KEY COMPONENTS IN THE MEASUREMENT OF SAFETY CULTURE

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ORGANIZATION OF PRESENTATION

- What is safety culture?
- Why is safety culture important?
- How can we measure it?
- What do we do with this information?
- How do we create safety culture?
- Next steps

STATEMENT OF THE PROBLEM

- The issue of safety culture as a key component in the maintained and facilitation of an acceptable world class safety record. Many examples of how lapses in safety culture of operations have contributed to major accidents have been described in the literature.

ORGANIZATIONAL CULTURE

- Study of Culture – Margaret Mead
- Person Environment Interaction – Kurt Lewin
- Edgar Schein - Defined organizational culture

DEFINITIONS OF CORPORATE CULTURE

Definition	Author
'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.'	(Cunningham & Gresso, 1994)
'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."'	(D'Andrade, 1996)
'the learned patterns of behavior and thought characteristic of a societal group.'	(Harris, 2004)
'We will restrict the term *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.'	(Kessing & Strathern, 1998)
'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)


Safety climate


Safety climate
Safety culture

WHAT IS SAFETY CULTURE?

- "how we do things around here"

DEFINITIONS OF SAFETY CULTURE

UK HEALTH & SAFETY EXECUTIVE (1993)

- The product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management.

- Barnes (2009) • (NRC) The values, attitudes, motivations and knowledge that affect the extent to which safety is emphasized over competing goals in decisions and behavior.

- Guldenmund (2000) • Those aspects of the organizational culture which will impact on attitudes and behavior related to increasing or decreasing risk.

SAFETY SUBCULTURES

- Many definitions of safety culture (e.g. ASCNI, 1993) present a view of employees having a shared set of safety values and beliefs.
- Studies have found the presence of subcultures within an organization which suggest an absence of a cohesive safety culture. Subcultures are likely to develop when employees within the same organization experience different working conditions.
- Work groups within an organization are likely to view risk differently depending on the type of work they do.

DOT DEFINITION

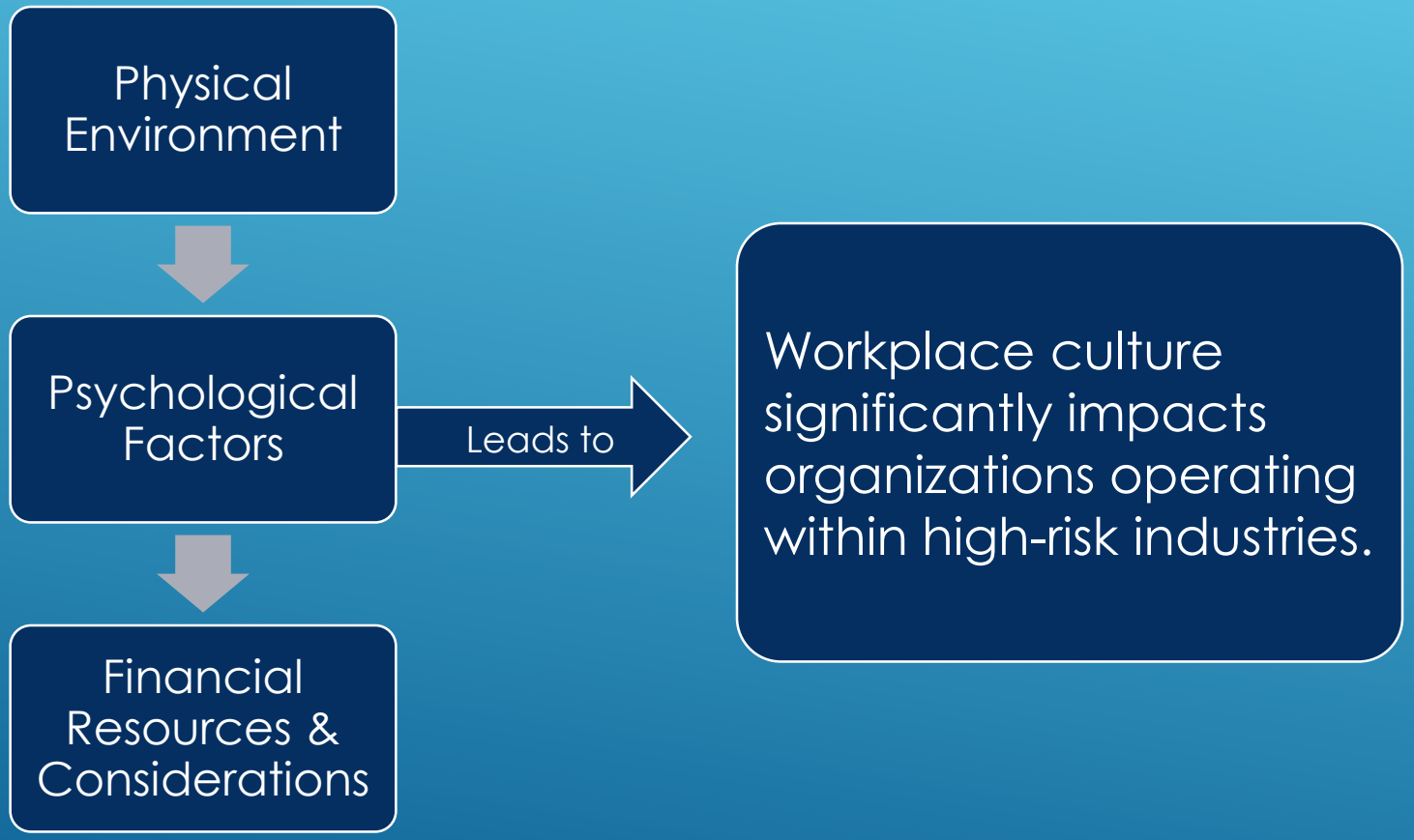
- The DOT Safety Council has developed the following definition of safety culture intended to support development of a broader departmental policy on safety culture:

ELEMENTS OF SAFETY CULTURE

- *1. Leadership is Clearly Committed to Safety*
- *2. Open and Effective Communication Exists Across the Organization*
- *3. Employees Feel Personally Responsible for Safety*
- *4. The Organization Practices Continuous Learning*
- *5. The Work Environment is Safety Conscious*
- *6. Reporting Systems are Clearly Defined and Not Used to Punish Employees*
- *7. Decisions Demonstrate that Safety is Prioritized Over Competing Demands*
- *8. Employees and the Organization Work to Foster Mutual Trust*
- *9. The Organization Responds to Safety Concerns Fairly and Consistently*
- *10. Safety Efforts are Supported by Training and Resources*

From FRA - DOT/FRA/OR-17/09 - 2017

FACTORS AFFECTING SAFETY CULTURE



IMPACT OF SAFETY CULTURE

WHAT IS SAFETY CULTURE?

