or procedural violations. Often
personal errors are the result of distraction, lack of interest, sloppiness, negligence, thoughtlessness, haste, and recklessness. Workplace accidents resulting from purely personal errors often allow for uncomplicated responses. Because the liable individual is the sole cause of the accident, the organization of the company does not have to change. However, many argue that workplace accidents are typically caused by both personal and systemic errors.

Systemic errors describe organizational processes that allow for accidents to occur. For example, the 1998 explosion at the Esso natural gas plant was thought to be caused by systemic problems. The gas plant suffered a two-day fire after a lean oil pump failed, causing a fracture in the exchanger. In this event, no individual employee directly caused the blowout. However, the mechanical failure was the result of poor plant design, training, supervision, management, communication and reporting (Boult & Pitblado, 2001). A similar systemic problem is hypothesized to be responsible BP’s Deepwater Horizon well explosion. Here, the off shore rig exploded due to a burnout caused by uncontained natural gas. The explosion led to 11 employee deaths and a record-setting oil leak in the Gulf of Mexico (Kerr, Kintisch, & Stokstad, 2010). When evaluating the catastrophe, investigators point to problems with maintenance and operations (Witze, 2010).

When describing safeguards against workplace accidents, Reason, (1990) noted that all safety measures contain flaws. Although each measure is expected to fully prevent accidents, alone they are incomplete. The author explained that the protective features are imperfect because active failures and latent conditions exist. Active failures
reference the personal mistakes that exist within any organization. They may occur in the form of procedural violations, slips, misjudgments, and drops. These mistakes can lead to catastrophic accidents. Reason cites the Chernobyl calamity, prior to which employees violated procedures by disabling safety systems. As a result, the plant explosion was not prevented. As was previously mentioned, workplace accidents are rarely caused by personal errors alone. Reason notes that latent conditions, defined as structural circumstances that allow for mishaps to occur, are inevitably involved in workplace accidents. The researcher explained that these conditions may present as

“error provoking conditions within the local workplace (time pressure, understaffing, inadequate equipment, fatigue, and inexperience) and they can create long lasting holes or weaknesses in the defenses (untrustworthy alarms and indicators, unworkable procedures, design and construction deficiencies, etc)” (Reason, 2000).

When left unresolved, latent conditions can exist enduringly prior to an unwanted incident. The conditions lie undeveloped until they are triggered by active failures. In an effort to describe an effective error management approach, Reason referenced the structure of Swiss cheese. Alone, a single slice of Swiss cheese has many visible holes. Like Swiss cheese, protective efforts have holes, through which errors can occur. When isolated, a single protective measure is not sufficient to avoid workplace accidents, too many holes exist. However, most organizations have many protective barriers. Like layers of Swiss cheese, when these defenses are held together, the gaps become filled. For this reason, the author explained that a single latent condition or active failure does not typically result in an accident. The supporting barriers protect against an unwanted
incident. When accidents occur, they are created in the rare moments that an active failure exposes a single hole through each of the defensive layers (Reason, 2000).

**Corporate Safety Culture**

The combined set of a corporation’s safety-related attitudes, shared meanings, behaviors, practices, and beliefs, can be labeled the corporation’s safety culture. Safety culture is important as it reduces the prevalence of what Reason (2000) called active failures and latent conditions. When safety becomes a priority over productivity, companies with strong safety cultures are believed to be the most protected and safe organizations. Approximately 25 years ago, the concept of corporate culture became significant to investigators working in safety management, because it was believed to be a significant moderator of employee behavior. This focus on culture as a predictor of corporate safety was prompted, in large part, by the 1986 nuclear catastrophe at Chernobyl. After this tragic accident, and several other significant work-place calamities involving chemical plants, commuter boats, oil tankers, freight trains and commercial aircraft, investigators observed that commonalities existed in the conditions surrounding each accident. Hopfl (1994) explained that “despite the obvious differences in the industries involved and their technologies,….at a contextual level, there [were] many common characteristics (Reason, 1990, as cited in Hopfl, 1994). As researchers identified circumstantial similarities, they began to emphasize social and organizational factors in their evaluations of workplace accidents (Hopfl, 1994). This amended focus was shown in the International Atomic Energy Agency’s (IAEA) updated safety report on the accident at Chernobyl. The IAEA report explained that “the accident … flowed from
a deficient safety culture, not only at the Chernobyl plant, but throughout the Soviet
design, operating and regulatory organizations for nuclear power that existed at that time”

The impact of corporate culture was also revealed after the 2003 Challenger
Space Shuttle disaster. This tragedy was caused by a combination of latent conditions
that, though foreseeable, were not corrected prior to the shuttle launch. In 2003, the
National Aeronautics and Space Administration (NASA) had a history of success. The
organization had not experienced an in-flight accident in the 17 years prior the 2003
tragedy. Though engineers were aware of structural problems, the glitches were ignored
and considered acceptable risks for the Challenger exploration (National Aeronautics and
Space Administration, 2003). NASA had a culture focused more on success than safety.
As a consequence, when the Challenger space shuttle reentered the earth’s atmosphere, a
crack in the thermal protection system led to a major catastrophe (National Aeronautics
and Space Administration, 2003).

Given the influence of corporate culture on safety, it is no surprise that
investigators have started evaluating the culture at BP (previously known as British
Petroleum) in the aftermath of the Deepwater Horizon blowout and gas explosion. As a
result of the accident, eleven BP employees are presumed dead, and over 1 billion gallons
of oil have leaked into the Gulf of Mexico. This is not the only accident associated with
BP. In 2005, a BP refinery located in Texas exploded, killing 15 employees and injuring
180 additional people. The company was also associated with the 1989 Exxon Valdez oil
spill in Alaska. BP held a controlling interest in the Alaskan oil consortium, which was
largely responsible for the cleanup effort, and heavily criticized for errors. In reference to BP’s accident record, Rep. Joe Barton stated that BP has created a “corporate culture of seeming indifference to safety and environmental issues” (Mauer, 2010).

Statement of the Problem

Following the IAEA report, research on corporate safety culture proliferated. As a result of the hypothesized predictive power of corporate culture, managers, consultants, engineers, psychologists and industrialists, all working with different theoretical backgrounds, were interested in the far reaching impact of the construct. Although this common interest increased the relevance and study of corporate culture, it did not allow for the development of a systematic examination of the construct. These early investigators agreed on the influence of culture but were unable to unanimously support a single conceptualization or definition. Due to the diverse occupational and theoretical circumstances, the literature on culture became disorganized, lacking in consistent theory. Today, the research remains chaotic as investigators continue to debate interpretations of corporate culture (Pidgeon, 1998).

Justification of the Study

Literature consistently demonstrates a relationship between corporate culture and organizational growth and performance (Deshpande, Farley, & Webster, 1993; Miron, Erez, & Naheh, 2004; Ogbonna & Harris, 2000; Prather, & Turrell, 2002). However, the various theoretical positions of different investigators limit the interpretability of these findings. It becomes challenging to comprehend the results of any given assessment of
corporate culture because every measure takes a different perspective. Moreover, common quantitative measures of corporate culture deviate from the construct of culture and unintentionally assesses corporate climate.

The creation of a single measurement tool that is built on a solid theoretical foundation, and pointedly assesses corporate culture would be extremely valuable. The corporate executive could then use the measure to gain a comprehensive understanding of the state of his/her company’s culture. This would be especially be important in the measurement of safety culture, as the repercussions of a poor safety culture can be dire (Hopfl, 1994; Reason, 1990).

By unifying the research into a single, comprehensive measure, this study will enable executives to predict and avoid company disasters. As opposed to identifying culture problems after the occurrence of large-scale accidents, as has been shown in the case of BP and Compania Minera San Esteban, companies will have the ability to identify problems in safety culture prior to accidents. The use of a valid and reliable comprehensive measure of safety culture could save the lives of employees and increase productivity.

Research Questions

1) Will the hypothesized three factor structure used to select items for the Corporate Safety Culture Scale fit the data better or worse than the empirically derived factor structure, and the modified empirical factor structure?
i. Utilize exploratory factor analysis to derive the empirical factor structure.

ii. Use confirmatory factor analysis to develop the experimental model.

iii. Use confirmatory factor analysis to build the empirical factor model.

iv. Improve the fit of the empirical factor structure by consulting theory and the modification indices produced by confirmatory factor analysis. Then use confirmatory factor analysis to build the modified empirical factor structure.

v. Compare the model fit of the empirical, modified empirical, and experimental structures.

2) Will the developed Corporate Safety Culture Scale be a reliable measure of corporate safety culture?

   a. Evaluate the Cronbach’s Alpha values of the full measure and each identified domain.

3) Will the developed Corporate Safety Culture Scale be a valid measure of corporate safety culture?

   a. Evaluate frequency of safe behaviors by assessing the responses to the following question: “I received a performance documentation form for using good safety practices during the past 12 months.”

       i. Question has three answer choices: “Yes,” “No,” and “Not Sure.”
b. Use one-way between group analysis of variance to evaluate the relationship between answers to the behavioral frequency question and scores on the CSCS.

c. Complete a post hoc analysis using Tukey’s HSD to assess the relationship between safety behavior and scores on the full CSCS and each identified domain.
Definition of Major Concepts

Workplace accidents: Defined as unanticipated occurrences that are preceded by unsafe behaviors or conditions (DiBerardinis 1999).

Corporate Culture: “The product of individual and group values, attributes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization’s health and safety management” (Lee, 1996).

Corporate Climate: “A set of characteristics that describe an organization and that (a) distinguish the organization from other organizations, (b) are relatively enduring over time, and (c) influence the behavior of people in the organization” (Forehand & Gilmer, 1964).

Meaning Systems: Underlying mental constructions that allow for the interpretation and understanding of how daily events fall into an individual’s personal narrative.

Values: The fundamental moral expectations that an individual uses to appraise daily events.

Behavioral Expectations: The activities that are anticipated as part of an individual’s employment responsibilities.
Summary

This chapter introduced the problems associated with workplace accidents. It discussed the physical, psychological and financial setbacks that can be created by critical incidents in the workplace. Corporate safety culture was identified as a critical component of safety and accident prevention in corporate environments. The chapter explained that current corporate culture literature is unorganized and lacking in consistent theory. It noted that current measurement tools are dissimilar and do not adequately measure corporate safety culture. The importance of a new measurement tool was discussed. The chapter concluded by delineating the research questions of the current project.
CHAPTER 2

REVIEW OF THE LITERATURE

In common managerial argot, the terms culture and climate are often misused and misinterpreted. Executives frequently refer to culture in reference to an organization’s environment, mood, or feel, yet these organizational factors are more closely related to climate than culture. Organizational culture references an underlying quality that impacts productivity, structure, strategy and climate within an organization. Despite its recent surge in popularity, culture is an illusive construct that is rarely considered. For example, many managers in high risk industries hope to enhance the safety of their organizations. They proactively work to modify their facilities, guidelines, mission statements and reward programs. However, very few consider how cultural assumptions about individual success, responsibility, and masculinity may be thwarting their efforts toward a safer work environment (Schein, 2000). It is clear that defining culture and climate, and understanding the difference between the two concepts is critical to any evaluation of corporate culture. The following section discusses the etiology and definition of each construct.

Corporate Culture and Corporate Climate

Climate
The notion of corporate climate was first identified in the 1950’s and 1960’s as school researchers considered the psychological effects of diverse educational settings (Hoy, 1990). They were particularly interested in uncovering the educational benefits of different teaching environments, and worked to define and measure different aspects of educational atmospheres (Halpin & Croft, 1963). This initial interest in environments was appreciated by investigators working in large businesses, that believed climate could explain the long-term characteristics of any work environment (Hoy, 1990). In 1964, Forehand and Gilmer defined corporate climate as “a set of characteristics that describe an organization and that (a) distinguish the organization from other organizations, (b) are relatively enduring over time, and (c) influence the behavior of people in the organization.” Similarly, Taguiri (1968) drew a connection between personality traits and an organization’s climate. The author explained that “a particular configuration of enduring characteristics of the ecology, milieu, social system and culture would constitute a climate, as much as a particular configuration of personal characteristics constitute a personality” (Taguiri 1968 p. 23, as cited in Hoy, 1990).

Culture vs. Climate

Research on corporate climate proliferated because it was understood to be a critical construct that could influence employee behavior (James & Jones, 1974). As the concept matured through research, investigators began to identify a distinction between the characteristics, behaviors and feelings that are universally supported by an organization’s workforce, and the values and beliefs held by most of an organization’s employees (Ekvall, 1983). This recognition of difference led to the identification of
corporate culture as opposed to corporate climate. Globally, corporate climate refers to the overt characteristics of an organization’s environment, while corporate culture references the underlying values and beliefs of a given organization (Guldenmund, 2000). It is clear that the constructs of corporate culture and corporate climate are not mutually exclusive. In fact, they are inter-connected, influencing one another as a company grows and works through challenges (Schien, 2004).

Culture

With the identification of culture as an important construct, corporate leaders, researchers, managers, and the general public began to develop an interest in the possibility of creating an organizational culture that influenced employees to behave in a desired manner. This fascination with culture was fueled by the publication of Theory Z: How American Business Can Meet the Japanese Challenge (Ouchi, 1981). This well-received management work suggested that American corporations could increase productivity by adopting Japanese management practices. Specifically, the author referred to an organizational shift that would carry a more collectivistic culture, characterized by long-term job security, responsibility, group work, and cautious promotion and evaluation practices (Ouchi, 1981).

Similarly, Peters and Waterman’s work, In Search of Excellence: Lessons from American’s best run companies (1982) became a seminal management book that discussed business from a more flexible perspective. As opposed to focusing on productivity alone, the authors suggested that managers reduce bureaucratic control, focus on customers, facilitate entrepreneurship, value low-paid employees, centralize
company values and maintain a committed management team (Peters & Waterman, 1982).

As the construct of corporate culture entered the awareness of the general population, research on the topic proliferated. Investigators with different occupational and theoretical backgrounds began exploring the impact of culture, finding that positive cultures correlate with positive financial outcomes (Denison, 1990; Kotter & Heskett, 1992). Although researchers agreed on the value of culture, their fundamental theoretical differences led to variant definitions of the construct. As a result, the burgeoning research continued to expand without a solid theoretical foundation. Today, the literature remains theoretically disorganized (Pidgeon, 1998; Schien, 2004). In an effort to describe the unsystematic mass of literature, several investigators have created large, all-inclusive, models of corporate culture. In the following section models created by Keesing, Allaire and Firsrotu, and Schein are described.

Theoretical Perspectives of Corporate Culture

*Keesing*

Keesing (1974) showed that conceptualizations can be placed in two broad categories, those that perceive culture as a component of a social system, *sociocultural*, and those that view culture as a more independent, *ideational*, construct. The author indicated that the ideational theories posit that culture is created in the minds of employees. Conversely, Keesing noted that the sociocultural theories suggest culture is
generated in the environment, through interpersonal behaviors and corporate circumstances (Keesing, 1974 as cited in Allaire & Firsio, 1984).

