

Developing a Valid and Reliable Safety Culture Instrument

DOE Safety Culture Sustainment and
Best Practices Workshop

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Programs & Projects



Purpose

1. Describe how we developed a safety culture questionnaire tailored for the DOE enterprise
2. Describe evidence gathered to demonstrate reliability and validity
3. Describe plans to further develop the instrument
4. Involve you in a construct validity exercise



Guidance

- Appendix to EFCOG Guidance Manual
- ORAU document to share today

Guide for Developing and Using Safety Culture Questionnaires

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Psychometrics

The field concerned with the theory and technique of psychological measurement

- constructing measurement tools
- employing mathematical methods to assist with construction and validation of interpretations, and investigation of psychological measures
- assessing the reliability level of interpretations based on the scores from an instrument
- assessing the validity level with which we can make inferences from the measurement tool

(Nunnally, 1970)



What is Reliability?

- Is the instrument precise?
 - do repeated measures yield the same result?
- A necessary condition of validity
- Measureable
 - Coefficient of reliability
 - Cronbach's alpha
 - Scale 0.0 – 1.0
 - Higher is better



What is Validity?

- Does the instrument measure what it is supposed to measure?
- No single measure
- Accumulate a body of evidence
- There are degrees of validity (less valid \leftrightarrow more valid)
- Construct validity the most important
 - What is the test really measuring?
 - 6 subordinate forms (content, substantive, structural, generalizability, external, consequential)