- First mentioned in a report about Chernobyl
- The Chernobyl disaster highlighted the importance of safety culture and the effect of managerial and human factors on safety performance.[4][5]
- The term 'safety culture' was first used in INSAG's (1988) 'Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident' where safety culture was described as:
  - "That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

IMPACT OF SAFETY CULTURE

- Workplace calamities are often related to poor safety culture
- Safety culture is important because it has been shown to reduce the prevalence of workplace accidents.
- Companies with strong safety cultures are believed to be the most protected against unforeseen accidents.

CHERNOBYL

After the accident, officials closed off the area within 30 kilometers (18 miles) of the plant, except for persons with official business at the plant and those people evaluating and dealing with the consequences of the accident and operating the undamaged reactors. The Soviet (and later on, Russian) government evacuated about 115,000 people from the most heavily contaminated areas in 1986, and another 220,000 people in subsequent years (Source: UNSCEAR 2008, pg. 53)

- Health Effects from the Accident
  - The Chernobyl accident's severe radiation effects killed 28 of the site's 600 workers in the first four months after the event. Another 106 workers received high enough doses to cause acute radiation sickness. Two workers died within hours of the reactor explosion from non-radiological causes. Another 200,000 cleanup workers in 1986 and 1987 received doses of between 1 and 100 rem (The average annual radiation dose for a U.S. citizen is about .6 rem). Chernobyl cleanup activities eventually required about 600,000 workers, although only a small fraction of these workers were exposed to elevated levels of radiation. Government agencies continue to monitor cleanup and recovery workers' health. (UNSCEAR 2008, pg. 47, 58, 107, and 119)
  - - https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/chernobyl-bg.html

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CLAPHAM JUNCTION

- On 12 December 1988, a crowded passenger train crashed into the rear of another train that had stopped at a signal, just south of Clapham Junction railway station in London, and subsequently sideswiped an empty train travelling in the opposite direction. **A total of 35 people were killed in the collision, while 484 were injured.**[1]
- The collision was the result of a signal failure caused by a wiring fault. New wiring had been installed, but the old wiring had been left in place and not adequately secured. An independent inquiry, chaired by Anthony Hidden, QC, found that the signalling technician responsible had not been told his working practices were wrong and his work had not been inspected by an independent person. **He had also performed the work during his 13th consecutive week of seven-day workweeks.** Critical of the health and safety culture within British Rail at the time,

RECENT EVENTS

- **Lac Megantic**
  - Canadian runaway oil train disaster blamed on ‘weak safety culture,’ poor oversight – Washington Post
  - “We now know why the situation developed over time,” Tadros said. “It was a weak safety culture at MM&A, poor training of employees and tanker cars that didn’t offer enough protection.”
    - https://en.wikipedia.org/wiki/Lac-M%C3%A9gantic_rail_disaster

- **Metro North**
  - Poor 'safety culture' blamed for train crashes
  - Metro-North Railroad management failed to follow its own safety protocols, according to a National Transportation Safety Board investigation.
- **WMATA**
  - ***NTSB Cites Track Circuit Failure and WMATA's Lack of a Safety Culture in 2009 Fatal Collision***7/27/2010
- **Amtrak – Philadelphia**
  - (NTSB) blamed for a deadly train crash that killed two workers near Philadelphia last year.

TYPES OF ACCIDENTS

- ***Individual accidents*** occur when an individual commits an error independent of organizational influences. An example of this type of accident would be an employee who follows company prescribed procedures, but loses his balance and falls off a ladder (Sumwalt, 2012).
- **Organizational accidents**, on the other hand, "have multiple causes involving many people operating at different levels of their respective companies…[and] can have devastating effects on uninvolved populations, assets and the environment" (Reason, 1997, p. 1).
  - "Organizational accidents arise from the concatenation of several contributing factors originating at many levels of the system" (Reason, 2004, p. ii29).

RESEARCH DATA

- **The relationship between safety climate and injury rates across industries: the need to adjust for injury hazards.**
- In a study of 33 companies, the association between injury and claims were used to test the predictability of safety climate on injury rates,
- **Findings:** Company level safety climate were negatively and significantly associated with injury rates.
  - Accid Anal Prev. 2006 May;38(3):556-62. Epub 2006 Jan 23.

- **Testing the effect of safety climate on micro-accidents in manufacturing jobs.**
- Safety Climate perceptions significantly predicted accident records during the 5-month recording period that followed climate measurement.
- The study established an empirical link between safety climate perceptions and objective injury data.

Table 4
Hierarchical Ordinary Least Squares Regression Model for Group-Level Microaccident Rate as Outcome Variable