Allaire & Firsio

Allaire & Firsio (1984) also provided a detailed explanation of culture, which worked to combine and explain previous conceptualizations. The authors noted that organizational culture is composed of three interconnected components: the sociocultural system, the cultural system, and the individual actors. Allaire and Firsio explained that the sociocultural system refers to the official structures and policies of a work environment. They provided examples of a corporation’s goals, job hierarchy and management procedures. The cultural system was described as an organization’s “expressive and affective dimension in a system of shared meaningful symbols manifested in myths, ideology and values” (Allaire & Firsio, 1984). They noted that the cultural system is influenced by the environment in which an organization exists (e.g. history, society, economy). The individual actors category refers to the employees of an organization, who actively interpret and influence the culture. Allaire and Firsio explained that employees are particularly significant because their interpretations of events lead to the development of culture. Allaire and Firsio went further to explain that each of the categorizations of culture interact and influence one another (Allaire & Firsio, 1984).

Schein

Schein, (2004) also worked to condense the literature by describing culture in three interacting levels. The first level, Artifacts refers to the observable characteristics
of an organization. This includes the language used, the facilities, the dress code, and any other tangible quality that can be quickly observed. The second level, espoused beliefs and values, describes shared ideas of people working within the organization. As a company grows and overcomes challenges, its employees learn from the growth and develop long lasting values and beliefs. The third level, labeled underlying assumptions, refers to core assumptions that are universally supported within a corporation. Schein explained that these assumptions are supported so often that employees are unable to consider a different thinking pattern (Schein, 2004).

The models presented by Keesing, Allaire and Firsirotu, and Schein are important in understanding the challenge of describing corporate culture. Each author struggled to provide an all-inclusive explanation of culture, while simultaneously providing specific details that maintain the integrity of the construct. The difficulty inherent in describing corporate culture lies in the need to honor the breadth of the topic while upholding a level of specificity that maintains the construct’s significance (Coffey, 2010). Definitions that are too broad run the risk of missing the particular characteristics of culture. Examinations that are too narrow miss the larger picture. Many researchers have attempted to produce an accurate explanation of corporate culture. However, it is clear that limitations can be found in each proposed definition. For a review of recent definitions of corporate culture please see Table 1.
Table 1  \textit{Definitions of Corporate Culture}

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<td>‘the totality of the learned and shared patterns of belief and behavior of a human group.’</td>
<td>(Aceves &amp; King, 1978)</td>
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<td>‘learned behavior copied from one another.’</td>
<td>(Steadman, 1982)</td>
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<tr>
<td>‘the way we do things around here.’</td>
<td>(Deal &amp; Kennedy, 1982)</td>
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<td>‘means that total body of tradition borne by a society and transmitted from generation to generation. It thus refers to the norms, values and standards by which the people act, and it includes the way distinctive in each society of ordering the world and making it intelligible.’</td>
<td>(Murphy, 1986)</td>
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<td>‘the patterned behavior and mental constructs that individuals learn, are taught, and share within the context of the group to which they belong.’</td>
<td>(Whitten, &amp; Hunter, 1987)</td>
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<td>‘a set of shared ideals, values, and standards of behavior; it is the common denominator that makes the actions of individuals intelligible to the group.’</td>
<td>(Haviland, 1993)</td>
</tr>
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<td>‘in its most basic form is an understanding of “the way we do things around here.” Culture is the powerful yet ill-defined conceptual thinking within the organization that expresses organizational values, ideals, attitudes and beliefs.’</td>
<td>(Cunningham &amp; Greso, 1994)</td>
</tr>
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<td>‘consists of “learned systems of meaning, communicated by means of natural language and other symbol systems, having representational, directive, and affective functions, and capable of creating cultural entities and particular senses of reality.”’</td>
<td>(D’Andrade, 1996)</td>
</tr>
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<td>‘the learned patterns of behavior and thought characteristic of a societal group.’</td>
<td>(Harris, 2004)</td>
</tr>
<tr>
<td>‘We will restrict the term \textit{culture} to an ideational system. Cultures in this sense comprise systems of shared ideas, systems of concepts and rules and meanings that underlie and are expressed in the ways that humans live. Culture, so defined, refers to what humans learn, not what they do and make.’</td>
<td>(Kessing &amp; Strathern, 1998)</td>
</tr>
</tbody>
</table>
When reviewing the different conceptualizations of corporate culture, it is clear that commonalities exist throughout. Specifically, the terms ‘thoughts,’ ‘beliefs,’ ‘meaning,’ ‘values,’ ‘learning,’ and ‘behavior’ are repeatedly mentioned. However, the definitions undoubtedly hold distinct differences. Many focus on behavior and norms, while others center on personal ideals. Each characterization describes an aspect of culture, but there is no single description that combines the critical components of each definition.

**Proposed Model of Corporate Culture**

In an attempt to fill this gap in the literature, the current project aspired to develop a measure of corporate culture that combined major themes of previous instruments. Specifically, culture was described as the sum of the *Values, Meaning systems* and *Behavioral expectations* that exist within a corporation. Each domain was anticipated to hold an equal role in the assessment of corporate culture.

Many of the aforementioned measures of corporate culture hold a *values or beliefs* component. For the current project, this domain was designed to address the basic moral expectations that employees use to assess daily events. The assessment of values is

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| ‘the set of learned behaviors, beliefs, attitudes, values, and ideals that are characteristic of a particular society or population.’ | (Ember & Ember, 2001) |
| ‘All aspects of human adaptation, including technology, traditions, language, and social roles. Culture is learned and transmitted from one generation to the next by nonbiological means.’ | (Jurmain et al., 2000) |
| (As described in Coffey, 2006) |
important because they have been shown to motivate and influence behavior (Verplanken, & Holland, 2002).

The Meaning systems category was intended to describe the underlying mental constructions that influence an employee’s perception of how events fit into their personal narrative. Meaning systems are very challenging to assess. However, the abstract construct is considered a central component of organizational culture. The way an individual interprets their personal narrative has a significant role in their behaviors, affect and psychological well-being (Frankl, 1963; Ryff, 1989).

The Behavior domain was included because it is an easily measured construct that can provide clues about the characteristics of the ultimate culture. Many current culture scales include behavior-related domains. This feature is significant because it reflects the more tangible aspects of corporate culture. A pictorial representation of the author’s model of corporate culture can be seen in Figure 1.
The value of the proposed model lies in integration of shared meaning systems. To this author’s knowledge, meaning systems have been considered by numerous researchers (D’Andrade, 1996; Geertz 1973; Kessing & Strathern, 1998), but never considered as part of a global model alongside values and behavioral expectations.

Typically, meaning (D’Andrade, 1996; Geertz 1973; Kessing & Strathern, 1998) and values (Aceves & King, 1978; Cunningham & Gresso, 1994; Murphy, 1986) are considered in unassociated models or in a single model as one catch-all factor. It is
possible that researchers reject the simultaneous inclusion of both constructs in an effort to avoid redundancy. This is seen as a critical mistake. Though meaning and values are related, they refer to distinct human experiences. The inclusion of shared meaning systems and values along with behavioral expectations makes the current model of corporate culture unique, and more comprehensive than earlier conceptualizations of culture. The subsequent sections will describe each of these three domains and explain the related work of previous researchers.

Hypothesized Domains

*Meaning Systems*

Researchers believe all humans carry unique cognitive orienting systems (global meaning systems) that influence the way they understand themselves, interpret experiences and develop self-perceptions. These orienting systems are created over time, as individuals continually identify patterns and themes in daily events (Park and Folkman, 1997). This process has strong implications in the occupational setting. Employees enter the work environment with preexisting orienting systems. However, these meaning systems are eventually modified to fit the work environment. If all employees experience events at work in a similar way, they develop similar meaning systems. In this project, these common meaning systems are identified as “shared meaning systems.”

The development and impact of shared meaning systems may be best described in the following hypothetical example. If a male employee is raised in a misogynistic
family, he may consider men to be better workers than women. At work, if a female coworker is praised for her impressive work ethic and attention to detail, the male’s preexisting meaning system will be challenged. If the work environment consistently validates the skill of women, he will be forced to adjust his global meaning system over time. This will change the way the male employee perceives himself and his female counterparts. This will lead him to interact more genuinely with his female peers. If other employees have a similar experience, a shared meaning system that reflects a feminist ideology will develop.

In the above example, the change in the shared meaning system improves gender cohesion and likely increases productivity. Due to the power of meaning systems, many researchers have considered the value of the meaning in culture research. The perspectives of Clifford Geertz, and Karl Weick are discussed below.

*Clifford Geertz*

Clifford Geertz was well known for describing culture as an ordered system of meaning. Geertz’s explained that every aspect of human existence is controlled and supported by an underlying meaning. He believed this fundamental meaning system was the totality of culture. Geertz’s accepted the difficulty of studying meaning/culture, and suggested that the construct be evaluated through a review of artifacts. Geertz noted that artifacts of existence, such as human relationships, celebrations, and accomplishments, survive as observable indicators of meaning/culture. (Geertz, 1973; Haukelid, 2008).
Karl Weick

Karl Weick believes meaning making is a central process in all business practices. In his 1995 publication, *Sensemaking in Organizations*, Weick noted that the human process of sense making, defined as a human practice of assigning meaning to experience, repeatedly occurs in organizations. The author posited that any event which transpires within an organization becomes framed in a context of meaning as employees continually appraise their physical surroundings and social environments in an effort to understand a global purpose. Weick suggested that this meaning making process is not passive. In addition to finding meaning as they are confronted by daily events, employees also consider a universal meaning as they actively make short and long-term decisions (Weick, 1995).

Values

The importance of the values construct is two fold. First, the operation of a large organization is dependent on the reliable behavior of employees presenting with varied histories and experiences. In order for a diverse group of people to successfully connect with each other and with the company, they must hold similar values and beliefs. This connection and similar focus is central to culture. Second, values are known to directly influence behavior (Schien, 2004). The control of employee behavior is often an ultimate goal of corporate executives. In fact, culture is important because it is known to influence behavior. Because values are seen as a strong link between culture and behavior. The study of values has been a central component of many culture projects. The views of Edgar Schein and Benjamin Schneider are briefly outlined below.
Edgar Schein

Edgar Schein (2004) describes culture as a pattern of shared beliefs that are developed and learned as a company overcomes periods of difficulty. When confronted with challenges, a group must prevail, or fall short. Companies that prevail find value in their achievements and develop a culture that supports successful behaviors. When new members join the organization, they are quickly taught previously successful approaches to thinking, feeling and behaving. Conversely, companies that do not overcome challenges are not likely to duplicate the negative behavior. As a result, they do not develop a strong culture. Schein notes that this understanding of culture explains why changing culture is difficult. Companies that have found success, are not likely to abandon a culture of success for untried approaches to business (Schein, 2004).

Benjamin Schneider

Benjamin Schneider shared that culture is best defined as a system of beliefs. In 1975, the author explained that the structure of an organization is valuable because it influences the way employees perceive their roles. It changes their perspective and adjusts their belief systems (Schneider, 1975). In 1996, Schneider, Brief, and Guzzo discussed the connection between beliefs, values and culture. The authors explained that “a good way to think about the culture of an organization…is to focus on what the people in the organization worship.” They share that this focus on worship points to the corporation’s values and beliefs, which are created by culture (Schneider, Brief, & Guzzo, 1996).
Behavioral Expectations

Researchers are interested in the study of culture because they believe the construct has the power to influence behavior. They are invested in the enhancement of employee performance. The relationship between behavior and culture suggests that behavioral expectation is a component of culture. In addition to being a desired outcome variable, behavior is closely related to both meaning systems and values.

Humans are thought to seek congruence between their values and systems of meaning, and their behaviors. Consequently, behaviors are heavily influenced by these constructs (Schein, 2004; Weick, 1995). For example, individuals that value fidelity are less likely to cheat on their partners. Similarly, people that find meaning in their physical fitness are more likely to exercise. The significance of behavior is well known in the study of culture. Since behavior can be easily observed and quantified, its influence has been evaluated by numerous investigators. Below, the views of Marvin Harris, and Terrance Deal and Allan Kennedy are highlighted.

Marvin Harris

Marvin Harris rejects the notion that culture must be interpreted as a collection of values or meaning systems, or any other learned categorization. In fact, the author reports that these additional considerations complicate the study of culture. Harris states that culture should only be seen from a behavioral perspective. “The culture concept comes down to behavior patterns associated with particular groups of peoples, that is, to “customs,” or to “people’s way of life” (Harris, 2001). In this way, Harris worked to simplify the study of culture. As an anthropologist, Harris supports his perspective by
explaining that for years, anthropologists have thoroughly studied culture without consideration for values, and meaning (Harris, 2001; Harris, 2004).

Terrance Deal & Allan Kennedy

Terrance Deal & Allan Kennedy are well know for describing corporate culture as “the way we do things around here” (Deal & Kennedy, 1982; Schein, 2004). Though the authors explain that culture is an ethereal construct that involves meaning, values, and beliefs, they report that culture is best understood through an assessment of behavior. For example, they argue that a company’s rituals and ceremony’s can provide outstanding insight into the company’s culture. Deal and Kennedy take interest in how members of a company behave on a continual basis and how they interact during celebrations. They provide an example of physicians washing their hands for seven minutes prior to surgery. This ritual is unnecessary as germs are eliminated after 30 seconds of scrubbing. The authors explain that this routine procedure reveals a culture focused on safety (Deal & Kennedy, 1983).

In addition to focusing on celebrations and rituals, Deal and Kennedy suggest that culture can be identified through an evaluation of a corporation’s heroes and heroines. Most companies have employees or executives that are idolized as the perfect employee. A review of these individuals’ behaviors can help illuminate the culture of the company. As an example, Deal and Kennedy point to IBM’s Tom Watson and GE’s Charles Steinmetz, both of whom passed away long ago. Each of these individuals remain highly regarded in their respective companies, as currently employees continue to emulate there behaviors (Deal & Kennedy, 1983).
Corporate Safety Culture

Creating a model of corporate culture is important because it informs the assessment process. With effective measurement, executives can evaluate their companies, identify any weaknesses in culture, and make necessary changes. The ability to identify limitations in operation is significant for any organization, but it is especially important in companies working in high risk industries. Companies working in high-risk industries, including mining, agriculture (fishing and forestry), construction, transportation, wholesale trade and manufacturing, are constantly concerned with safety related issues (Katz-Navon, Navah, & Stern, 2005). For companies in these industries, a strong corporate safety culture is of paramount importance.

Empirical research validates an interest in safety culture, as investigators have shown repeatedly that a robust culture of safety significantly reduces the overall risk of workplace accidents. For example, in 1997 Judith Erikson completed a nationwide study on the impact of corporate culture on safety performance. Using a survey to evaluate the perceptions of employees, Erikson showed that when an organization’s management team works to implement a culture of safety, safety performance and employee health improve (Erickson, 1997).