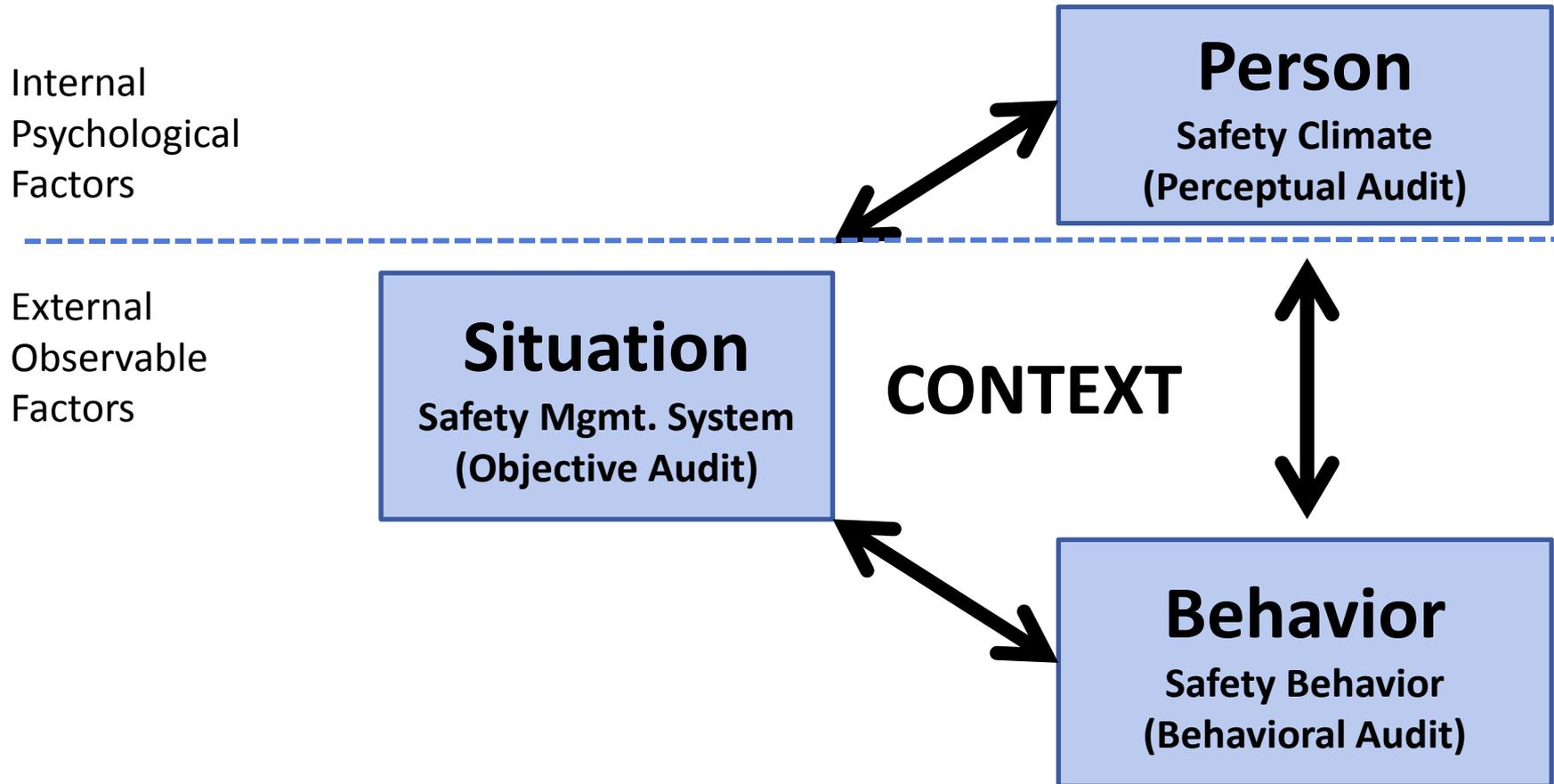


Background

- A safety culture questionnaire was developed
- Collaboration between ORAU, Y-12, and the UPF Project
- Theory based
 - Theory of reciprocal safety culture (Cooper, 2000)
 - Conceptual approach to organizational culture and leadership (Schein, 2012)
- Structure aligned with the NRC/INPO model of a healthy safety culture



Reciprocal Safety Culture Model



Cooper, 2000



10 Traits of a Healthy Safety Culture

1. **Leadership Safety Values and Actions**—Leaders demonstrate a commitment to safety in their decisions and behaviors
2. **Problem Identification and Resolution**—Issues potentially impacting safety are promptly identified, fully evaluated, and promptly addressed and corrected commensurate with their significance
3. **Personal Accountability**—All individuals take personal responsibility for safety
4. **Work Processes**—The process of planning and controlling work activities is implemented so that safety is maintained
5. **Continuous Learning**—Opportunities to learn about ways to ensure safety are sought out and implemented
6. **Environment for Raising Concerns**—A safety conscious work environment is maintained where personnel feel free to raise safety concerns without fear of retaliation, intimidation, harassment, or discrimination
7. **Effective Safety Communication**—Communications maintain a focus on safety
8. **Respectful Work Environment**—Trust and respect permeate the organization
9. **Questioning Attitude**—Individuals avoid complacency and continuously challenge existing conditions and activities in order to identify discrepancies that might result in error or inappropriate action
10. **Decision-making** – decisions that support or affect nuclear safety are systematic, rigorous, and thorough



Item Development

- Pool of ~200 items from various instruments
- Mapped items to INPO traits and attributes
- Created operational questions for each attribute
- Modified questions to fit DOE enterprise
- Close-end, Likert-type scale



Mapping the Items

Question #	#	Safety Culture Trait (Construct)	Description	Attributes (Variable)	Question (Measure the Variable)	Modified Question
1	PA.1	Personal Accountability	All individuals take personal responsibility for safety. Responsibility and authority for nuclear safety are well defined and clearly understood. Reporting relationships, position authority and team responsibilities emphasize the overriding importance of nuclear safety.	Standards: Individuals understand the importance of adherence to nuclear standards. All levels of the organization exercise accountability for shortfalls in meeting standards.	PA.1.1 I understand the importance of adhering to nuclear standards.	I understand the importance of our safety rules.



Item Development

- Selected 3-5 items per trait
- 36 safety culture items selected
- 9 demographic items selected
- Reviewed by panel of 10 subject matter experts
- Field tested with 40 participants



Administered at Three DOE Sites

- Uranium Processing Facility Project
- Y-12 National Security Complex
- Oak Ridge Associated Universities
- <10 minutes to complete
- ~5,000 people have completed the survey



Evidence of Reliability

- Test-retest method
- 15 participants
- Cronbach's Alpha = 0.94
- Highly reliable



Evidence of Construct Validity

- Based on published theory (content validity)
- Reviewed by subject matter experts (content validity)
- INPO traits widely accepted; Items appropriate for measuring safety culture (substantive validity)
- Positive direction and strong correlation between traits (structural validity)
- Convergence with QLT data (external validity)



Does the Instrument Fit the Model?

- Factor analysis
 - Confirmatory
 - Exploratory
- Measures the relationships between the variables (i.e., common variance)
- What fits; what doesn't
- Some items fit better than others



Next Steps

- Adjust items as necessary
- Repeat reliability testing
- Repeat confirmatory factor analysis
- Perform structural equation modeling



Exercise

- The purpose of this exercise is to help you learn how to critically examine a questionnaire item.
- Distribute the handout



Proposed Changes

10. I feel that, if necessary, I could communicate openly and honestly with oversight, audit and regulatory organizations.

I would communicate honestly with external auditors.

36. Complete, accurate and up-to-date documentation of work processes is available to me.

Up-to-date procedures are available to me.



Final Observations

Safety culture questionnaire best practices include:

- Measuring reliability
- Gathering of evidence of validity
- Making iterative improvements