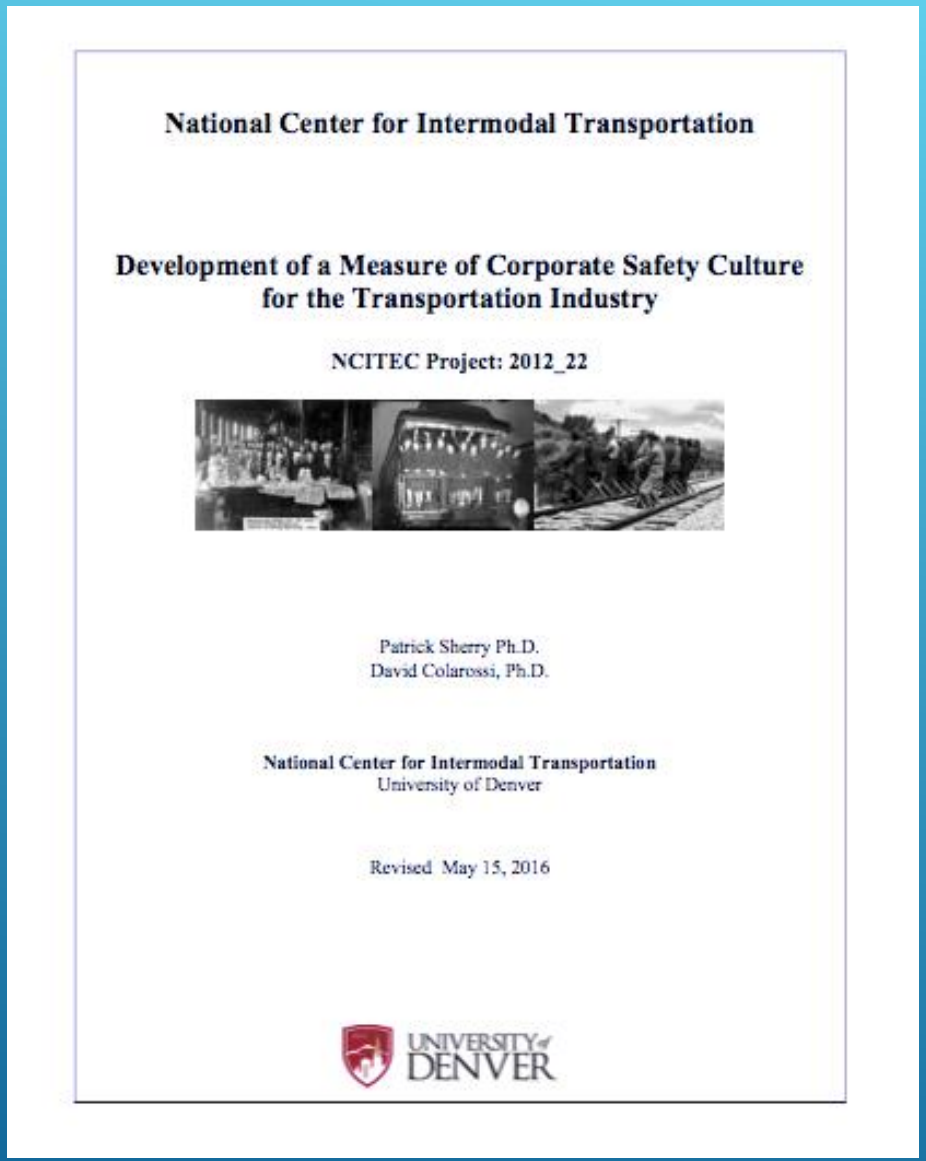
Variable	β	ΔR^2
Step 1		
Subunit risk	0.03	.01
Step 2		
Subunit risk	0.01	
Action	−0.47***	
Expectation	−0.45**	.16*

* $p < .05$. ** $p < .01$. *** $p < .001$.

Zohar, Dov .Journal of Applied Psychology, Vol 85(4), Aug 2000, 587-596.

NEED A METRIC TO MANAGE AGAINST

- ‘You can't manage what you can't measure’ - Drucker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Development of a Measure of Corporate Safety Culture for the Transportation Industry

NCITEC Project: 2012_22

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Summary of the development of instrument and initial reliability & validity statistics.

Available online at:

http://www.du.edu/ncit

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BENEFITS OF SAFETY CULTURE ASSESSMENT

- Assessment of Safety Culture
  - Can lead to a more complete adoption of overall set of attitudes , beliefs, and code of conduct with respect to workplace safety practices. In reality organizations can produce reams of rule books with instructions, standards and recommendations. But, when it comes to decision making and thoughtful purposeful acts the beliefs, norms and ideas contained within a commonly shared culture will fill gaps and lead to motivation to behavior according to a consistently higher code of conduct.
  - We can see evidence in the failure of culture or a lax culture
  - Some research suggests that differences in culture and beliefs area associated with lower numbers of accidents and incidents.

GAPS IN THE LITERATURE

- Current measurement tools are dissimilar and do not adequately measure corporate safety culture.

- Current measurement tools are dissimilar and do not permit benchmarking and comparisons.
- **Our tool/instrument proposes to address these issues by developing normative data from a variety of organizations.**

MEASUREMENT OF CORPORATE SAFETY CULTURE

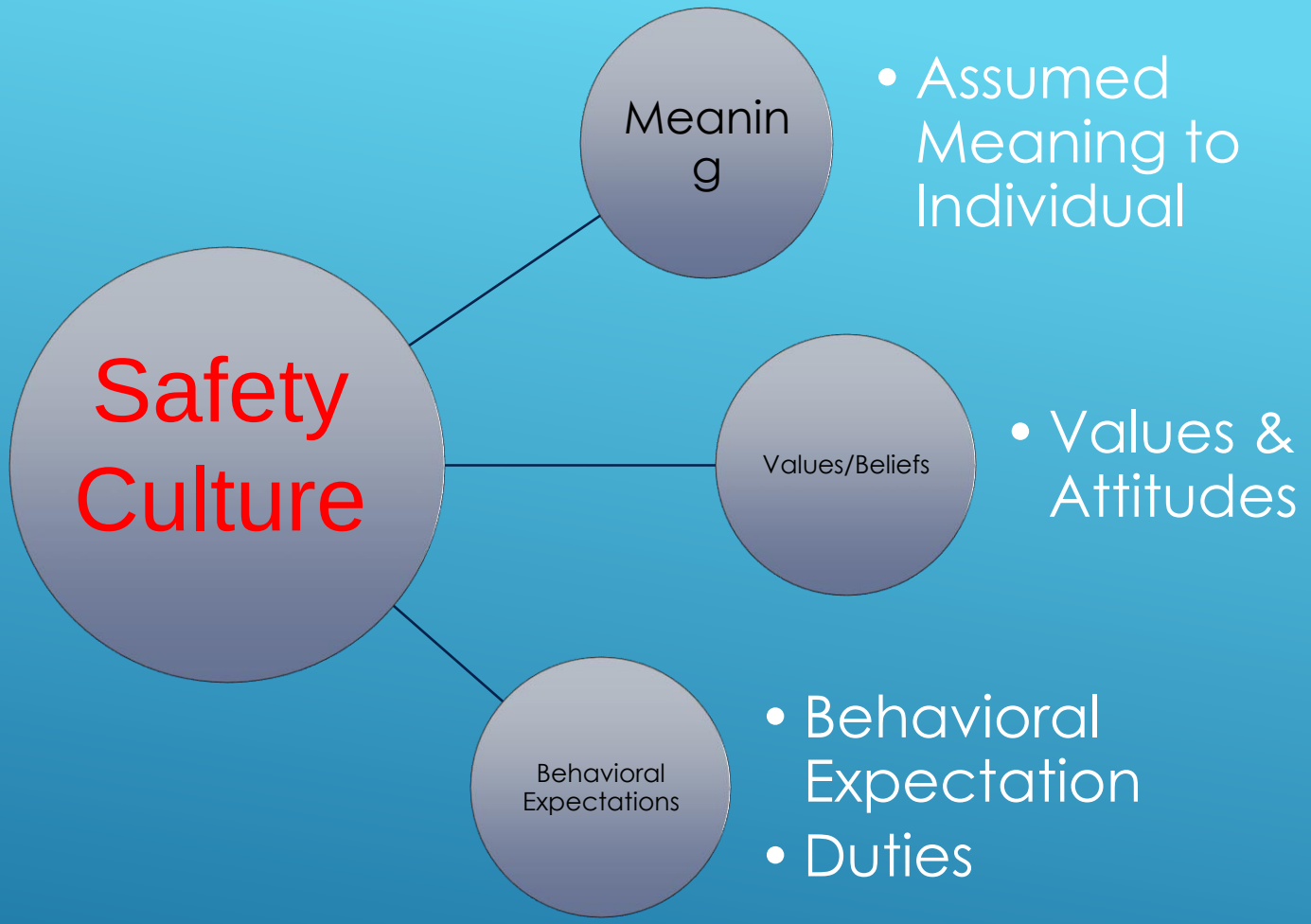
MEASURE	AUTHOR	WEAKNESS	EVIDENCE
Organizational Culture Inventory	Cooke & Lafferty	1) Theory (unknown) 2) No statistical support	Absent of any reliability or validity data
Denison Organizational Culture Survey	Denison & Neale	1) Theory (measures values, but no other aspect of culture) 2) No statistical support	Absent of any reliability or validity data
Safety Culture Survey	Safety Performance Solutions	1) Theory (measures climate)	Absent of any reliability or validity data
Safety Culture Values and Practices Questionnaire	Diaz-Cabrera, Hernandez-Fernaud, & Esla-Diaz	1) Theory (measures values, but no other aspect of culture)	Absent of any reliability or validity data
Safety Culture Indicator Scale Measurement System	Thaden & Gibbons	1) Theory (measures climate)	Alfa coefficients =.81-.95