These results were corroborated by Shannon, Mayr and Haines, (1997) who reviewed the conclusions of ten studies that evaluated the connection between safety and workplace factors. The authors’ analysis was comprehensive, as each study included in the review had assessed at least 20 separate occupational settings. Shannon, Mayr and Haines identified workplace factors that were significantly correlated with injury rates.
The significant factors fell under the following 4 headings: 1) Joint health and safety committees, 2) Management style and culture, 3) Organizational philosophy, and 4) workforce characteristics. The authors synthesized the results by identifying variables that were significantly correlated with injury rates in at least 66% of the reviewed studies. Safety culture and management style, though influential in each of the assessed factors, was explicitly shown to be a significant predictor of reduced injury rates in 100% of the studies evaluating this relationship.

In 2002, Michael O’Toole added to the literature by evaluating a large mining and construction firm that altered its approach to safety in the year prior to the data collection. The firm had made a change from a culture “driven by compliance to one driven by doing the right thing to prevent accidents and injuries to employees” (O’Toole, 2002). By evaluating the employees’ perceptions of the management’s devotion to safety, and recording accident rates over a two year period, the author was able to identify a trend of safety. Specifically, the subject company experienced a significant reduction in their OSHA Lost Time Injury Rate. O’Toole, suggested that the decline in injury rates were directly related to the company’s shift in safety culture (O’Toole, 2002).

Theoretical Perspectives of Safety Culture

As a characteristic of corporate culture, the construct of corporate safety culture carries the same weaknesses. Researchers greatly value the construct, but differences in conceptualization and theory prevent the development of a universally supported definition of the construct. This theme was shown in Guldenund’s (2000) review of
safety culture and safety climate definitions. The author identified seven published
definitions of safety culture, all of which were slightly different (Guldenund, 2000).
Significantly, the variation in the reviewed definitions matched the range of factors
suggested in the current project’s model of corporate culture.

Specifically, three definitions centered around values: a) “the attitudes, beliefs,
perceptions, and values that employees share in relation to safety” (Cox, & Cox, 1991),
b) “Set of beliefs, norms, attitudes, roles, and social and technical practices” (Pidgeon,
1991), c) “Assembly of characteristics and attitudes in organizations and individuals”
that the organization’s beliefs and attitudes are manifested in actions, policies, and
procedures (Ostrom, Wilhelmsen, & Kaplan, 1993), b) The product of individual and
group values, attitudes, perceptions, competencies, and patterns of behavior (Lee, 1996).
Finally, two definitions pointed to the importance of meaning systems: a) “Everyone feels
responsible for safety and pursues it on a daily basis (Geller, 1994), b) “the collective
mental programming towards safety of a group of organization members (Berends,
1996).

Measurement of Corporate Culture

Given the allusive nature of corporate culture, it is no surprise that measurement
of the construct is limited by methodological inconsistencies. As researchers attempt to
measure corporate culture, they are confronted by significant challenges. To start, they
must support a single conceptualization. As was previously mentioned, this process can
be very difficult as the diverse theoretical perspectives have led to a proliferation of various conceptualizations of corporate culture.

After choosing a theoretical position, researchers must select between qualitative and quantitative measurements. This is a highly debated issue in the study of corporate culture. Many researchers advocate for quantitative measurement through the use of questionnaires. This approach to measurement is valued because it allows for the quick and cost-effective assessment of sizable groups of people (Guldenmund, 2007). When working with large corporations, self-administered questionnaires save resources. The same questionnaire can be completed simultaneously by numerous participants and quickly scored by a single investigator. Moreover, this approach encourages a high level of consistency in scoring. When using choice-limited response formats, subjective interpretation is eliminated. Another benefit of quantitative measurement is the ability to acquire instant results, which can allow researchers to “produce medians or means, compare subgroups and benchmark these” (Guldenmund, 2007).

Despite the advantages of quantitative measurement, many corporate culture experts support the use of qualitative assessments (Guldenmund, 2007; Denison, 1996). Guldenmund (2007) explained that the use of surveys is problematic because corporate culture is a construct that is shared by employees. The author noted that

“in survey research, one is caught between the theoretical demands of statistics (heterogeneous normally distributed variables around a single mean obtained from a large population) and the theoretical requirements of culture ([strong] convictions shared by groups or categories of people, which are small enough to interact and create a culture about safety or any other related topic)” (Guldenmund, 2007).
More simply stated, statistical theory requires a large and diverse sample that comes in opposition to corporate culture, which is created in smaller, homogeneous populations.

Guldenmund’s reservations about the use of quantitative methods have been echoed by other investigators, who believe quantitative surveys do not accurately assess the culture. These researchers argue that surveys usually address characteristics, behaviors, and feelings associated with an organization. However, they do not consider the participant’s underlying values and meaning systems. Essentially, most current culture assessments measure climate, as opposed to culture (Denison, 1996; Mearns, Whitaker, & Flin, 2001).

Culture Measurements Evaluated

Because the logistical advantages of quantitative measurement (time, money, ease) are overwhelming, the purpose of the present project is to design an effective survey-based quantitative measurement tool. The aspiration to develop a successful quantitative measure of corporate safety culture is important because very few measures of corporate culture and corporate safety culture exist. Those that are available for use are theoretically limited and statistically weak. The following section describes the most well-known corporate culture and corporate safety culture surveys. This review is intended to inform the development of a new theory-based measure that more accurately assesses safety culture.
Organizational Culture Inventory

The Organizational Culture Inventory (OCI) is a measure designed to evaluate a corporation’s work-related behavioral norms across 12 organizational styles. 120 items are used to assess the expectations across the following categories: “humanistic-encouraging, affinitive, approval, conventional, dependent, avoidance, oppositional, power, competitive, perfectionistic, achievement, and self actualizing” (Alexander, 1990). The OCI is considered a unique test because it purports to measure a participant’s interpretation of their company’s culture, as opposed to the participant’s own thoughts and behaviors. This difference in focus is believed to decrease personal bias and thus make the measure more valid.

In addition to evaluating the style characteristics of the assessed corporation, the OCI also identifies the corporation’s culture across the following culture categories: Constructive, Passive/defensive, and Aggressive/Defensive. The results of the culture categorization are used to provide information about the reviewed organizations’ strengths and weakness. Specifically positive outcomes are associated with constructive cultures, while negative results are said to be related to the passive/defensive and aggressive/defensive categories. The conclusions of the measure are cataloged in a culture profile that is easy for a consumer to review and understand (Alexander, 1990). The validity of these outcomes, with respect to organizational safety, are indeed unknown (Alexander, 1990).

The OCI appears to have two major strengths. First, the test evaluates the perceived culture of the company, as opposed each individual participant’s personal
thoughts and behaviors. Second, the test produces a comprehensive explanation of a studied company’s culture profile, which can be used help the company’s executives improve upon their organization.

That said, the measure holds several limitations. First, the test creators have not published any clear findings associated with the reliability or validity of the measure. This lack of statistical support drastically limits the value of the measure. Similarly, no explanation is provided regarding the selection of the three culture clusters or the 12 style categories. It is unknown if these groupings have theoretical underpinnings.

Denison organizational culture survey

The Denison Organizational Culture Survey (DOCS) was developed by Denison, a consulting firm based in Ann Arbor Michigan. Denison is well-known for their specialization in executive coaching, corporate culture assessment and corporate culture improvement. The foundation for all of Denison’s work is the “Denison Model,” a conceptual model of an organization’s cultural-based characteristics. The company reports that each of the Denison Model’s four global characteristics, (Mission, Adaptability, Involvement and Consistency) must be maximized for a company to operate effectively. Within each general characteristic, the Denison model includes three trait indicators. Specifically, the Mission trait is indicated by: strategic direction and intent, goals and objectives, and vision. The Adaptability characteristic is designated by: creating change, customer focus, and organizational learning. The Involvement quality is composed of: empowerment, team orientation and capability development. Finally, the
Consistency trait is indicated by: core values, agreement, coordination and integration (Denison, 2010).

The DOCS is used to evaluate the 12 separate indices, which are measured via 60 items. After the test has been completed by employees of a reviewed organization, the scores are aggregated and compared to the norming sample. A final report provides percentile scores, which show the percentage of the organizations in the normative group that scored lower than the reviewed organization. With this information, an executive team can make informed decisions about their corporation’s culture (Denison, 2010).

The DOCS clearly has many positive qualities. Perhaps most significant is the applicability of the model for companies working in diverse settings. The consulting company has experience using the test with over 1000 organizations operating in numerous industries. The results of the test are comprehensive and easy to understand. The limitations of this measure fall on its conceptual foundation. Although the Denison Model completely describes organizational characteristics, only one of the indices (values) addresses corporate culture. With this foundation, the DOCS seem to be more of a climate survey than a culture survey. It is also important to note that, to this author’s knowledge, Denison has not published any data regarding the DOCS’s reliability or validity.

Safety Culture Measures Evaluated

Many researchers use general organizational culture surveys without considering industry characteristics. It is clear, that the previously described surveys contain no
reference of safety culture. This is problematic because safety culture carries industry-specific characteristics. Accordingly, it is likely the construct is best measured by safety culture inventories. The following section will discuss the three most commonly used safety culture instruments.

*Safety Culture Survey (SCS)*

The Safety Culture Survey (SCS) was designed by Safety Performance Solutions (SPS), a consulting organization that specializes in helping other companies acquire a “Total Safety Culture.” SPS explains that a total safety culture requires the identification of barriers to safety performance. Accordingly, SPS created the SCS to act as a tool for the discovery of cultural characteristics that thwart safety performance. The SCS is specifically designed to evaluate employee’s perceptions of a reviewed company’s safety culture. It is a 93-item measure, which questions employees about numerous aspects of the current safety culture: 1) management support for safety, 2) peer support for safety, 3) personal responsibility, 4) discipline, 5) incident reporting and analysis, 6) safety rules, regulations, and procedures, 7) training, 8) safety suggestions and concerns, 9) rewards and recognition, 10) safety audits and inspections, 11) communication, 12) employee engagement, 13) safety meetings and committees, 14) miscellaneous (Safety Performance Solutions, 2010).

Once completed, the results of the SCS are compiled and compared to the norming sample. Currently, the SCS carries a norming sample of approximately 200,000 employees from hundreds of companies that have previously utilized the measure. This
enables SPS to accurately describe a company’s current safety culture performance (Safety Performance Solutions, 2010).

The SCS is a strong assessment that has been normed on a very large sample. It is user-friendly and easy to interpret. The greatest strength of the survey lies in its domains. With 14 separate domains, this test considers a large range of company characteristics. Although the SCS carries many strengths, it is also limited in its evaluation of culture. The extensive domain list is designed to assess a company’s current safety environment, which best fits the definition of climate. There are no domains that directly address meaning or values.

**Safety Culture Values and Practices Questionnaire (QCS)**

The QCS is an intricate measure that uses a double-pronged approach to assess corporate safety culture. First, QSC uses a competing values framework to describe a reviewed organization’s orientation towards safety. This process ranks the organization across the following values: human relation or support, open system or innovation, internal process or rules and rational goals or goal models. The test creators explain that each of these orientations exist within all companies, but the different degrees of their presences can provide insight into the safety of the organization (Diaz-Cabrera, Hernandez-Fernaud, & Esla-Diaz, 2007).

In addition to identifying a reviewed company’s orientation towards safety, the QSC also evaluates an organization’s safety practices across seven dimensions. The seven dimensions are described as foundational components of safety culture. The dimensions are: 1) training program content, 2) incident and accident reporting systems,
3) orientation of safety rules and procedure, 4) performance appraisal and safety promotion strategies, 5) motivation patterns used, 6) information and communication systems, and 7) leadership styles (Diaz-Cabrera, Hernandez-Fernaud, & Esla-Diaz, 2007).

The strength of the QCS lies in its detailed approach to safety. By evaluating a company’s culture, in addition to dimensions of safety, the measure endeavors to provide a comprehensive view of a given organization’s safety orientations. However, the limitation of this measure is found in the specific categories of culture. The QCS’s competing values framework provides insight into the level of value within an organization. However, the specific categories do not present a full picture of culture. The domains are very specific, ignoring the role of meaning and focusing largely on tangible aspects of the corporate climate.

Safety Culture Indicator Scale Measurement System

The Safety Culture Indicator Scale Measurement System (SCISMS) is a safety culture survey designed for use in high risk industries. Most recently, the test has been widely used in the aviation industry. The test uses a four-factor model, including: 1) organizational commitment, 2) formal safety indicators, 3) operations interactions, and 4) informal safety indicators. Combined, each of these factors is purported to identify the strengths and weaknesses of an evaluated organization. In an effort to increase the measurability of the modes, each factor carries three concrete dimensions. Specifically, organizational commitment is composed of: a) safety values, b) safety commitment, and c) going beyond compliance. Formal safety indicators include the following: a) reporting
system, b) response and feedback, and c) safety personnel. Operations interactions consist of: a) supervisors/foremen, b) operations control/ancillary operations, and c) instructors/training. Finally, informal safety indicators incorporates: a) accountability, b) employee authority, and c) professionalism (Thaden, & Gibbons, 2008).

In addition to the aforementioned factors of safety culture, the SCISMS also carries a correlated factor labeled Safety Behaviors/Outcomes. The authors use this factor, composed of two dimensions: a) perceived personal risk/safety behavior, and b) perceived organizational risk, as an outcome measure. The test creators believe safety culture influences both corporate safety behavior, and perceptions of risk (Thaden, & Gibbons, 2008).

The SCISMS is a powerful tool because it has strong empirical foundations, which were used to identify the measured domains. The specific factors are comprehensive and measurable through the more-tangible sub-categories. Moreover, this survey carries high internal reliability. That said, the measure has the same weaknesses as each of the previously mentioned surveys. It evaluates the concrete categories of safety, but it is not a measure of culture. Culture is a subtle construct that includes behaviors, values and meaning. The SCISMS does not measure these aspects of a reviewed corporation.

