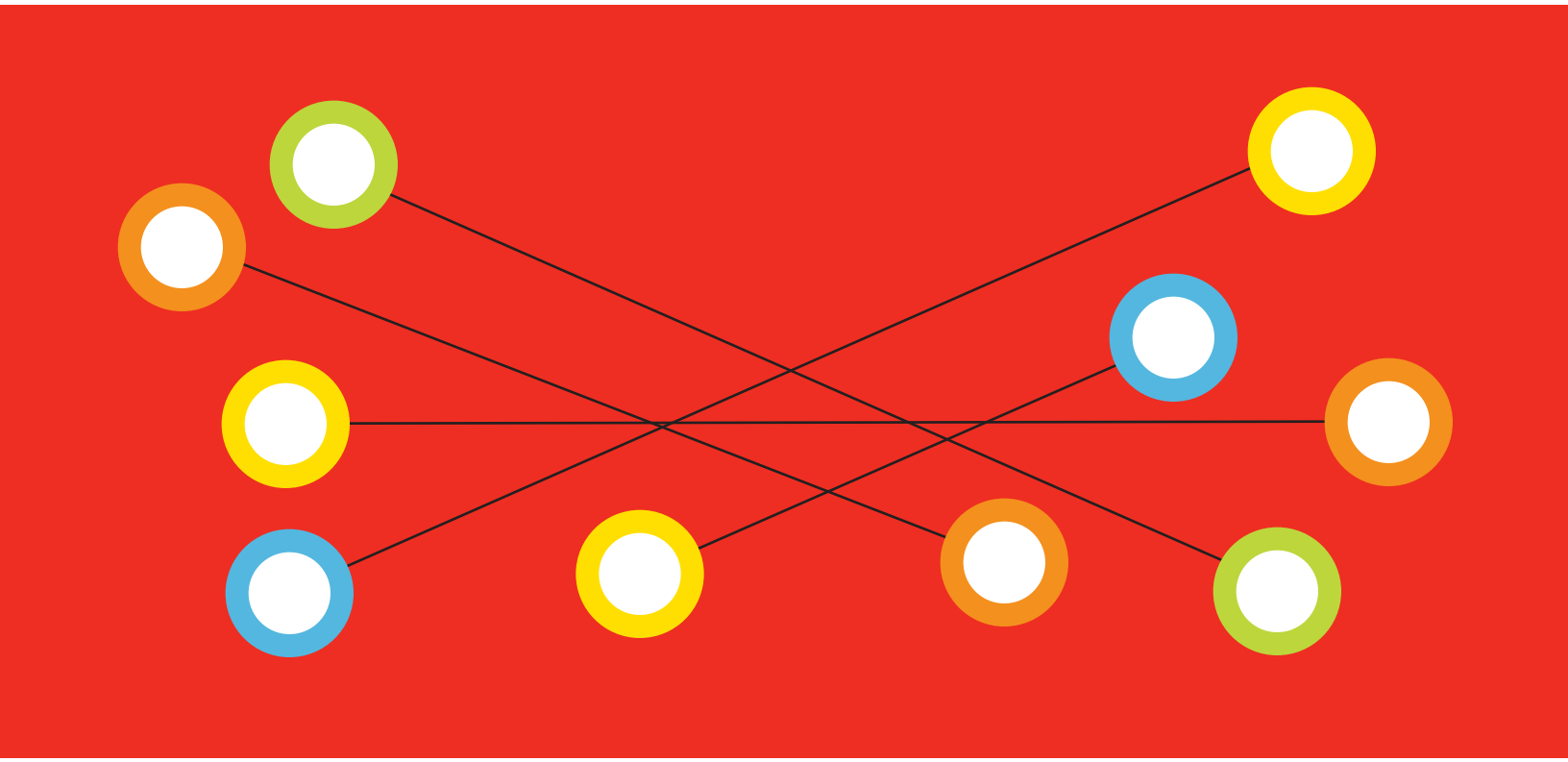
Safety Culture and Climate in Construction:

Bridging the Gap Between Research and Practice

June 11-12, 2013
Omni Shoreham Hotel – Washington DC

WORKSHOP REPORT



National Institute for Occupational Safety and Health
NIOSH

CPWR
THE CENTER FOR CONSTRUCTION
RESEARCH AND TRAINING

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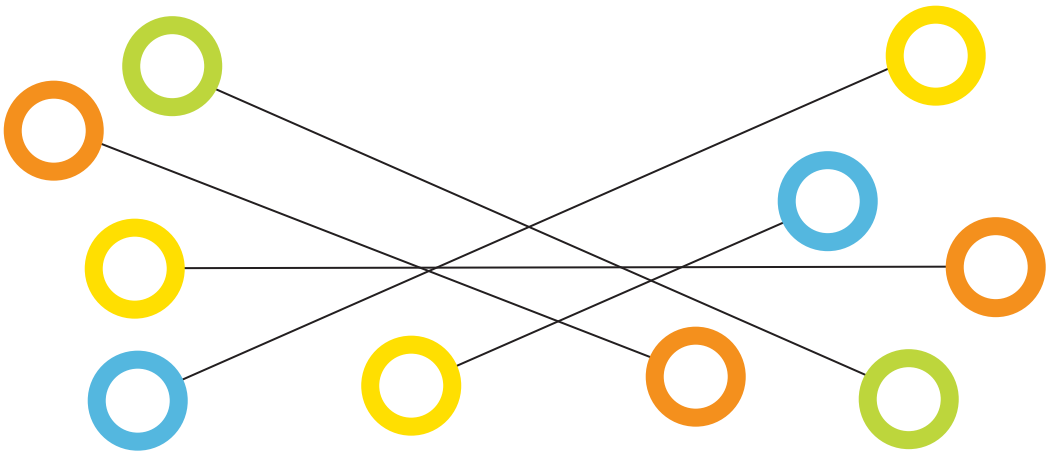

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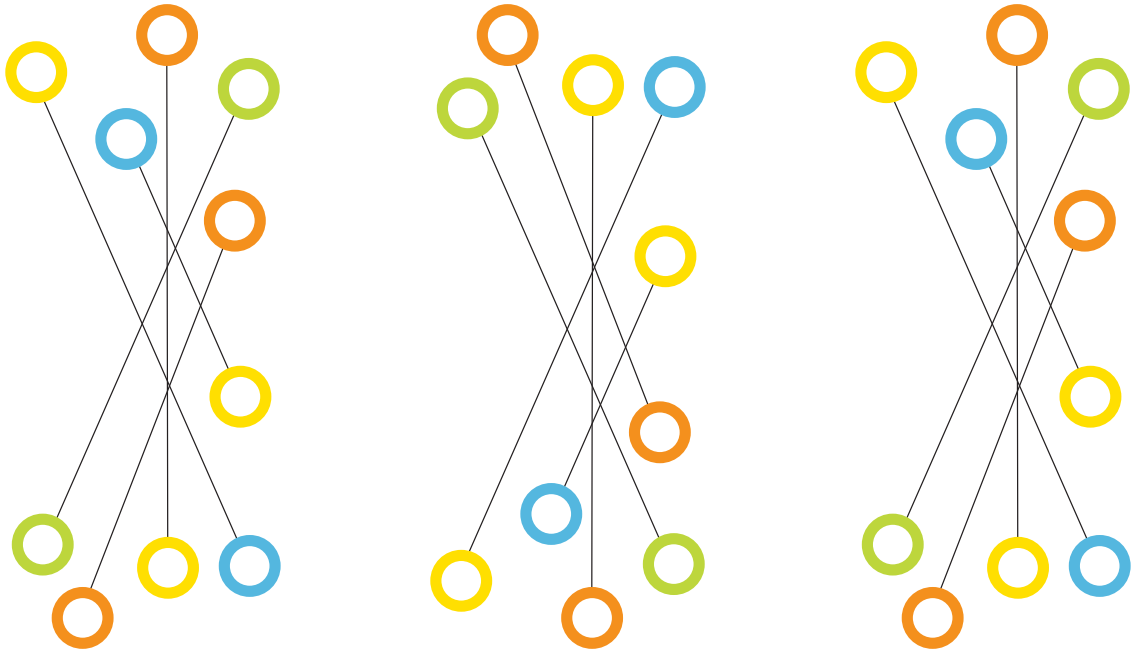

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EXECUTIVE SUMMARY

Researchers and practitioners have identified safety culture and safety climate as key to reducing injuries, illnesses and fatalities on construction worksites. Many construction contractors are trying to improve these indicators as a way to move closer to a goal of achieving zero injury worksites. Unfortunately, neither the industry nor the scientific literature have reached a consensus on how to define these concepts, how they should be measured, or which interventions designed to improve them are likely to succeed. If we are to ever understand the degree to which safety culture and safety climate contribute to improving safety outcomes, we need to 1) agree on what safety culture and safety climate mean, 2) develop reliable and valid ways to measure them so we can identify and target sites needing improvement, and 3) design, implement, and evaluate interventions that, based on the research metrics, actually improve them.

In 2008, the Construction Sector Council of the National Occupational Research Agenda (NORA), sponsored by NIOSH, developed a research agenda. One of the 15 strategic goals identified for research was "Construction Culture." It specified the need to better understand safety culture in construction and how it impacts construction safety and health.