OTHER MEASURES – NO PSYCHOMETRICS AVAILABLE

- UK HSE
- Multi-level Safety Climate Survey
- Safety Management Questionnaire

A PERFECT MEASURE

- 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.
  - meaning systems,
  - values/beliefs, and attitudes
  - behavioral expectations & practices



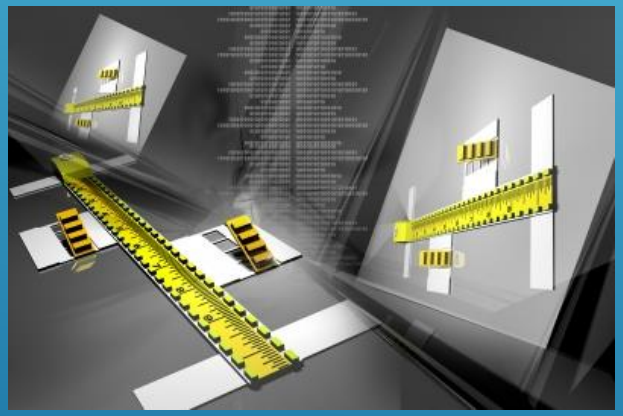
PROPOSED MODEL OF SAFETY CULTURE

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/Beliefs: 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.

MEASURE DEVELOPMENT

- Items are developed conceptually, following an attempt to create items within the three themes.
- Items from previously validated tests can be used and integrated into measure.
- Total of item pool of 70-100 items



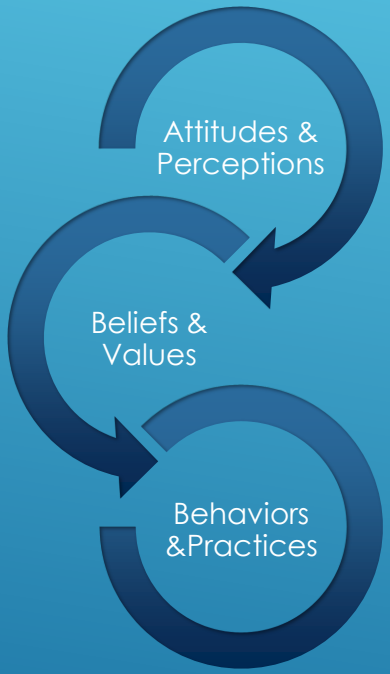
OUR EFFORTS

- Colorado State Department of Transportation (CDOT N=1900).
  - 1) Participants did not hold managerial positions.
  - 2) Participants held high-risk jobs, (divisions of transit and rail, or maintenance).
- Cross-validation sample obtained from a Regional Heavy Rail Company N=600

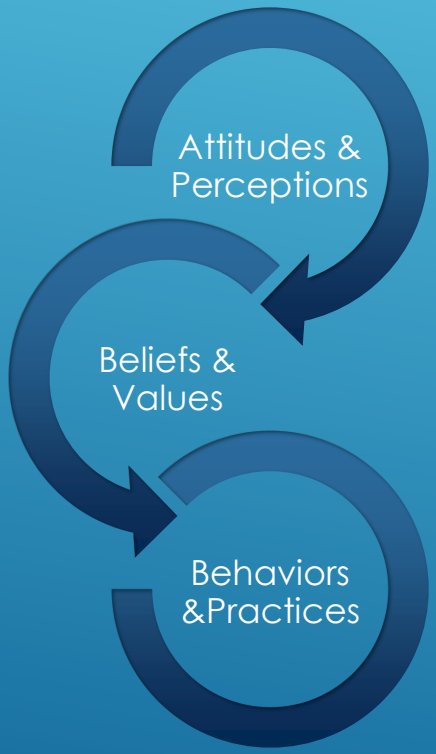
METHODOLOGY

- Index was administered to 1900+ CDOT employees
- 970 cases met participant criteria
- Exploratory factor analysis was completed to discover latent factors.
- Second data set obtained from a sample 0f 600+ Employees from Large Regional Rail Company

THREE COMPONENTS



THREE COMPONENTS



Attitudes & Perceptions

- Focus Groups
- Questionnaires
- Interviews

Beliefs & Values

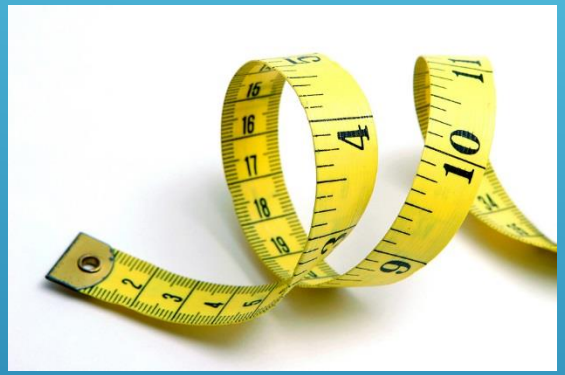
- Focus Groups
- Questionnaires
- Interview