*Need for a new survey*

When reviewing the available measures of corporate culture and corporate safety culture, it is clear that the current measures are deficient. Only two of the identified measures hold a domain of corporate culture. These measures, the Safety Culture Values
and Practices Questionnaire, and the Denison Organizational Culture Survey, are still limited in the depth at which it addresses culture. This review highlights the need for an empirically supported measure of corporate safety culture. A review of the evaluated measures can be found in Table 2.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Author</th>
<th>Dimensions</th>
<th>Weakness</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Culture Inventory</td>
<td>Cooke &amp; Lafferty</td>
<td>(a) Constructive, (b) Passive/Defensive, (c) Aggressive/Defensive</td>
<td>1) Theory, 2) No statistical support</td>
<td>No reliability or validity data</td>
</tr>
<tr>
<td>Denison Organizational Culture Survey</td>
<td>Denison &amp; Neale</td>
<td>(a) Mission, (b) Adaptability, (c) Involvement, (d) Consistency</td>
<td>1) Theory (evaluates values, but no other aspect of culture), 2) No statistical support</td>
<td>No reliability or validity data</td>
</tr>
<tr>
<td>Safety Culture Survey</td>
<td>Safety Performance Solutions</td>
<td>a) Management support for Safety; b) Peer Support for Safety; c) Personal Responsibility; d) Discipline; e) Incident reporting; f) Safety Rules Regulations g) Training; h) safety Suggestions i) Rewards and Recognition; j) Safety Audits k) Communication l) Engagement m) Safety Meetings</td>
<td>1) Theory (measures climate)</td>
<td>No reliability or validity data</td>
</tr>
<tr>
<td>Safety Culture Values and Practices Questionnaire</td>
<td>Diaz-Cabrera, Hernandez-Fernau, &amp; Eslada-Diaz</td>
<td>(a) Human Relation or Support, (b) Open system or Innovation, (c) Internal Process or Rules, (d) Rational Goal or Goal Models</td>
<td>1) Theory (measures values, but no other aspect of culture)</td>
<td>No reliability or validity data</td>
</tr>
<tr>
<td>Safety Culture Indicator Scale Measurement System</td>
<td>Thaden &amp; Gibbons</td>
<td>(a) Organizational Commitment, (b) Formal Safety Indicators, (c) Operations Interactions, (d) Informal Safety Indicators</td>
<td>1) Theory (measures climate)</td>
<td>Alpha coefficients = .81-.95</td>
</tr>
</tbody>
</table>
A review of the literature does not uncover a complete or comprehensive measure of corporate culture or corporate safety culture. A perfect measure would include an evaluation of each global domain of culture. To ensure validity, these overarching domains would be empirically supported. In an effort fill the gaps in the literature, the current project is designed to develop a measure of corporate safety culture that considers the overarching domains of culture. These domains have been identified as: Meaning systems, Values, and Behavioral expectations. To satisfy the need for an empirically validated measure, the aforementioned domains will be subjected to statistical tests of reliability and validity.

Analytic Methodology

The purpose of this project is to create a valid and reliable quantitative measure of corporate safety culture. In the modern statistical era, researchers have the ability to use many different statistical techniques when designing measurement tools. The following section will discuss the benefits of factor analysis and explain the difference between exploratory and confirmatory analyses.

Factor Analysis

Factor analysis is an approach to test construction that was initiated by Charles Spearman in 1904 as a tool to aid in intelligence test development. (Spearman, 1904 as cited in Thompson, 2004). The difficulty inherent in intelligence test construction lies in the numerous dimensions associated with the single concept identified as ‘intelligence’ (Gardner, 1999). Prior to Spearman’s work, the design of intelligence tests was limited.
Because researchers were unaware of the particular variables measured by items on prospective tests, they had no ability to ensure parsimonious and thorough evaluations. Spearman responded to this problem by developing the statistical technique now called ‘factor analysis’ (Thompson, 2004).

Factor analysis is a statistical method that allows researchers to identify the latent ‘factors’ that control or influence the variation in several observed variables (Thompson, 2004). For example, a factor analysis of an intelligence test would show that individual respondents typically answer questions related to addition, multiplication, subtraction and division with similar proficiency. Questions associated with reading, vocabulary, spelling and grammar are separately answered with related skill. This ‘grouping’ of variables, identified through factor analysis, would reveal the existence of two separate ‘factors.’ In this example, these latent factors might be math and language respectively.

Factor analysis is critical to the test construction process as researchers are often unaware of the underlying factor structure. Grouping the variables allows investigators to develop theories and better understand measured constructs. In the example above, the researcher would learn that ‘intelligence’ holds the factors of language and a math.

Factor analysis is also beneficial in test construction because it helps researchers identify and improve the validity of a measure. By grouping variables that are answered similarly, factor analysis highlights the items that ‘load together’ and simultaneously draws attention to the items that do not. Items that load together are believed to have an identifiable commonality (Devellis, 1991). This commonality is believed to validate the existence of an underlying factor. Conversely, items that do not load with other items do...
not validate the presence of important factors. Instead, they appear uninfluenced by underlying factors and reduce the validity of the test. By removing these isolated items, a test creator can improve the validity of a measure (Thompson, 2004).

_Exploratory Factor Analysis vs. Confirmatory Factor Analysis_

Two main forms of factor analysis exist: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA is the original and most common form of factor analysis. It does not necessitate any theoretical assumptions or factor-related expectations. EFA allows latent factors to be identified through unbiased statistical analysis. EFA is most useful when researchers are interested in learning more about a given construct and do not have solid theory regarding potential factors (Devellis, 1991; Netemeyer, Bearden, & Sharma, 2003).

CFA on the other hand was more recently developed and requires “specific expectation regarding (a) the number of factors, (b) which variables reflect given factors, and (c) whether the factors are correlated” (Thompson, 2004). For researchers with theories, CFA is often considered more valuable than EFA because the analysis is directed to evaluate the specific theorized factors. This direct analysis, allows a researcher to quantifiably assess the degree of model fit. In general, CFA produces more specific results, though the investigator runs the risk of discovering that the theorize model is grossly inaccurate. When this is the case, the researcher may employ EFA to discover the latent factors (Thompson, 2004). In the present project, both EFA and CFA were utilized. EFA was employed to identify an empirical model and CFA was
employed to develop a experimental model. CFA was then utilized to compare the fit of identified models.

Outcome Measurement

In addition to developing a measure of corporate safety culture, this study also endeavored to evaluate the value and importance of the survey. To assess the relationship between the measure and safety behavior, an outcome variable of behavioral frequency was assessed. This was challenging because, to this author’s knowledge, there were no preexisting measures of safety behavior. Without a validated preexisting test, the most efficient way to measure behavioral frequency as an outcome variable was to assess a single behavioral frequency item with high face validity. The use of untested items to assess an outcome raised some methodological questions. It was possible that the assessed question was invalid, thus limiting the accuracy of the outcome assessment.

Despite these important concerns, extant research reveals that the use of new, simple, face valid questions, can be used to assess research outcomes. Due to the high level of face validity, there is little question about the items’ applicability to assessed outcomes. The following section shows a precedent in test creation literature of the use of this methodological practice.

In a study similar to the present project, Toll, O’Malley, McKee, Salovey, and Krishnan-Sarin (2007) designed a measure of nicotine withdrawal. The authors used CFA to validate the Minnesota Nicotine Withdrawal Scale. In an effort to add validity to the scale, Toll et al. used an outcome measure of smoking behaviors. They did not have a previously created and validated measure of smoking outcomes. Instead, they designed a
behavioral frequency scale, which assessed for smoking frequency (“are you smoking?”). The use of this binary outcome scale is very similar to the methodology used in the current study, as a similarly objective question was asked: “Did you receive a performance documentation form for using good safety practices during the past 12 months?” (Toll, et. al., 2007).

In a comparable project, Witte et. al. designed a measure of suicide risk. After using EFA and CFA to identify the factor structure, the authors evaluated the new measure’s predictive validity. To test validity, Witte et. al. asked binary questions: 1) “Since you called the crisis center, have you tried to kill yourself?” 2) “Have you had any thoughts of killing yourself since you called the crisis line?” These items had not been validated, and were used as outcome measures.

In a unique study, Vitacco and Kosson (2010) validated a measure of interpersonal psychopathology through the use of EFA and CFA. To gain predictive validity, the researchers compared scores on the created test to antisocial personality disorder symptoms (ASPD). The authors did not use a validated measure to assess ASPD. Instead, they used a demographic questionnaire and a semi-structured interview. Although this study does not use a new behavioral frequency scale, it shows that in the development of a measure, it is acceptable to use outcomes measures that are not validated (Vitacco & Kosson, 2010). It is believed that the diagnosis of ASPD through interview is more subjective and less reliable than an evaluation of behavioral frequencies through a fact-based face valid question.
Summary

This chapter distinguished between the concepts of corporate culture and corporate climate. The value of corporate culture and corporate safety culture was discussed. The state of corporate culture theory was exposed. A new model of corporate culture was proposed with Meaning systems, Values, and Behavioral Expectations as the fundamental factors. Current corporate culture and corporate safety culture measures were described. Limitations of content were identified in each measure. Finally, exploratory factor analysis and confirmatory factor analysis was described and evaluation of an outcome measure was discussed.
CHAPTER 3

METHODOLOGY

The present study was designed to create and validate a comprehensive measure of corporate safety culture. This chapter describes the methodology that was used in the development of the Corporate Safety Culture Scale (CSCS). It includes an explanation of the planning, construction, evaluation, and validation of the instrument.

Research Design

The project used factor analysis and structural equation modeling to design and evaluate the CSCS. Exploratory factor analysis (EFA) was used to develop an empirical model. Confirmatory factor analysis (CFA) was employed to present the experimental model, containing the predicted components: Meaning systems, Values, and Behavioral expectations. The model fit of each developed model was assessed and compared. After identifying the model with best fit, the researcher used a one-way between groups analysis of variance to appraise the relationship between safety behavior and scores on the CSCS.

Planning

The development of the CSCS was important because current measures of corporate safety culture are limited in their theoretical foundations. Theorists have used...
myriad definitions to describe corporate culture and corporate safety culture. When reviewing the current definitions, several themes are apparent. Specifically, there is often reference to employee behavior, values, and shared meanings. Though there seems to be some agreement on the importance of these constructs, no single definition of corporate culture includes each of these factors. The development of a theory-based test is also significant because only two identified measures of corporate safety culture are shown to have a theoretical foundation. These measures, the Safety Culture Values and Practices Questionnaire and the Denison Organizational Culture Survey, each hold only one of the aforementioned factors of corporate culture.

Based on the limitations of the existing theories and related measures, the purpose of the current project was to develop a more successful measure of corporate safety culture. In an effort to honor the themes of previous definitions, the present study’s description of corporate culture holds that culture is the sum of organizations’ shared meanings, values, and behavioral expectations.

Participants

Organization

Approximately 41% of all workplace accidents occur during periods of transportation (U.S. Department of Labor, 2010). It is evident that within the transportation industry safety culture is extremely important. Due to the significance of safety in transportation, participants for the current project were recruited from the Colorado Department of Transportation (CDOT).

The Colorado Department of Transportation is a state-run organization that
manages public transportation within Colorado. The CDOT website reports that the
organization manages over “28 billion vehicle miles of travel” annually in the state of
Colorado. Along with controlling the 9144 mile Interstate system, bridges and smaller
roads, CDOT also supports other forms of transportation, including aviation, within
Colorado. Additionally, the department of transportation assists local law enforcement
agencies as they work to improve safe traveling behaviors (Colorado Department of
Transportation, 2011).

From its inception in 1991, CDOT has placed great importance on safety. The
value of safety is revealed in the company’s mission statement: “To provide the best
multi-modal transportation system for Colorado that most effectively and safely moves
people, goods, and information.” To emphasize their desire for a low incident rate,
CDOT lists safety as the first of their six core values (Colorado Department of
Transportation, 2011).

Because safety is critically important to CDOT, the executive team responded
strongly when, in 2009, researchers produced a report on CDOT’s behalf indicating that
the organization recorded more incidents than similar public transportation departments
and comparable private organizations (Chinowsky, & Hallowell, 2009). In an effort to
evaluate the safety-related climate at CDOT, the organization’s safety committee planned
to administer an internally created safety survey that was completed by CDOT employees
in 2006 and 2007. See Appendix C.

CDOT Recruitment
The investigator contacted the Colorado Department of Transportation’s training academy director, via email. The director previously worked with the University of Denver, and openly noted his interest in corporate culture. As a result of his interest in the topic, the training academy director quickly organized a meeting between, himself, the investigator, and a CDOT executive. In the meeting, the CDOT representatives agreed to partner with the investigator on this project in exchange for the results of the study, including feedback and recommendations regarding the organization’s safety culture.

**Individuals**

As was previously mentioned, prior to being contacted by the investigator, CDOT executives planned to administer a safety climate survey that was completed in 2006 and 2007. For the purposes of the present project, CDOT allowed the researcher to add items to the previously created measure to create a shorter test within the larger measure. Specifically, the CDOT survey held a total of seventy questions, twenty-four of which were attributed to the CSCS. The final version of the survey was electronically distributed to all 3,349 CDOT employees. The survey received a strong response rate of approximately 57%. In total 1909 surveys were fully completed.

Although all CDOT employees were asked to complete the survey, only responses provided by a specific group of employees were eligible for analysis as part of the present project. In particular, there were three eligibility requirements for participation in the study. First, in an effort to gain the best perspective on safety, responses provided by participants working in high risk positions were evaluated. Specifically, this included
employees working in divisions of transit and rail, and the maintenance division. Second, participants did not hold managerial positions within their organizations. This requirement was intended to reduce respondent bias. It was believed that higher-ranking employees would be more invested in the outcomes of the study and more aware of efforts made to implement a culture of safety. Lower ranking employees were thought to be less familiar with executive mandates, and thus more likely to accurately describe the safety culture of CDOT. Finally, all evaluated participants were between the ages of 18 and 65. This age limitation was important as it allowed the researcher to assess the most typical segment of employees working in high-risk industries.

Consideration was also given to the participant’s tenure as CDOT employees. It was believed that employees who had been employed for longer periods of time would have a better understanding of the corporate safety culture. However, due to sample size necessities, the investigator was unable to exclude employees with limited tenure at CDOT. Please see Table 3 for tenure statistics

<table>
<thead>
<tr>
<th>Years of Tenure</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>413</td>
</tr>
<tr>
<td>6-10</td>
<td>203</td>
</tr>
<tr>
<td>11-15</td>
<td>130</td>
</tr>
<tr>
<td>21+</td>
<td>64</td>
</tr>
</tbody>
</table>
Prior to commencement of this project, the researcher anticipated measuring the effects of demographic differences amongst the participants. However the CDOT safety committee was unwilling to record demographic information because they deemed the information to be unnecessary. Specifically, they did not allow for the inclusion of questions associated with race, ethnicity, gender, age, SES, or education level. The researcher was forced to accept this limitation. With this restriction, the results must be interpreted with care. They likely only generalize to similar state departments of transportation.

Construction

*Corporate Safety Culture Scale: Item Pool*

This study was completed to create a measure of corporate safety culture. Several steps were followed in the development of the item pool. First, the principle investigator completed a comprehensive review of the literature. The extant literature clearly revealed fragmented research. Corporate culture has been understood through numerous theoretical positions, which has lead to a significant number of diverse instruments. No single instrument was found to bridge the gap between the different theories.

With the goal of creating a more well-rounded and inclusive instrument, the investigator attempted to connect the theories by organizing the research into overarching thematic categories. The following three groupings were identified: shared Meaning systems, Values, and Behavioral expectations. The recognition of three global themes
led to the hypothesis that corporate culture is a large construct that is composed of the previously mentioned three themes, or factors. The factors described above are further defined in Table 4.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaning Systems:</td>
<td>Meaning Systems are underlying mental constructions that allow for the interpretation and understanding of how daily events fall into an individual’s personal narrative.</td>
</tr>
<tr>
<td>Values:</td>
<td>Values represent the fundamental moral expectations that an individual uses to appraise daily events.</td>
</tr>
<tr>
<td>Behavioral Expectations:</td>
<td>Behavioral Expectations refers to the activities that are anticipated within the course of an individual’s employment responsibilities.</td>
</tr>
</tbody>
</table>

Potential items of the CSCS were developed conceptually, following an attempt to create items consistent with the three themes. The author generated approximately 10 items per theme. Then, in conjunction with the dissertation chair the investigator reduced the item pool by eliminating unnecessary items. In total 25 new items were retained, with at least 8 items in each domain. All items were given a six option Likert response format with a continuum ranging from strongly agree to strongly disagree.

Corporate Safety Culture Scale: Cognitive Interviews

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As was recommended by DeVellis (1991), the investigator met with the CDOT executive safety committee to ensure applicability of the survey items. Members of this committee held expertise in safety, culture, risk, survey development, and the transportation industry. All members were high ranking CDOT employees. The committee was composed of members holding the following positions within CDOT: Training Academy Director-Organizational Psychologist, Maintenance Superintendent, Traffic Engineer, Tunnel Superintendent, Risk Management Unit Supervisor, Regional Safety Manager, and Maintenance Superintendent.

During the meeting, the committee read through and discussed the applicability, value, and composition of each item suggested as part of the new measure. The investigator used the recommendations provided by the committee to develop a final version of the CSCS. In total, the measure held twenty-four items.

*Corporate Safety Culture Scale: Expert Review*

In an effort to improve the validity of the items, the survey was evaluated by 23 graduate students at the University of Denver. The students were asked to assess the extent to which each proposed survey item addressed the intended culture domains. The reviewers recorded their evaluations by completing an attached rating form (see Appendix B). The form held a definition for each proposed domain, and allowed for each item to be rated for relevance to the anticipated components.

On balance, the evaluators concluded that each of the items was better than a “good fit.” However to ensure that only valid items were used, the investigator eliminated all items that were given a mean score that was less than an “excellent fit.”
This required the investigator to eliminate 7 items. With the unsatisfactory items eliminated, the final version of the SCSC was identified. The item pool held 18 items, with at least 5 items predicted to load on each proposed domain.

Quantitative Evaluation

Procedures

The CSCI was administered to all 3,349 CDOT employees. After the test results were gathered, data from non-eligible participants was discarded. In total, the data provided by 907 employees was retained. The investigator started by randomly sorting the sample into two groups. The groups, identified as groups “A” and “B” from here forward, each held approximately 50% of the total sample.

Exploratory Factor Analysis

Group “A” was submitted to an exploratory factor analysis to identify the empirical factor structure. This analysis started with an evaluation of the assumptions. The assumptions of sample size, outliers, factorability of the correlation matrix, linearity were tested. The sample was modified to ensure that the expectation of each assumption was achieved.

Principle components analysis was used to reduce the data and identify the most robust independent factors. The identification of the empirical model required the assessment of Communalities, Eigen values, the pattern matrix, and the Scree Plot. At each step, items shown to diminish the power of factor loadings were removed.

Confirmatory Factor Analysis
The second analysis, using group B, started with an appraisal of the assumptions of normality and reliability. Again, the sample was modified to meet the requirements of each assumption. Using Amos software, group B was used to evaluate the model fit of the empirical model and the experimental model, composed of the originally theorized items and domains. The investigator completed theoretically supported modifications to improve model fit. Model fit was evaluated and compared using the following fit indices: Chi-squared ($\chi^2$), Root-mean-square error of approximation (RMSEA), Bentler comparative fit index (CFI), and Expected cross-validation index (ECVI).

The $\chi^2$ goodness-of-fit statistic is a fundamental assessment of model fit. The value evaluates the difference between the “sample and fitted covariance matrices” (Hu and Bentler, 1999). The null hypothesis holds that there is no significant difference between the observed and expected values. Accordingly a significant $\chi^2$ value suggests the model does not adequately fit the data (Kline, 2011). While the $\chi^2$ goodness-of-fit statistic is an essential value of model fit, it does carry significant limitations. In particular, it is easily skewed by sample size. In the current project, with group samples greater than 400, the $\chi^2$ statistic was likely to be significant despite the possibility of only minor data discrepancies (Kline, 2011).

The root-mean-square error of approximation is an absolute fit index that follows a non-central $\chi^2$ distribution. It estimates the model parameter’s ability to limit the population covariance (Thompson, 2004). RMSEA is considered a “badness-of-fit index
where zero indicates that best fit” (Kline, 2011). An acceptable RMSEA value is lower than, or equal to, .08 (Browne & Cudeck, 1993).

The Bentler comparative fit index is an incremental fit index, which evaluates the relative enhancement of the presented model fit over that of the independence model (Kline, 2011). Incremental fit indexes can be criticized because they assume zero covariances among observed variables. However, when evaluated along with other fit indices, such as the RMSEA, they provide helpful information. Researchers believe the CFI threshold for adequate fit if greater than, or equal to, .95 (Hu and Bentler, 1999).

The expected cross-validation index is used to compare non-nested models. Non-nested models are structures that do not carry the same variables. Nested models, on the other hand, hold the same variables, and can be differentiated only through an additional subset of parameters present in one of the identified structures (Maruyama, 1998). The ECVI, is designed to contrast non-nested models, carrying different variables. The index helps an investigator select the model with that has will best cross-validate in a similar sample. The ECVI of a single model presents very little information. However, when comparing the ECVI values to multiple models, the index can be used to rank cross validation capacities. The model with the lowest ECVI is thought to have the best fit (Browne & Cudeck, 1989).

**Validation**

After identifying the model with the best fit. The full sample was submitted to an analysis of variance. This statistical technique was used to further assess the developed
scale’s validity. Specifically, the relationship between scores on the CSCS and scores on a self-report behavioral frequency item were evaluated.

Summary

This chapter discussed the methodology that was used in the study. This included an explanation of each phase of test construction. Specific attention was given to the research design, participant recruitment, test development, and quantitative assessment.
CHAPTER 4

RESULTS

This chapter describes the results and conclusions of the scale development phases discussed in Chapter 3. It also highlights the results of the research questions introduced in Chapter 1. In an effort to provide a linear depiction of this study’s findings, this chapter begins with a discussion of the phase 1 and phase 2 results. Because these stages of scale development were described in detail as part of chapter 3, the discussions attributed to these phases within this chapter are limited to brief summaries. This chapter then continues with a more thorough report of the phase 3 and 4 findings. The results section is concluded by an explanation of the research findings.

Planning

Participants

In exchange for the results of this project, the Colorado Department of Transportation (CDOT) agreed to participate in the study. In total, 1,909 CDOT employees (60% response rate) completed the measure. After eliminating ineligible individuals, 907 employees were retained as participants in the study.

Construction

Corporate Safety Culture Scale
To ensure that the items created for the CSCS were applicable to the transportation industry, a cognitive interview was held with the CDOT Safety Committee. Through the cognitive interview, the items pool was paired down to twenty-four items, with approximately 8 items addressing each of the established domains. The item pool was then submitted to an expert review. In this step, designed to increase validity, the items pool was distributed to a group of 23 graduate students. The students assessed the extent to which each item addressed the intended culture domain. Those items that were not shown to have “very good” fit were eliminated. After this process, the following nineteen items remained:

- Q6 Employees feel free to report safety hazards
- Q8 Employee safety is not sacrificed for production during a job
- Q16 I know how to avoid safety hazards
- Q18 Employees are encouraged to fix safety hazards
- Q20 Employee safety is not sacrificed for speed during a job
- Q22 My coworkers look out for my safety
- Q30 I am encouraged to raise safety concerns
- Q32 Employee safety is not sacrificed for quality during a job
- Q40 I pride myself on my ability to work safely
- Q41 Safety is more important than productivity
- Q42 I hope to be known as a safe worker
- Q43 CDOT personnel usually follow safety guidelines
- Q44 Safety at work is as important as safety at home
- Q46 The most important part of completing a job is being safe
- Q47 I would rather be a safe employee than a productive employee
Q49 I can prevent and avoid accidents through my personal actions
Q51 The best employees are usually the safest employees
Q52 My coworkers see me as a safe worker
Q53 Safe employees should be rewarded

Qualitative Analysis

Tests of Assumptions: Sample size, Factorability of the correlation matrix, Linearity

The assumption of sample size was met by with the starting sample of 907 cases. The large sample allowed for the use of a split file analysis (A=EFA) (B=CFA) while maintaining an adequate number of cases (Tabachnick and Fidell, 2007). The factorability of the correlation matrix was clearly shown, as the correlation matrix, complete with each anticipated item, revealed many relationships of r=.3 or greater. Bartlett’s test of Sphericity was significant at the p<.001 level. This revealed that the variables were not independent. The Kaiser-Meyer-Olkin value was .931, showing that the sample was appropriate for factor analysis. Linearity was assumed after the completion of several random evaluations of variable combinations. There was no evidence of curvilinear relationships.

Tests of Assumptions: Outliers

Outliers were identified using the Mahalanobis distance. This statistic describes the standard distance between “a set of scores for an individual case and the sample means for all variables (Kline, 2011). By comparing the Mahalanobis distance scores for each variable with the chi-squared critical values, cases with multivariate outliers were
detected. Cases with Mahalanobis distance scores greater than 43.82 (df=19, p< .001) were eliminated. In total, seventy cases were removed.

*Research Question #1*

*How well does the experimental factor structure of the Corporate Safety Culture Scale fit the data, when compared to an empirically derived factor structure?*

This section provides an explanation of experimental factor structure, and compares its fit with empirically derived models. Exploratory factor analysis was used to obtain the empirical factor structure. Confirmatory factor analysis was used to test the experimental model, along with the empirical model and a modified empirical model. CFA was used to compare the model fit of each of the aforementioned models. This fit was identified using the criteria discussed in chapter three.

*Exploratory Factor Analysis*

By exploring the independent variance carried by the variables, Exploratory Factor Analysis (EFA) enabled the researcher to identify the empirical model. In the segment below, the steps taken to uncover the empirical structure are identified. The discussion starts by presenting an explanation of Principle Components Analysis, the data reduction technique selected for this project. The conclusions of the analysis are presented with an evaluation of communalities, Eigen values pattern matrices, structural matrices, the scree plot, and correlations of identified components. At each step, the decision making process is explained.

*Principle Components Analysis*
Principle components analysis (PCA) was identified as the optimal analysis for the purposes of this project. PCA is a data reduction technique that accounts for the greatest amount of data variance with the fewest of factors. PCA is different from other factor analytic techniques because it evaluates the shared and unique error variance of each factor. As a result, the variability accounted by each factor is maximized. Moreover, the identified factors are independent, and do not correlate with one another.

**Communalities**

Communalities are important as they reveal the extent to which an item’s variance is explained by the extracted factors. With this data, essentially a correlation coefficient, the investigator was able to identify items that did not fit well with the extracted items. Costello & Osborne (2005) reported that items with low values, less than .4, need to be removed, or accommodated, through the creation of additional factors. Because no items in this project held communalities values below .4, all items were retained.

**Eigen values**

Eigen values describe the amount of variance that is accounted by each factor. The Kaiser criterion (Kaiser, 1960), suggested that Eigen values greater than or equal to one can be considered stable. The Principal components analysis revealed four factors carrying Eigen values that met this standard. These four factors accounted for 65.14% of variance. The Eigen values attributed to each identified factor, and their claimed variance can be seen in Table 5.
Table 5

*Total Variance Explained*

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigen values</th>
<th>% Variance</th>
<th>Cumulative Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.709</td>
<td>35.312</td>
<td>35.312</td>
</tr>
<tr>
<td>2</td>
<td>3.565</td>
<td>18.764</td>
<td>54.076</td>
</tr>
<tr>
<td>3</td>
<td>1.086</td>
<td>5.717</td>
<td>59.793</td>
</tr>
<tr>
<td>4</td>
<td>1.016</td>
<td>5.348</td>
<td>65.141</td>
</tr>
</tbody>
</table>

However, after evaluating the pattern matrix, and eliminating items that were cross loaded, two factors were identified. The specified factors were submitted to Oblimin rotation, which allows for the correlation of factors and leads to greater Eigen values. The rotation resulted in a between factors correlation of .25. When evaluating the “elbow” depicted in the scree plot, the decision to select 2 factors was confirmed.

The amount of variance explained by the first two components was much greater than the variance explain by the last ten components. The Scree plot can be seen below in Figure 2.
During the analysis of the Pattern Matrix, the following six items were dropped from the scale because they were shown to load on at least two factors.

\[
\begin{align*}
Q16 &= I know how to avoid safety hazards \\
Q43 &= CDOT personnel usually follow safety guidelines \\
Q47 &= I would rather be a safe employee than a productive employee \\
Q49 &= I can prevent and avoid accidents through my personal actions \\
Q52 &= My coworkers see me as a safe worker \\
Q53 &= Safe employees should be rewarded
\end{align*}
\]

Based on the suggestions of Tabachnick & Fidell, (2001) factors with loadings of .40 or greater were extracted and identified. Items loading on factor one addressed behavioral and performance and expectations. Accordingly, this factor was identified as “Behaviors.” The second identified factor seemed to hold items created to measure values held by employees. Accordingly, This factor was labeled “Values.” Two items found in this factor (\(Q40 = I pride myself on my ability to work safely\), and \(Q42 = I hope to be known as a safe worker\)), were originally anticipated to fall into the “meaning”
domain. However, objective review indicated that they clearly addressed underlying values.