Conduct & Behavior

Observations
Rule Books - Printed Materials
Physical infrastructure

ASSESSMENT OF CULTURE

- Culture Assessment
  - Takes place on three levels
    - Attitudes & Perceptions
      - Interviews and focus groups with key employees and use of survey questionnaires
    - Beliefs & Values
      - Review of written published materials as well as interviews, focus groups and survey questionnaires
    - Conduct & Behaviors
      - Observation of workplace activities and inspection of work place and equipment as well as use of survey questionnaires



ASSESSMENT TOOLS

- Survey Questionnaire (online and paper and pencil)
- Interview Format and Questions
- Workplace Observation Audit Checklist
- Analysis of Initial Data and Explanatory Rep

KEY METHODOLOGY

Conceptual Framework

- Attitudes
- Behaviors
- Values
- Identify Sample items
- Identify Sample Practices
- Implementation

Implementation Team

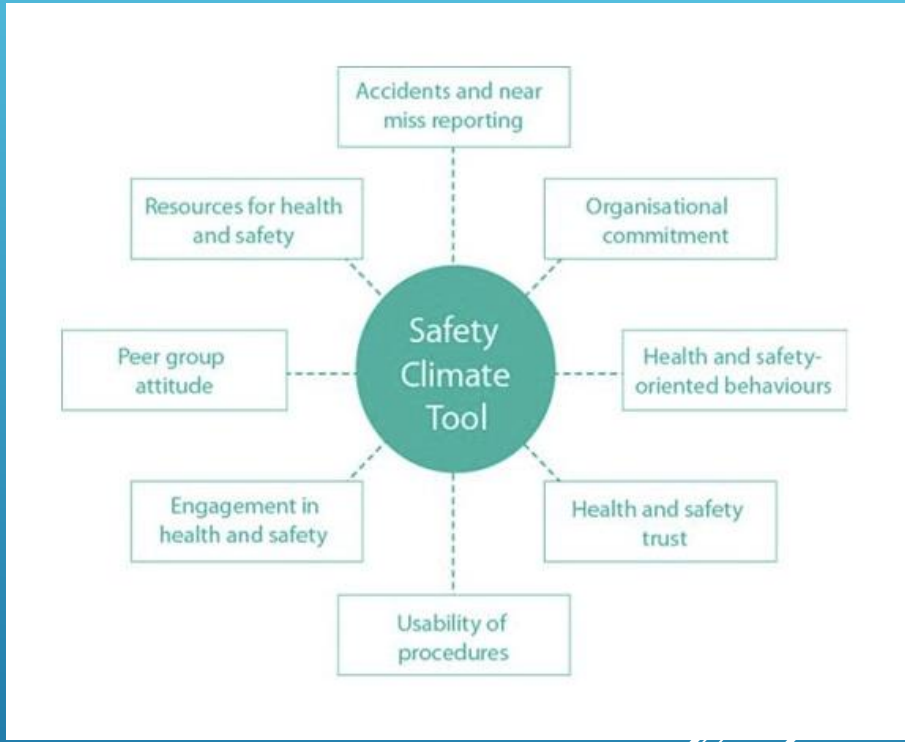
- CEO and Safety Manager
- Steering Committee
- Implementation Team
- Data Managers

SAMPLE PROJECT TIMELINE

Week	Task	Description
1	1	Meet with CEO & Project manager to agree upon scope and plan
	2	Select members of internal Steering Committee
	3	Select members of Industry, Labor & Advisory Committee – will participate in pilot assessment
	4	High level Conceptual Briefing with key officials
2	5	Identify potential sites for initial field study review
	6	Obtain approval of sites from govt and joint steering committee
3	7	Visit several sites to conduct interviews and gather information needed
	8	Visit sites
4	9	Prepare initial draft of materials for review
	10	Obtain approval of assessment tools, survey & interview & observation
	11	Finalize tools after feedback
5	12	Administer assessment tools to selected locations – collect data
6	13	Analyze data
7	14	Submit reports draft admin guidelines
8	15	Submit final report and guidelines for admin and interpretation

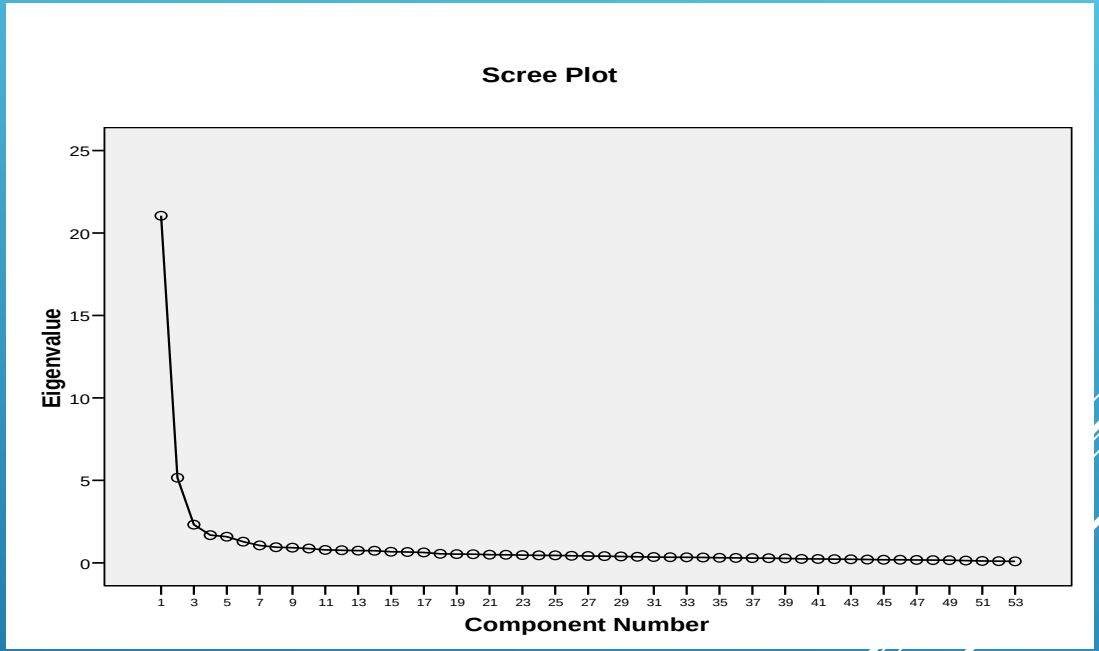
OBSERVATION GUIDE

- Management Commitment
- Communication
- Employee Involvement
- Training & Information
- Motivation
- Compliance with procedures
- Learning organization



FACTOR ANALYSIS OF CULTURE ELEMENTS

- Principle components analysis showed three component.
- Evaluation of the scree plot revealed a separation after the second component.
- Seven components were retained for further investigation.
- The resulting solution explained over 64 % of the variance.



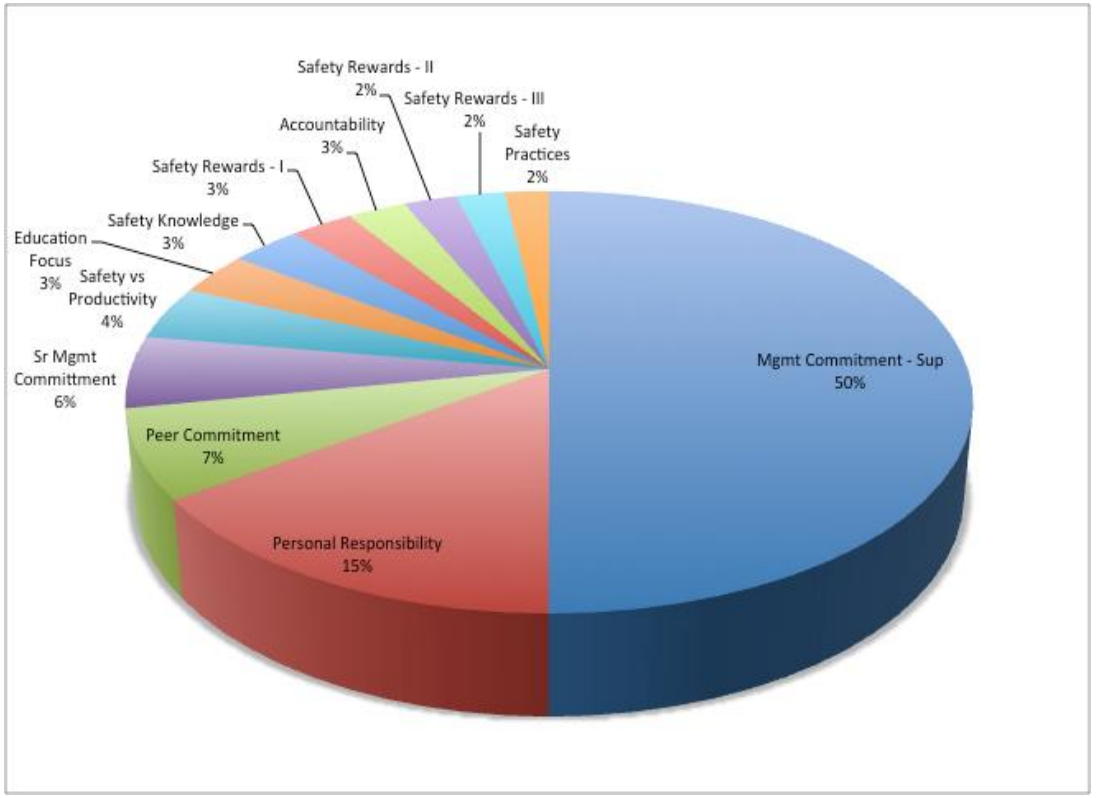
Key Elements/Dimensions of Denver Safety Culture Tool

F1 – Management Commitment – Immediate Supervisor
- Assesses perceptions that supervisors are committed to safety as evidenced by the perception that they are encouraged to raise safety concerns and that supervisors are engaged in in and investing time in improving safety
F2 - Personal Responsibility
- Assesses perceptions that safety is a personal responsibility which can be can be prevented by personal actions.
F3 - Peer Commitment
- Assesses perceptions that co-workers are committed to personal safety contribute to making the workplace safe.
F4 – Management Commitment – SR
- Assesses perceptions that the degree to which employees feel that senior mgmt. and the corporation is committed to employee safety.
F5 – Safety vs Productivity
- Assesses perceptions that employees believe that safety is not sacrificed for productivity and that the work area has been made as safe as possible.
F6 – Education Focus
- Assesses perceptions regarding the extent to which the organization and the safety professionals have provided safety training and information to assist with emp safety.
F7 – Safety Knowledge
- This scale assesses the extent to which employees understand and know how to address risks and hazards in the work environment.
F8 – Safety Rewards – (Inc)
- Assesses perceptions regarding the believe that safe work behaviors are rewarded in the organization through promotions and performance ratings.
F9 – Accountability
- this scale assesses the extent to which employees believe that persons engaged in unsafe practices or work behaviors are held accountable for their actions.
F10 – Safety Practices
- Assesses the extent to which employees feel that they utilize personal protective equipment and safe work practices as encouraged to do so by their supervisors.

RELATIVE IMPORTANCE OF COMPONENTS OF CULTURE

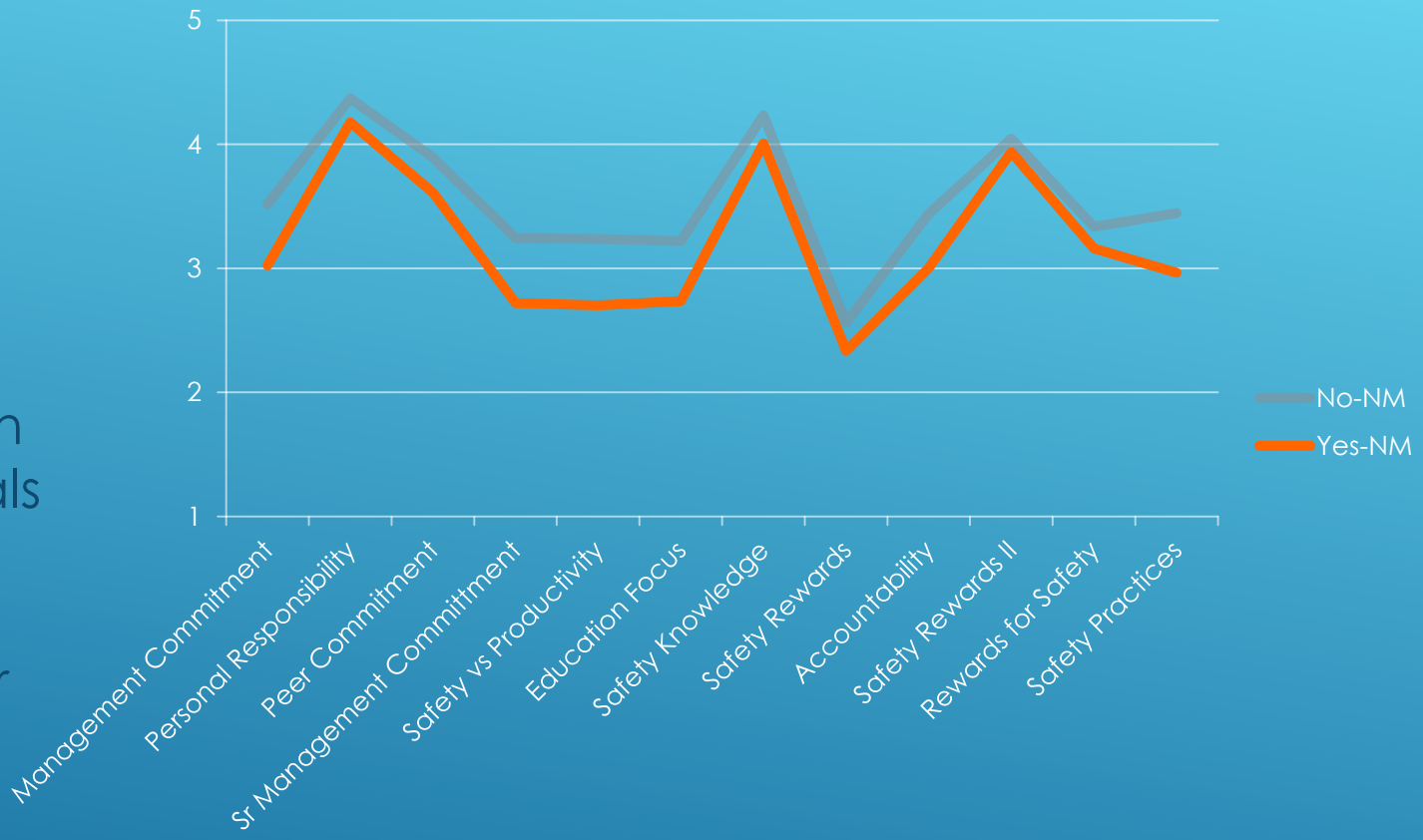
RESULTS OF UNIVERSITY OF DENVER RESEARCH