One item, (Q51=The best employees are usually the safest employees) was removed because it carried a factor loading below .4 and could not be extracted. The resulting pattern matrix can be seen below in Table 6. The mean and standard deviations of the identified factors is shown in Table 7.
<table>
<thead>
<tr>
<th>ID</th>
<th>Component</th>
<th>Item</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Q6</td>
<td>.770</td>
<td>Employees feel free to report safety hazards</td>
<td>Behavior</td>
</tr>
<tr>
<td>Q8</td>
<td>.840</td>
<td>Employee safety is not sacrificed for production during a job</td>
<td>Behavior</td>
</tr>
<tr>
<td>Q18</td>
<td>.787</td>
<td>Employees are encouraged to fix safety hazards</td>
<td>Behavior</td>
</tr>
<tr>
<td>Q20</td>
<td>.871</td>
<td>Employee safety is not sacrificed for speed during a job</td>
<td>Behavior</td>
</tr>
<tr>
<td>Q22</td>
<td>.483</td>
<td>My coworkers look out for my safety</td>
<td>Behavior</td>
</tr>
<tr>
<td>Q30</td>
<td>.794</td>
<td>I am encouraged to raise safety concerns</td>
<td>Behavior</td>
</tr>
<tr>
<td>Q32</td>
<td>.876</td>
<td>Employee safety is not sacrificed for quality during a job</td>
<td>Behavior</td>
</tr>
<tr>
<td>Q40</td>
<td>.825</td>
<td>I pride myself on my ability to work safely</td>
<td>Values</td>
</tr>
<tr>
<td>Q41</td>
<td>.781</td>
<td>Safety is more important than productivity</td>
<td>Values</td>
</tr>
<tr>
<td>Q42</td>
<td>.864</td>
<td>I hope to be known as a safe worker</td>
<td>Values</td>
</tr>
<tr>
<td>Q44</td>
<td>.833</td>
<td>Safety at work is as important as safety at home</td>
<td>Values</td>
</tr>
<tr>
<td>Q46</td>
<td>.849</td>
<td>The most important part of completing a job is being safe</td>
<td>Values</td>
</tr>
</tbody>
</table>
Table 7  \textit{Mean and Standard Deviation}

<table>
<thead>
<tr>
<th>Factors</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Behavior</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2 Values</td>
<td>.214**</td>
<td>1</td>
</tr>
<tr>
<td>Mean</td>
<td>31.54</td>
<td>37.84</td>
</tr>
<tr>
<td>SD</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

**significant at the .01 level

\textit{Tests of Assumptions: Normality}

Because multivariate normality is assumed for the following analysis, the Kolmogorov-Smirnov value was evaluated. The statistic (p<.001) revealed a violation of the normality assumption. Accordingly, skewness statistics were used to inform variable transformation. However, square root, inverse, reflect, and logarithmic transformations did not improve normality within the variables. Accordingly, the original data was retained. The original skewness and kurtosis values are listed below in Table 8. As is shown, the kurtosis values for all variables were within the normal assumed range except Q44.
Table 8  
*Skewness and Kurtosis*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Skewness of Original Variable</th>
<th>Kurtosis of Original Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavior Items</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q6: Employees feel free to report safety hazards</td>
<td>436</td>
<td>-1.26</td>
<td>1.33</td>
</tr>
<tr>
<td>Q8: Employee safety is not sacrificed for production during a job</td>
<td>436</td>
<td>-0.75</td>
<td>-0.233</td>
</tr>
<tr>
<td>Q18: Employees are encouraged to fix safety hazards</td>
<td>436</td>
<td>-1.34</td>
<td>2.20</td>
</tr>
<tr>
<td>Q20: Employee safety is not sacrificed for speed during a job</td>
<td>436</td>
<td>-0.84</td>
<td>0.06</td>
</tr>
<tr>
<td>Q22: My coworkers look out for my safety</td>
<td>436</td>
<td>-1.10</td>
<td>1.83</td>
</tr>
<tr>
<td>Q30: I am encouraged to raise safety concerns</td>
<td>436</td>
<td>-1.50</td>
<td>2.31</td>
</tr>
<tr>
<td>Q32: Employee safety is not sacrificed for quality during a job</td>
<td>436</td>
<td>-0.88</td>
<td>0.31</td>
</tr>
<tr>
<td><strong>Values Items</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q40: I pride myself on my ability to work safely</td>
<td>436</td>
<td>-0.64</td>
<td>0.91</td>
</tr>
<tr>
<td>Q41: Safety is more important than productivity</td>
<td>436</td>
<td>-1.52</td>
<td>2.68</td>
</tr>
<tr>
<td>Q42: I hope to be known as a safe worker</td>
<td>436</td>
<td>-0.89</td>
<td>1.53</td>
</tr>
<tr>
<td>Q44: Safety at work is as important as safety at home</td>
<td>436</td>
<td>-1.36</td>
<td>3.31</td>
</tr>
<tr>
<td>Q46: The most important part of completing a job is being safe</td>
<td>436</td>
<td>-1.07</td>
<td>1.46</td>
</tr>
</tbody>
</table>

*Test of Reliability*

To ensure that the developed scale was consistent and dependable, the reliability of the scale defined in the empirical model was tested prior to further evaluation. Items
with low item-total correlations were removed from the scale. Question 22 was eliminated from the Behavior scale, \( (r=.53) \). No items were dropped from the Values scale, as they all had item-total correlations greater than .60. An appraisal of the two domains and the full scale’s reliability is depicted below in Table 9. DeVellis, (1991) suggested that Cronbach’s Alpha values above .7 are acceptable.

<table>
<thead>
<tr>
<th></th>
<th>Number of Items</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavior Domain</td>
<td>6</td>
<td>.915</td>
</tr>
<tr>
<td>Values Domain</td>
<td>5</td>
<td>.88</td>
</tr>
<tr>
<td>Full CSCS</td>
<td>11</td>
<td>.885</td>
</tr>
</tbody>
</table>

**Confirmatory Factor Analysis: Empirical Model**

The researchers started the assessment of model fit by testing the empirical model developed though discussed Exploratory Factor Analysis. This measurement model can be viewed in Figure 4. The following fit indices were assessed to compare the fit of the empirical model with that of the experimental structure: \( \chi^2 \), RMSEA, CFI, and ECVI. The fit indices resulting from the empirical model are listed in Table 11.

The evaluated indices revealed an inconsistent depiction of model fit. The chi-squared value \( (\chi^2 = 307.5, \text{df} = 43, p<.0001) \) showed that a significant discrepancy existed between the sample and hypothesized covariance matrices. The RMSEA (.119) did not quite meet the standards for a strong model fit. However, the CFI (.917) statistic did describe an acceptable model fit. The empirical model was shown to carry an ECVI score of .813.
In order to provide a comparison of model fit, the investigator’s initial experimental structure was developed and evaluated. The experimental model was composed of the nineteen items initially submitted to analysis. The inclusion of all nineteen items was unique to the experimental model. Prior to the CFA, several items were removed from analysis due to cross loading, low factor loading, and low item total correlations. The empirical and modified empirical models were developed with the remaining eleven items. Because the experimental model was developed with all nineteen items in mind, the eliminated items were retained for the model. For clear depiction of the items included in each model structure see Table 10.

The experimental model, composed of the initial nineteen items, held seven items designed to measure meaning, five items designed to evaluate values, and eight items intended to assess behavioral expectations. The completed structure is shown in Figure 5. The model was evaluated using the following fit indices: $\chi^2$, RMSEA, CFI, and ECVI.

The experimental model was not shown to improve the model fit. When compared to the empirical model, the identified indicators revealed a reduced fit. Specifically, the $\chi^2$ score ($\chi^2 = 683.048 \text{ df} = 149, p<.0001$) was clearly poorer than that of the other tested model. The RMSEA (.091) was only a slight improvement on the empirical model, and the CFI (.888) score revealed a fit that was inferior to that of the empirical model. When compared to the empirical model, the ECVI value of 1.76 showed that experimental model did not have a strong fit. See Table 11 for a depiction of the model fit indices.
Confirmatory Factor Analysis: Modifications to Empirical Model

Because the experimental and empirical models did not present an adequate fit, the investigator evaluated a third model, a modified empirical model. The original empirical structure narrowly missed adequate model fit, so the investigator consulted the modification indices to improve model fit. Through this process, the researcher identified three suggested modifications that had both large modification index values and conceptual support. It was shown that the unexplained error of the following items was correlated.

<table>
<thead>
<tr>
<th>Item 1</th>
<th>Item 2</th>
<th>Modification Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees are encouraged to fix safety hazards</td>
<td>I am encouraged to raise safety concerns</td>
<td>98.085</td>
</tr>
<tr>
<td>Employees feel free to report safety hazards</td>
<td>I am encouraged to raise safety concerns</td>
<td>59.275</td>
</tr>
<tr>
<td>I pride myself on my ability to work safely</td>
<td>I hope to be known as a safe worker</td>
<td>20.773</td>
</tr>
</tbody>
</table>

In each of the three chosen modifications, the language, or theme of the items were similar. Due to these similarities, the correlation in unexplained error made conceptual sense. These similarities were not perceived to be as significant in any other pair of survey items. Specifically, Q18 and Q30 were comparable questions, using similar wording. Both items held the terms “encouraged,” and “safety.” Further, both items referred the resolution of safety problems. In the same way, Q40 and Q42 carried equivalent language that likely caused the correlation of errors. Most clearly, both items carried the words “I,” “safe,” and “work.” Additionally, both Q40 and Q42 held a theme of self-reflection. Q30 and Q6 were also both associated with the identification, and
report of safety problems. As in the other selected modifications, the relationship between error terms was supported by the similarity in item purpose and language.

When accounting for the relationship between the previously mentioned error terms, the resulting model demonstrated in an overall acceptable model fit. The chi-squared value of \( \chi^2 = 126.54 \) df = 40, \( p<.001 \) was overlooked due to the large sample size. The RMSEA value (.071) suggested a strong fit, and the CFI (.978) confirmed an adequate fit. Further, the ECVI score showed that when compared with the experimental model, the modified empirical model had the best fit. The path analysis of this measurement model can be seen in Figure 4. See Table 11 for a description of the fit indices.

<table>
<thead>
<tr>
<th>Table 10</th>
<th>Model Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Empirical and Modified Empirical Models</td>
</tr>
<tr>
<td>Retained Items</td>
<td>Eliminated Items—Reasons for elimination</td>
</tr>
<tr>
<td>Q6, Q8, Q18, Q20, Q30, Q32, Q40, Q41, Q42, Q44, Q46</td>
<td>Q16, Q43, Q47, Q49, Q52, Q53</td>
</tr>
</tbody>
</table>

Q6, Q8, Q16, Q18, Q20, Q22, Q30, Q32, Q40, Q41, Q42, Q44, Q46, Q47, Q49, Q51, Q52, Q53
Table 11  
*Comparison of Fit Indices for Tested Models*

<table>
<thead>
<tr>
<th>Tested Models</th>
<th>Fit Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\chi^2$</td>
</tr>
<tr>
<td>Empirical Model</td>
<td>307.5</td>
</tr>
<tr>
<td>Modified Empirical Model</td>
<td>126.54</td>
</tr>
<tr>
<td>Experimental Model</td>
<td>683.04</td>
</tr>
</tbody>
</table>

*Confirmatory Factor Analysis: Summary*

When considering the results shown by the evaluated fit indices, it is clear that corporate safety culture is a complex construct that, given the developed items, is best measured through the domains identified in the modified empirical model. It is important to note the domains contained in this factor structure retain experimental support. This is shown in similarities between the modified empirical model and the experimental model. Specifically, both models hold domains related to behavioral expectations, and values. The similarity between the modified empirical model and the original experimental framework adds support for the conclusions of the CFA.

**Validation**

*Research Question #2*

Is there a relationship to between scores on the Corporate Safety Culture Scale and safety behaviors?
After identifying a reliable model, the validity of the CSCS was evaluated. The researcher endeavored to understand how well the CSCS, along with each identified component of the measure, related to safety behavior. This assessment was completed with the use of a single behavioral indicator item found in the full CDOT measure. The selected item is listed below.

Q61  I received a performance documentation form for using good safety practices during the past 12 months.

Tests of Assumptions: Homogeneity

Prior to completing the statistical analysis, the assumption of homogeneity was evaluated. Levene’s test of homogeneity showed that the assumption of homogeneity of variance was achieved by the CSCS (p=.071) and the Value domain (p=.474). However, the Behavior domain was shown to have significant homogeneity (p=.01). To accommodate this violation, the Welsh test was consulted when comparing groups.

Analysis of Variance

A one-way between groups analysis of variance was completed in effort to assess the relationship between safety behavior, measured through the above item, and scores on the full Corporate Safety Culture Scale, and the individual factors. Participants were divided into three groups based on their answer to the previously mentioned frequency item. The available response groups were: “Yes,” “No,” and “Not Sure.” Scores on the full CSCS and the Behavior domain were both shown to be significantly different, at the p<.001 level for subjects in the three behavioral frequency groups. Similarly, scores on
the value domain were statistically different at the p<.05 level for subjects in the different frequency groups. This finding was corroborated by the conclusions of the Welsh test.

A review of the descriptive statistics, shown in Table 11, describes the direction of the differences between the “Yes,” “No,” and “Not Sure” groups. For the full scale, and each of the identified domains, the “Yes” group was shown to have a higher mean score than the “No” and “Not Sure” group. This finding suggests that high scorers on the CSCS are safer employees than those who score lower. For a visual depiction of these findings please see Figures 7, 8, 9.

<table>
<thead>
<tr>
<th>Table 12</th>
<th>Descriptive Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full CSCS</td>
</tr>
<tr>
<td>Statistical Measures</td>
<td>Identified Groups</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>N</td>
<td>233</td>
</tr>
<tr>
<td>Mean</td>
<td>65.36</td>
</tr>
<tr>
<td>SD</td>
<td>7.39</td>
</tr>
<tr>
<td></td>
<td>Behavior Domain</td>
</tr>
<tr>
<td>Statistical Measures</td>
<td>Identified Groups</td>
</tr>
<tr>
<td>N</td>
<td>233</td>
</tr>
<tr>
<td>Mean</td>
<td>65.36</td>
</tr>
<tr>
<td>SD</td>
<td>7.39</td>
</tr>
<tr>
<td></td>
<td>Values Domain</td>
</tr>
<tr>
<td>Statistical Measures</td>
<td>Identified Groups</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>N</td>
<td>233</td>
</tr>
<tr>
<td>Mean</td>
<td>31.92</td>
</tr>
<tr>
<td>SD</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Effect Size

While the participants in the different behavioral frequency groups were shown to have significantly different scores on the CSCS, and the Value and Behavior domains,
the effect size for these findings was shown to be small (Cohen, 1988). Specifically, the eta squared value for the full measure was .022. The Behavior domain carried a similarly low score of .022, and the Values domain was the lowest, at .007.

**Post Hoc**

Tukey HSD Post hoc tests provided more information about significant differences shown between participants in the three behavioral frequency groups. The statistic showed that on the full CSCS, the average value for the “Yes” group was significantly (p<.001) different from the “no” group. However, neither the “Yes” group nor the “No” group were significantly different than the “Not sure” group. For the Value domain, the post hoc statistic showed that none of the groups were significantly (p<.05) different from each other. The final post hoc analysis revealed that on the Behavior domain, participants in the “Yes” group scored significantly (p<.001) different than participants in the “No” group. Again, the “Not Sure” group was alternatively shown not to score differently than the “Yes” or the “No” group.

**Summary**

This chapter described the development of an empirical model through exploratory factor analysis. It also delineated the model testing process using confirmatory factor analysis. A modified empirical model was shown to have a superior model fit. This identified model was found to hold many theoretical similarities to the original conceptual model. An analysis of validity revealed that the full Corporate Safety
Culture Scale and the two identified domains maintained a relationship to safety behaviors.
CHAPTER 5

DISCUSSION

This project was designed to develop a measure of corporate safety culture for the transportation industry that inclusively addressed each domain of corporate culture. This chapter provides a summary of the project’s development and results, and presents the theoretical implications of the findings. The limitations of the study and recommendations for future research are also discussed.