1. Management Commitment
2. Personal Responsibility
3. Peer Commitment
4. Senior Mgmt Commitment
5. Safety vs Productivity
6. Education Training Focus
7. Safety Knowledge
8. Safety Rewards
9. Accountability
10. Safety Practices



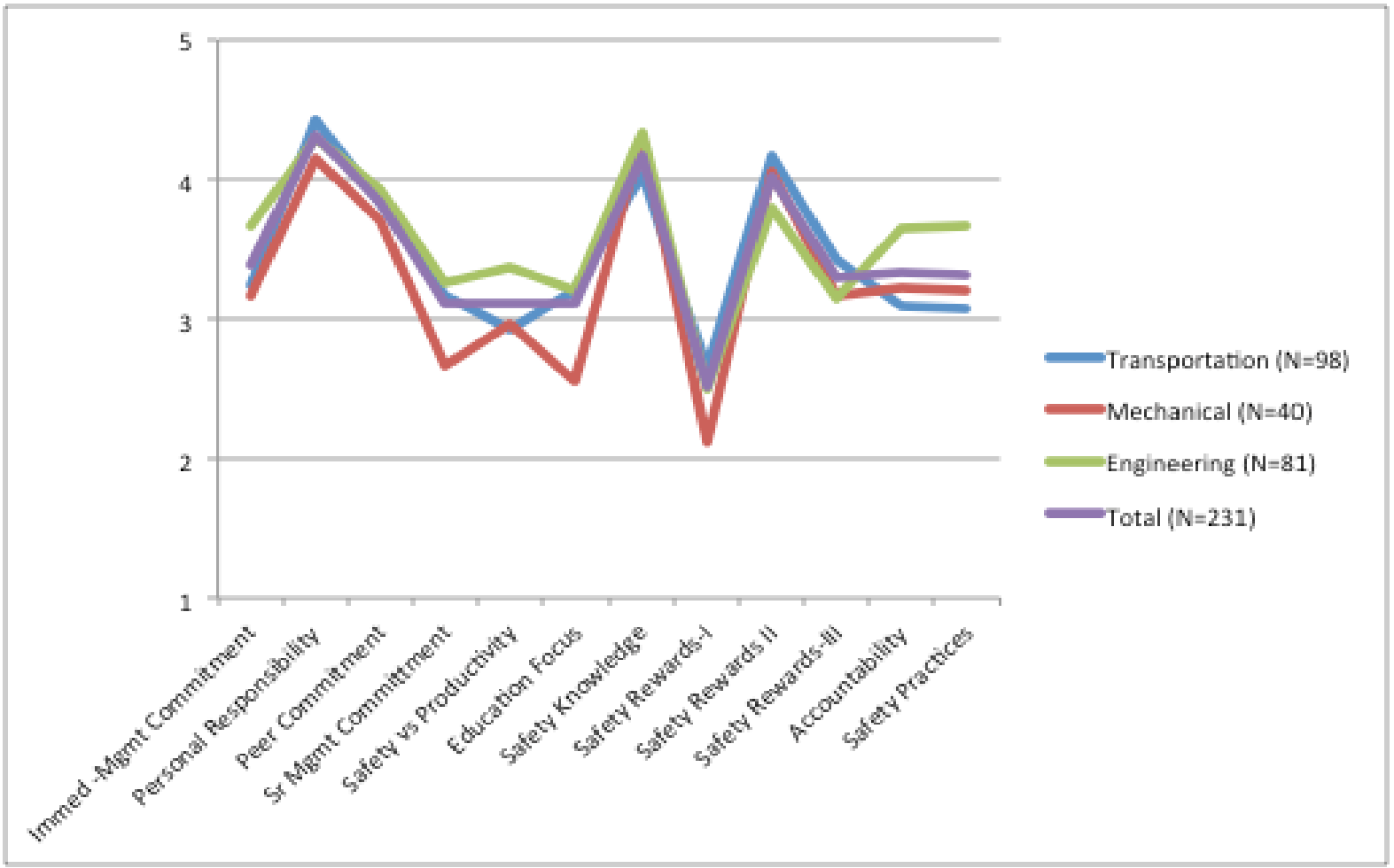
Previous Research

Comparison of individuals who reported a near miss or not.

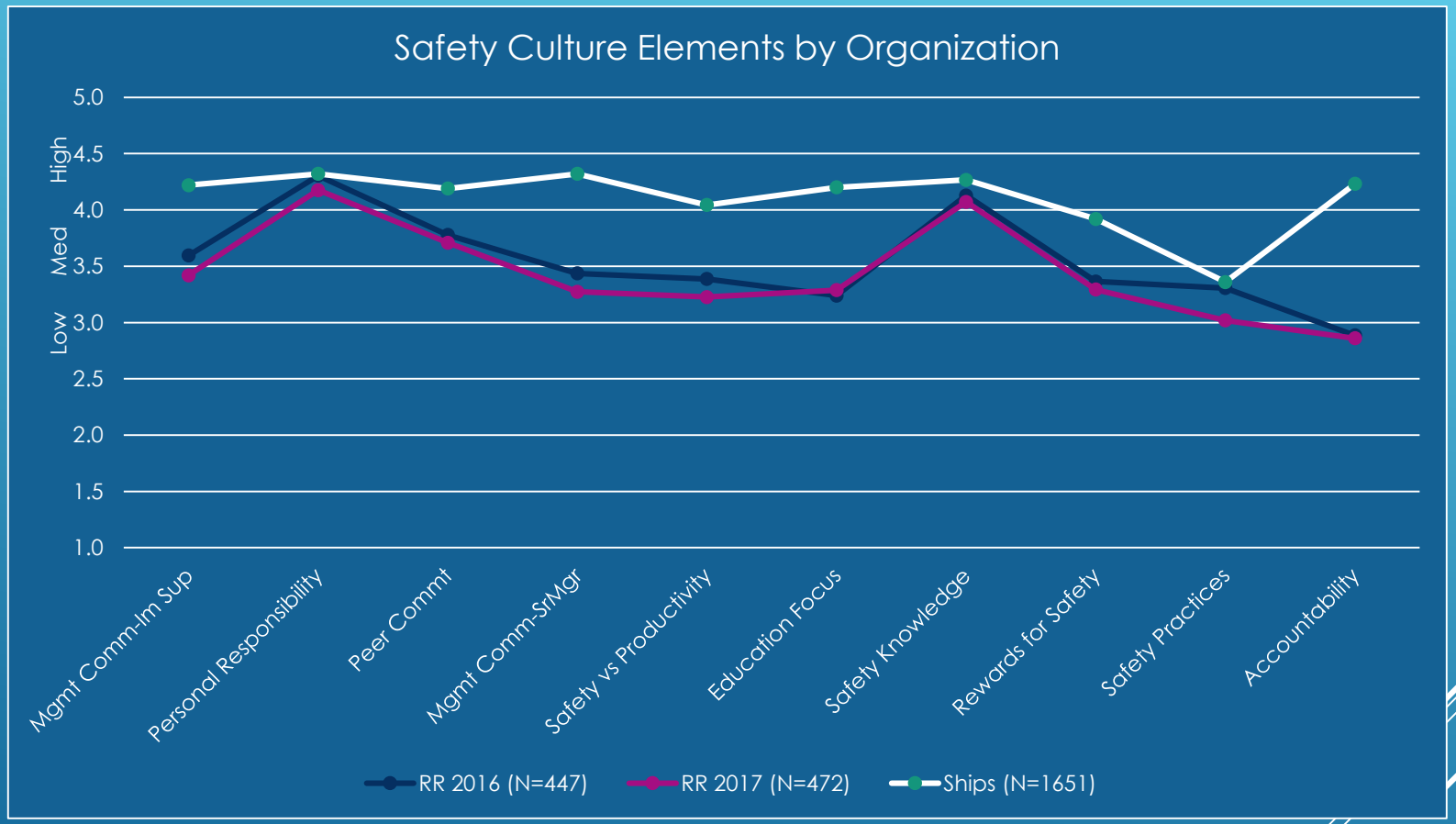


COMPARISON OF EMPLOYEES - NEAR MISS

COMPARISON OF DEPARTMENTS



COMPARISON OF CULTURE ELEMENTS



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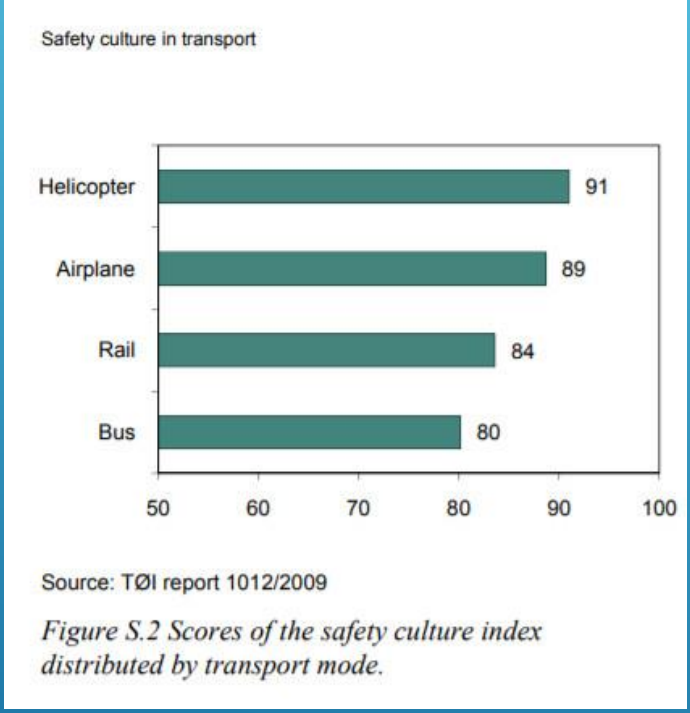

Figure S.2 Scores of the safety culture index distributed by transport mode.

DISCUSSION

- Work continues factors and items related to behavioral targets.
- Improve reliability.
- Validate relationship to criterion.

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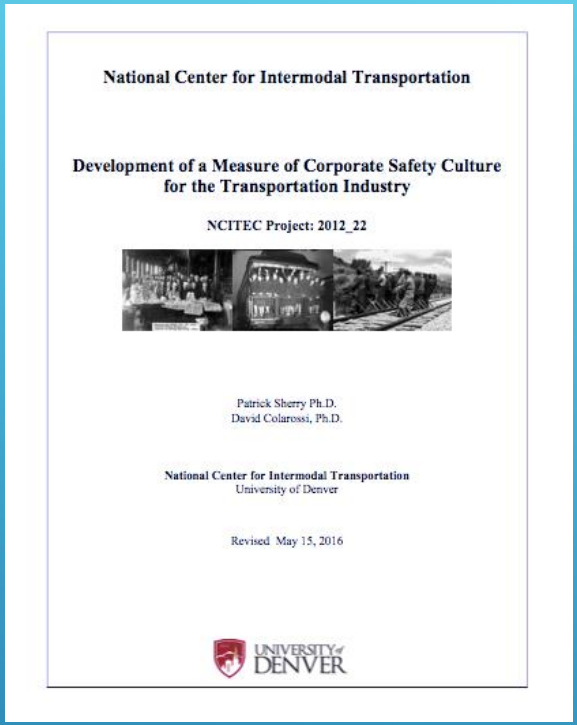
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THANK YOU!

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