General Summary

Corporate culture is consistently shown to impact organizational growth, performance, and safety (Miron, Erez, & Naheh, 2004; Prather, & Turrell, 2002; Ogbonna & Harris, 2000; Deshpande, Farley, & Webster, 1993). However, corporate leaders may have difficulty evaluating and influencing the culture of companies because the construct has been poorly defined in the literature. Without solid and consistent theoretical underpinnings, current tests of corporate of corporate culture are not easily understood (Hopfl, 1994). The objective of this project was to develop a comprehensive tool that accounted for the most common definitions of culture. In particular, the created measure was designed to address: (1) Meaning systems, (2) Values, and (3) Behavioral expectations.
To complete this project, the investigator worked with the Colorado Department of Transportation (CDOT). Because 40% of workplace accidents occur during periods of transportation, CDOT places great emphasis on safety. Leaders in the organization reported that they were invested in improving CDOT’s culture as it related to safety because they believe positive changes in safety culture lead to increased safety practices. With this aspiration in mind, the transportation company partnered with the investigator to modify its annual safety survey. The investigator identified twenty-four items, both developed by the researcher and adopted from the original CDOT survey, that conceptually fit the hypothesized domains of culture. After these items were paired down through expert review, and factor analysis, eleven items were defined as part of the Corporate Safety Culture Scale (CSCS).

In the development of the Corporate Safety Culture Scale the investigator had two major goals; first, to identify the factor structure that fit the data best, and second, to evaluate the validity of the final measure. The findings associated with each of these goals are discussed in the sections below.

Factor Structure

Prior to statistical analysis, the original twenty-four items were submitted to expert review. Through this appraisal, five items were removed from the original scale. To identify the factor structure of the CSCS, the data was first submitted to an exploratory factor analysis. During the requisite test of assumptions, the investigator determined that sample size was sufficient. Also, factorability of the correlation matrix
was demonstrated, sphericity was significant, and linearity was assumed. When testing the outlier assumption using the Mahalanobis distance, seventy cases were identified as multivariate outliers. Because the investigator was unable to identify any theoretical reason for the outliers, all seventy cases were removed.

*Exploratory Factor Analysis*

After testing, and correcting for the assumptions, the data was randomly split into two files. The first file (A) was used to complete the exploratory factor analysis, which allowed for the identification of an empirical model. Principle components analysis was used to explore the data because it allows for the greatest amount of data variance with the fewest number of factors. After eliminating items that were shown to load on multiple components, two factors were identified. When submitting the factors to an Oblimin rotation, a between factors correlation of .25 was shown. In an effort to retain only items with robust factor loadings, eleven of the twelve items were extracted. A review of the remaining factor loadings showed two item groupings. Items grouped on the first factor pertained to behavioral expectations. Items grouped on the second factor pertained to employee values. Accordingly, the empirical model was identified as a two-factor structure, with the following domains: 1) Behaviors, 2) Values.

*Confirmatory Factor Analysis*

To assess the model fit of the empirical factor structure, the second data file (B) was submitted to a confirmatory factor analysis. Again, the required tests of assumptions were completed. It was discovered that the assumption of normality was violated. The investigator attempted to use skewness statistics to inform variable transformation, but all
investigated transformations did not improve normality within the variables. As a result, the original data was retained. The reliability of the empirical models was also assessed. After removing one item from the behavior factor due to a low item-total correlation, the reliability of the full scale was shown to be sufficient. Significant differences were consistently shown between the groups. However, an evaluation of the eta’ squared statistic showed that the effect size of these findings was very small. Although the significant differences were shown between group, the power of these differences was clearly limited.

Using CFA, the investigator compared the fit of the empirical model, and the experimental model. The following fit indices were used to evaluate the fit of each proposed model: $\chi^2$, RMSEA, CFI, and ECVI. The empirical model carried two factors: Values and Behaviors (See Figure 4). Assessment of the empirical model revealed inconsistent fit indices. Specifically, the chi-squared value was significant, and the RMSEA suggested a poor model fit. The CFI statistic described an adequate model fit, and the ECVI carried a score of .813.

The experimental model was tested in an effort to provide a theoretically supported comparison to the empirical model. The original experimental structure held the following three domains: Values, Meaning systems, and Behavioral expectations (See Figure 5). When evaluated through CFA, the experimental structure was shown to fit the data worse than the empirical model. Again, the chi-squared value was significant, and the RMSEA identified an inadequate fit. The CFI statistic described an poor model fit, and the ECVI carried a score of 1.76.
Since neither the experimental or empirical model was shown to carry a strong fit, a third model was assessed. The original empirical structure, which carried two domains (Values, and Behaviors), barely missed sufficient fit. Consequently, the investigator consulted the modification indices, and theory, to enhance model fit. The resulting model was identified as the modified empirical model (See Figure 6). When evaluated, the model was shown to have an adequate model fit. Each of the evaluated fit indices pointed to a strong model fit, except the chi-squared value, which was overlooked due to the large sample size. The ECVI value of .410 revealed a better fit than the experimental model.

Validation

After identifying the model that best fit the data, the model’s validity was assessed. Validity was evaluated using a one-way analysis of variance to test the relationship between the full CSCS, along with its identified domains, and safety behaviors. Safety behavior was measured by a single behavioral indicator item, listed below.

Q61  I received a performance documentation form for using good safety practices during the past 12 months.

Assumptions: Homogeneity

Tests of homogeneity showed that the assumption of homogeneity of variance was achieved by the CSCS and the Value domain, but violated by the Behavior domain. Accordingly the Welsh test was considered when contrasting groups.
The participants were separated into three groups based on their answer to the frequency item, (groups: (1) Yes, (2) No, and (3) Not Sure). The group member’s scores on the full CSCS and each domain were compared. This evaluation showed that subjects in the “Yes” group scored significantly higher, (P<.001) on the CSCS and the Behavior domain than subjects in the “no” group. Similarly, subjects in the “Yes” group also scored significantly higher (p<.05) on the Value domain than subjects in the “no” group. Descriptive statistics revealed that the “Yes” group scored higher on the CSCS and each of the identified domains than the “No” group and the “Not Sure” group. This finding suggested that the CSCS is a valid measure of corporate safety culture.

The Tukey HSD Post hoc test was used to assess the differences between the “Yes,” “No,” and “Not Sure” group on the full CSCS and the identified domains. The statistic revealed that the difference between the “Yes” and “No” groups was significant (p<.001) for the full scale and the Behavior domain. However, no significant difference was shown for the Values domain. This finding showed that the scores on the behavioral domain of the CSCS are related to scores on the behavioral frequency item, while scores on the values domain are unrelated to values on the behavioral frequency item.

In summary, the results showed that the data is best explained by a modified empirical factor structure. The identified model was shown to be reliable, with a limited effect size. The full CSCS was validated.

Conclusions

*Identified Model*
The present study sought to create a comprehensive and inclusive measure of corporate culture, which assessed corporate safety culture across the following domains: (1) Behavioral expectations, (2) Values, and (3) Meaning systems. However, this project only partially fulfilled this objective. The factor analyses identified and supported a two factor model, composed of a Behavior domain and a Values domain.

*Extant Literature*

A review of the corporate culture literature, shows a mass of research describing themes associated with behavioral expectations, values, and meaning systems (Aceves & King, 1978; Cunningham & Gresso, 1994; D’Andrade, 1996; Geertz 1973; Kessing & Strathern, 1998; Murphy, 1986). Despite the common presence of these themes, the three constructs are not known to be included in any single definition or measure of corporate culture. As was previously explained, the assessment of all three constructs has been thwarted because researchers have not been able to successfully include both meaning and value-focused items within a single survey.

Researchers do not attempt the simultaneous measurement of meaning systems and values because the concepts are conceptually very similar. The distinction between the constructs is particularly difficult to create and explain in a measurement tool. As a likely consequence, this author knows of no assessment of corporate culture that deliberately assesses both meaning systems and values. Because both constructs are present in the research, unique, and individually powerful, current instruments are limited by this omission.
On the other hand, the construct of behavior is contained in nearly every definition of culture (Aceves & King, 1978; Deal & Kennedy, 1982; Cunningham & Gresso, 1994; Ember & Ember, 2001; Haviland, 1993; Murphy, 1986; Whitten, & Hunter, 1987; Steadman, 1982). Because behavior is effortlessly observed, it is easy to assess. As a likely result, employee behavior is often the focus of corporate culture and corporate safety culture measures (Safety Performance Solutions, 2010; Thaden, & Gibbons, 2008).

While the focus on behavior is seen as an important component of culture assessment, the extent of this focus is seen as excessive. As opposed to measuring the effects of the underlying culture, many current measures only evaluate the specific expectations of management. This myopic focus on behavior may reflect a misunderstanding of the theoretical foundations of culture. For example, the Safety Culture Indicator Scale Measurement System (SCISMS) is a well-known measure that devotes approximately 80 percent of it’s questions to behavior-related topics. The fixation on behavior misses the global construct of culture.

Findings

This project’s initial aspiration to define and measure culture as the sum of an organization’s meaning systems, values, and behavioral expectations, was intended to provide a more complete assessment of corporate safety culture. While the initial theory maintains theoretical and intuitive appeal, it was not supported by the project’s findings.

The data produced can be interpreted in two ways: 1) The hypothesized model was incorrect, and corporate safety culture is not best described as the sum of meaning
systems, values, and beliefs. Or, 2) Corporate safety culture was not sufficiently addressed by the items developed for present study.

1) Incorrect Model

The overwhelming data from the empirical analyses points to the superiority of the two factor model, containing a Behavior and a Values domain. This conclusion fits research suggesting that, at its core, safety culture consists of only behavior and values (Cooper, 2000). If this premise is accepted, culture may be explained as values and their behavioral indicators alone. More clearly, an organization’s safety culture might be recognized simply as the values held by members of the organization, and reflected in the member’s behavioral choices or perceptions. With this perspective, future investigations of safety culture could focus entirely on values, and how those values are revealed through behavior.

This concept may be interpreted further. If corporate culture can be recognized as values held by employees and resulting behavioral decisions, then culture may be most efficiently addressed through the measurement of behavior. If one assumes that behavior is the result of values, it may be considered a strong indicator of the underlying culture.

With this interpretation, the item ratios contained in many of the measures discussed in Table 2 makes conceptual sense. Behaviors are observable, easy to address, and easy to measure. If they are the key to corporate safety culture, measures of culture would effectively assess the construct through behavior-based questions. This conceptualization fits the literature well. Several investigators have described culture as “the way we do things around here” (Deal & Kennedy, 1982; Harris, 2004).
Although the argument could be made that culture is best assessed with consideration only given to behavior, this author posits that it does not seem sensible to take this approach. It is clear that behaviors can be influenced by many factors outside the influence of underlying values. For example, when taking the CSCS, an employee might respond positively to Q8, “Employee safety is not sacrificed for production during a job.” While this answer provides information about safety behaviors, it does not necessarily provide a reflection of the underlying culture. The positive answer may or may not be a result of the employee’s values. Alternatively, it might reflect the employee’s lack of motivation or interest in work.

In this case, the employee’s ambivalence about productivity could be the cause of his/her response. If an investigator left the analysis at behavior, too much important information is left to be assumed. With the addition of a Values domain, the investigator is able to gain essential information about the underlying culture. For instance, if the previously mentioned employee responded to values-focused Q46, “The most important part of completing a job is being safe” A much clearer picture of culture would be revealed.

2) Poor Items

As part of the item development phase, the investigator completed cognitive interviews with the CDOT safety committee. In this meeting, the investigator presented approximately thirty unique items to the safety committee. The committee paired down the accepted items to thirteen. While this process increased the validity, readability, and applicability of the created items, it also limited the investigator’s control of item
creation. Because the safety committee was invested in limiting the number of additional items, they voted against numerous theoretically supported items. In the investigator’s estimation, the safety committee was unable to understand the theoretical underpinnings of prospective items, and incorrectly assumed the same constructs could be measured by items that were already included in the original CDOT survey items.

It is possible that the restrictions on item development and selection influenced the investigator’s ability to address the distinct qualities of meaning systems, values, and behavioral expectations. As a result, the similarities between values, and meaning systems lead to the grouping of these items into a single factor. If this is the case, the identification of the two factor model is explained by the poor item selection, and the investigator’s original theory may be valid.

Specifically, culture may be evaluated as the sum of an organization’s meaning systems, value’s behavioral expectations. With this interpretation, the implication for further research is clear. More care must be given to the development of items designed to measure the distinct constructs of meaning systems and values. For example, items that explicitly address the relationship between safety and meaning. For example:

1) I believe that being a safe worker is meaningful,
2) Meaningful work is always safe,
3) Being a safe worker is part of my mission in life.

Each of these items specifically refers to meaning and appears to have greater face validity than the items selected in the by the CDOT committee.
Limitations

Demographics

A major limitation of the item development phase was the lack of demographic questions. Although the investigator suggested that the CDOT Safety Committee include a more robust demographic section, the committee argued that demographic questions were unnecessary. They also noted that including demographic questions could potentially make CDOT vulnerable to litigation in the future. The absence of a full demographic section clearly limited that investigator’s ability to assess the impact of individual characteristics on responses to the CSCS.

Further, the dearth of demographic information was shown to be particularly disadvantageous during the assessment of outliers. The investigator felt obligated to remove seventy cases that were determined to be outliers because no theoretical explanation could be discovered. If demographic information had been gathered as part of the survey, the multivariate outliers may have been explained and the removed cases may have been retained.

One of the most necessary, but absent, demographic items concerned the participant’s specific tenure with CDOT. The project was designed to evaluate the safety culture of CDOT. In an effort to observe impact of the organization’s culture, as opposed to the aspersions of management, the decision was made to survey low-level participants working in high risk departments. To measure the true impact of the culture, it also would have been helpful to survey participants that had been working with CDOT for several years. Without a question evaluating the participants’ specific tenure with
CDOT, the responses of newly hired participants were indistinguishable from responses produced by long-term employees.

Because corporate culture may be influenced by a wide range of personal characteristics, it will be important for future researchers to create a comprehensive demographic survey. Participant tenure is one of many personal variables that might impact an individuals’ perception of corporate culture. For example, education, ethnicity, age, previous experience, salary, and experience with workplace accidents might all influence a person’s recognition of an organization’s safety culture.

**Outliers**

As was previously mentioned, the assumption of outliers was violated. As a result, seventy cases with Mahalanobis distance scores greater than 43.82 were removed. This was a controversial decision. From a pure statistical position, the choice makes sense. The outliers were unexplained and skewed the data. Eliminating the cases allowed for a more valid analysis. However, others might argue the outliers were a legitimate aspect of the sample. It could be said that removing the outliers, without any theoretical reason, led to an inaccurate evaluation.

**Skewness & Kurtosis**

An additional limitation was revealed when the assumption of normality was violated. The investigator attempted to transform variables in an effort to normalize the distribution. However, none of the tested transformations (square root, inverse, reflect, and logarithmic) increased normality. Because analysis of variance is thought to be robust to violations of the normality assumption, the original variables were left
unchanged. Given the unpredictable nature of accidents, the non-normality of the data made sense. That said, the non-normality of the data suggests that the results of the statistical analysis could be biased or misleading.

**Expert Review**

Another limitation of this study can be found in the investigator’s efforts to ensure the validity of the items. In the test construction phase, the survey was submitted to 23 graduate students, who worked to assess the extent to which the proposed items addressed the intended culture domains. While this process was designed to increase the validity of the questions, it may have prevented the selection of optimal items. Some might suggest that graduate students are likely to have a different perspective and understanding of the hypothesized domains than the expect participants. Because the population that evaluated the survey was very different than the population that took the survey, item evaluation may have been inaccurate. If transportation employees had assessed the items, it is possible that a different group of questions would have been identified in the initial survey.

**Validity**

A one-way analysis of variance was used to evaluate the relationship between scores on the CSCS, and a single safety behavior indicator item. In chapter two of this project, the decision to complete this analysis using a single item to measure safety behavior was discussed and supported. However, one might argue that a single item is
insufficient to measure safety behavior. Critics could suggest that safety is more appropriately measured through previously validated safety measures. This methodology would have been superior as it would have allowed for the use of a regression. In this case, predictive validity would have been assessed. With the methodology used in the present project, the investigator could only compare groups.

The use of a single behavioral frequency items also brought into question the importance of the full CSCS. Through the post hoc analysis, the behavior domain was shown to relate significantly to scores on the behavioral frequency item. However, the values domain was not shown to have a significant relationship with behavior. This result showed that the CSCS was statistically significant because the behavior domain was robust.

With this result, some might argue that the value domain should be removed from the CSCS. This interpretation is rejected by the investigator. The non-significance of the values domain points to the domain’s inability to relate to behavior. However it is important to remember that the CSCS is designed to assess safety culture. The research clearly shows that values are connected to culture. To remove the values domain would greatly diminish the importance of the CSCS.

Also, as has been mentioned, the single behavioral frequency item limited the breadth of assessment. It is possible that the value domain would relate significantly with other behavioral frequency items. For example, given the conceptual nature of values, the value domain might relate more significantly with behavioral frequency items that
involve choice. The selected item reflects an appraisal given by an individual’s superior. The item does not address a choice to behave in a safe manner.

**Effect size**

The analysis of variance showed that employees who received a performance documentation form as a result of positive safety behavior scored significantly higher on the CSCS, and the identified domains. The significant relationship between safety behavior and scores on the CSCS is very important. Statistical significance demonstrates that a given relationship not likely due to chance. However, significance does not mean the finding is substantive. The eta squared statistic showed that the difference between scores produced by participants in the “Yes,” “No,” and “Not Sure” groups was minor. This finding is critical as it reflects the usefulness of the CSCS, and it’s domains. When considering traditional eta squared expectations, (Cohen, 1988), the CSCS is not seen to be substantive. It is believed that corporate safety culture has a robust relationship with safety behavior. However, a strong relationship was not revealed by the statistical analysis. This finding pulls the value of the CSCS into question. However it is important that the reader does not interpret this finding as a reflection on the value of corporate safety culture. The extant literature a convincingly argues that corporate safety culture has a strong relationship with safety behavior (Erikson, 1997).

**Contamination/Anonymity**

The CSCS was developed by attaching conceptually supported items to an annual safety survey distributed by CDOT. This approach to test development was simple and efficient. In enabled wide distribution to a range of transportation employees working in
high risk jobs. However, administering the items along with an annual safety survey may have reduced the reliability of the data. The survey was administered by an organization that was clearly invested in improving safety. As a result, participating employees may have been concern that negative/unsafe responses would harm their reputation at work. CDOT attempted to eliminate this contamination effect by keeping the surveys anonymous. However it is possible that employees were unable to trust the promise of confidentiality, and therefore answered the items with fear of penalty.

Unique Qualities of CSCS

Length

The short, straight forward arrangement of the CSCS is an asset because it will produce lower dropout rates and limit answer fatigue (Cape, 2010). Also, from a practical stand point, the CSCS may be advantageous in a organizational setting. As organizations pursue productivity goals, efficiency is paramount. With eleven questions, the CSCS will make an assessment of culture less demanding, and more feasible.

While surveys with fewer items have clear advantages, they do carry an inherent limitation in scope. It is very difficult to measure multiple constructs without increasing survey size. The CSCS is a valid measure of corporate safety culture, but it does not assess any additional constructs. This is a limitation of the scale when compared to other measures of corporate culture, which evaluate a range of corporate characteristics outside the realm of culture.

Theory
Regardless of explanation, the conclusions the present project showed that a two factor model best fits the data. When accepted, this model suggests that safety culture can be described simply as a single unitary value. Safety culture is the sum of values held by employees as they pertain to safety. Behaviors likely represent indicators of underlying employee values.

This finding was unexpected, but theoretically supported by the investigator’s original theory and hypothesized model. Specifically, the investigator posited that corporate safety culture can be measured as the sum of an organization’s universally accepted meaning systems, values, and behavioral expectations as they relate to safety. Factor analysis, did not support the presence of a meaning systems domain, but the inclusion of values and behavior was supported.

Parsimony

The measurement of values and behavior is not unique to the CSCS. In fact, nearly every measure of corporate safety culture includes an assessment of values, and behaviors (Denison, 2010; Diaz-Cabrera, Hernandez-Fernaund, & Esla-Diaz, 2007; Safety Performance Solutions, 2010; Thaden & Gibbons, 2008). However, the CSCS is unique because it explicitly and parsimoniously addresses the two constructs. The other evaluated measures assess the domains through the evaluation of disparate organizational characteristics that relate to values and behaviors. To view a list of previously developed measures, please see Table 2 on page 43.

The most apparent asset of the CSCS is it’s simplicity. As an eleven item scale, containing two domains, the CSCS comes in stark contrast to other measures of corporate
safety culture. The measures of corporate safety culture evaluated for this project were much longer and more complicated. For example, the well-known Denison Organizational Culture Survey contains sixty items, and addresses four domains (Denison, 2010).

Several authors have argued for the importance of parsimony (Gauch, 2003). While the three factor model holds conceptual support, the laws of parsimony, as they relate to theory construction suggest that the most simple and elegant solution should be accepted. See Figure 3 for a diagram of the accepted model identified through factor analysis.

Figure 3  
*Accepted Model of Corporate Culture*
Further Research

This project was important because it endeavored to identify a solid definition and measure of corporate culture. However, the investigator’s three factor experimental model was not identified in the factor analysis. Instead, the analysis revealed a solid two factor model. Through this chapter, the investigator has speculated about potential causes for the rejection of the experimental model. However, to truly understand the model identification, and corporate safety culture, further research will be necessary. It is important that this project represents the initiation of new approach to the study of corporate culture.

Ideally, a future project will present the CSCS, along with an updated grouping of conceptually developed items to several large public and private transportation organizations. If the items consistently reveal the two factor structure carried by the current version of the CSCS, the investigator will be able to definitively support the measure of values and behaviors in the assessment of safety culture. To truly evaluate the validity and importance of any future interactions of the CSCS, the researchers will need to analyze the relationship between the scale and safety behavior outcomes.

Summary

This chapter discussed the present project at length. A summary of the purpose, methodology, and conclusions of the research were presented. Special attention was drawn to the limitations of the study. In particular, item development restrictions, skewed data, poor demographic analysis, validity, and effect size were discussed.
chapter included an explanation of the investigator’s final thoughts and recommendations for further research. The final section described the implications of the Corporate Safety Culture Scale.
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Figure 4  Empirical Model
Figure 6  
Modified Empirical Model
Figure 7

A Comparison of Means:

Scores on CSCS and Safety Behavior

I received a performance documentation form for using good safety practices during the past 12 months
Figure 8

A Comparison of Means:

Scores on Behavior Domain and Safety Behavior

I received a performance documentation form for using good safety practices during the past 12 months
Figure 9

A Comparison of Means:

Scores on Values Domain and Safety Behavior

I received a performance documentation form for using good safety practices during the past 12 months.
Hi Paul,

I hope all is well with you. I am sorry I have not contacted you in the last months. After our earlier meeting our research team took on a grant proposal that sapped all of our time. I wanted to get back to you regarding our discussion of corporate culture, and the role of family systems. Pat, Rob, and I were all very interested in your thoughts. It will definitely be a topic that we consider working with in the future. Unfortunately, we are each busy with individual projects that are temporarily taking time.

I am presently designing a measure of corporate culture for my dissertation, which I will propose at the end of September. I have created an item pool of approximately 40 items designed to evaluate 3 global categories of corporate culture. (observable characteristics, motivating factors, & implicit values). I believe the current measurement tools are limited because they only evaluate observable characteristics, (climate) Hopefully, my tool will offer a more comprehensive picture of safety culture.

As I developed the items for my measure, I frequently referred to the culture tool you used at CDOT. With your permission, I would like to incorporate some of your items into my measure. I believe you did an excellent job including a wide breath of factors. Earlier in the summer, we briefly spoke about using CDOT employees as a sample for upcoming projects. If this is still an option, I would greatly appreciate the opportunity. In return, I will provide you with data on your previously administered items, and feedback from the results of my project.

I understand that you are very busy, so I really appreciate the attention you have provided us at DU. You have already been extremely helpful. Thank you for your time and consideration.
Appendix B

Instructions:
Using the definitions, table and rating scale provided, rate the extent to which each item fits within the proposed culture domain. Also, rate the items’ wording, and offer suggestions for poorly written or unfocused items.

Domain Definitions

Meaning Systems:
Meaning Systems are underlying mental constructions that allow for the interpretation and understanding of how daily events fall into an individual’s personal narrative.

Values:
Values represent the fundamental moral expectations that an individual uses to appraise daily events.

Behavioral Expectations:
Behavioral Expectations refers to the activities that are anticipated within the course of an individual’s employment responsibilities

Rating Scale

Strong Fit  1  2  3  4  5  Weak Fit

Rating Table

<table>
<thead>
<tr>
<th>Items</th>
<th>Proposed Culture Domain</th>
<th>Domain Fit Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know how to spot safety hazards</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td>I know how to avoid safety hazards</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td>I know how to fix safety hazards</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td>I pride myself on my ability to work safely</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td>I hope to be known as a safe</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>worker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I avoid accidents by using safety practices</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td>I can prevent and avoid accidents through my personal actions</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td>I attempt to correct safety hazards at all times</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td>My coworkers see me as a safe worker</td>
<td>Meaning Systems</td>
<td></td>
</tr>
<tr>
<td>CDOT can only be successful if it has a strong safety record</td>
<td>Values</td>
<td></td>
</tr>
<tr>
<td>Safety is more important than productivity</td>
<td>Values</td>
<td></td>
</tr>
<tr>
<td>Safety at work is as important as safety at home</td>
<td>Values</td>
<td></td>
</tr>
<tr>
<td>The most important part of completing a job is being safe</td>
<td>Values</td>
<td></td>
</tr>
<tr>
<td>I would rather be a safe employee than a productive employee</td>
<td>Values</td>
<td></td>
</tr>
<tr>
<td>Safe employees should be rewarded</td>
<td>Values</td>
<td></td>
</tr>
<tr>
<td>The best employees are usually the safest employees</td>
<td>Values</td>
<td></td>
</tr>
<tr>
<td>Employees feel free to report safety hazards</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>My coworkers are committed to the safety of others</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>Employee safety is not</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>Behavior</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td></td>
</tr>
<tr>
<td>sacrificed for production/quantity during a job</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees are encouraged to fix safety hazards</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>Employee safety is not sacrificed for speed during a job</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>My coworkers look out for my safety</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>Employee safety is not sacrificed for quality during a job</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>CDOT personnel usually follow safety guidelines</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
<tr>
<td>I am encouraged to raise safety concerns</td>
<td>Behavioral Expectations</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix C

**Colorado Department of Transportation**  
**Employee Safety Survey**

<table>
<thead>
<tr>
<th>A. Overall Safety Climate</th>
<th>Scale Reliability: .83 .85</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overall, CDOT is a safe place to work</td>
<td></td>
</tr>
<tr>
<td>13. CDOT is committed to safety</td>
<td></td>
</tr>
<tr>
<td>25. CDOT values safety</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Management Support</th>
<th>Scale Reliability: .87 .91</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Senior management (division directors, RTD's) is committed to safety</td>
<td></td>
</tr>
<tr>
<td>14. Senior management (division directors, RTD's) helps make CDOT a safer place</td>
<td></td>
</tr>
<tr>
<td>26. Middle management (section/branch heads) is committed to safety</td>
<td></td>
</tr>
<tr>
<td>37. Middle management (section/branch heads) helps make CDOT a safer place</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Supervisor Support</th>
<th>Scale Reliability: .91 .94</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. My supervisor invests time to keep work safe</td>
<td></td>
</tr>
<tr>
<td>17. My supervisor invests time to improve safety</td>
<td></td>
</tr>
<tr>
<td>29. My supervisor helps make CDOT a safer place</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. Coworker Support</th>
<th>Scale Reliability: .88 .90</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. My coworkers are committed to the safety of others</td>
<td></td>
</tr>
<tr>
<td>22. My coworkers look out for my safety</td>
<td></td>
</tr>
<tr>
<td>34. My coworkers help make CDOT a safer place</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Employee Support</strong></td>
</tr>
<tr>
<td>---</td>
<td>----------------------</td>
</tr>
<tr>
<td>3.</td>
<td>Employees take all safety precautions before doing a job</td>
</tr>
<tr>
<td>15.</td>
<td>Employees wear appropriate personal protective equipment</td>
</tr>
<tr>
<td>27.</td>
<td>Employees do not take unnecessary safety risks at work</td>
</tr>
<tr>
<td>38.</td>
<td>Employees wear seat belts when riding in state vehicles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>Employee Involvement</strong></th>
<th>Scale Reliability: .83 .83</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Employees feel free to report safety hazards</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Employees are encouraged to fix safety hazards</td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>I am encouraged to raise safety concerns</td>
<td></td>
</tr>
</tbody>
</table>
Appendix D

Corporate Safety Culture Scale

Q6 Employees feel free to report safety hazards
Q8 Employee safety is not sacrificed for production during a job
Q18 Employees are encouraged to fix safety hazards
Q20 Employee safety is not sacrificed for speed during a job
Q30 I am encouraged to raise safety concerns
Q32 Employee safety is not sacrificed for quality during a job
Q40 I pride myself on my ability to work safely
Q41 Safety is more important than productivity
Q42 I hope to be known as a safe worker
Q44 Safety at work is as important as safety at home
Q46 The most important part of completing a job is being safe