To help address these needs and move the NORA Construction Sector Council research agenda forward, CPWR – The Center for Construction Research and Training and The National Institute for Occupational Safety and Health (NIOSH) convened a 1½ day workshop June 11-12, 2013. The construction-focused workshop was part of a larger Safety Climate and Safety Culture workshop co-hosted by the National Institute of Environmental Health Sciences (NIEHS) and CPWR. While there were shared plenary and closing sessions, there were two separate tracks, each attended by a different target audience (NIEHS report can be found at http://tools.niehs.nih.gov/wetp/).

A literature review and fifteen interviews were conducted prior to the workshop, and meeting organizers used the results to inform the meeting structure and provide input for session planning. Short trigger talks followed by small structured group discussions were used to ensure the workshop would be an interactive experience for all attendees. Seventy-two invited construction stakeholders representing the following constituency groups participated in the construction track: contractors (25%), employer associations (12%), labor organizations (14%), researchers/academics (40%), consultants (6%), and insurance firms (4%). Participants were assigned to one of the six work groups to guarantee a balanced mix of invited constituent groups in each group. Trained group facilitators used a structured set of topics and questions as a way to maximize discussion and obtain report-out material from each session. The planning committee spent five months developing the facilitator handbook (available upon request) along with relevant and useful handout materials to use during the various workshop sessions.

Workshop Process and Outcomes

This report describes the overall progression of the workshop and its individual sessions, output from the discussion groups and the workshop as a whole, and poses additional critical questions and action items for follow-up.

Session 1 titled: Defining and Framing Safety Culture and Climate for the Construction Industry, oriented participants to the workshop structure and activities, reviewed key considerations that frame safety culture and climate in construction, and included discussion and voting on the specific definitions of safety climate and safety culture.

Session 2 titled: Leading indicators: Key factors that contribute to safety climate, addressed current thinking on which leading indicators (i.e., factors) can reliably predict safety climate and the relationship between safety climate and safety outcomes. Work groups developed lists of the most critical factors comprising safety climate for the construction industry.

Session 3 titled: Assessing safety climate, pertained to ways in which safety climate is measured. The primary objectives were to discuss safety climate assessment in construction, describe how safety climate can be used as a leading indicator of safety performance, and explain the difference between surveys and rubrics and when it may be more useful to use one rather than the other.

Safety culture is inherent to the organization; safety climate is an expression of safety culture on a jobsite.

Session 4: titled Interventions to improve safety climate, focused on the work groups identifying interventions to improve safety climate factors/indicators and discussing practical considerations and tips for successful implementation including barriers to successful implementation.

Session 5, the final session, focused on next steps for bridging the gaps and moving forward. The primary objectives were to summarize the earlier discussions and identify areas of agreement, disagreement and uncertainty; current and future needs; and steps to carry the workshop discussion forward toward action.

In general, the workshop participants believed that safety culture was defined as inherent to the organization whereas safety climate was defined as the expression of safety culture on a particular jobsite and at a particular time. The work groups identified a number of factors they perceived were important indicators of safety climate. The final factors voted on by the larger group as being most critical are:

- Supervisory leadership
- Safety as a value/safety alignment
- Management commitment
- Employee empowerment /and involvement
- Accountability
- Communication
- Training
- Owner/Client Involvement

Participants believed that measuring safety climate was important for learning about a project's current level of safety climate as well as determining if changes to improve it are effective. Numerous safety climate surveys have been used in construction and while neither researchers nor practitioners have coalesced around any one standard survey tool, existing surveys have many similarities (See Appendix 4 for list of existing tools). A rubric approach was presented at the workshop which allows for a qualitative evaluation of progress towards achieving an 'exemplary' safety climate. A rubric is a scoring tool that includes a set of criteria for assessing achievement of a particular type of work or performance. Many of the participants saw advantages to such an approach.

The workgroups identified and discussed numerous interventions that could be used to improve each of the identified safety climate factors. They also noted barriers that could hinder implementation including construction schedules, perceived lack of time and resources, organizational silos, low bid contracting, and other project delivery constraints. Participants also discussed the need to evaluate interventions to identify those that are most effective.

Workshop Follow-up

The literature and presentations from the workshop are posted at http://www.cpwr.com/safety-culture. Also, in an effort to develop useful and measurable working definitions for both safety culture and safety climate, the meeting organizers examined the workshop voting results, definitions presented in the published literature, and construction stakeholder interviews. They concluded that while safety culture is more widely used it is often applied as a catchall term to reflect organizational norms and members' perceptions, attitudes and behaviors. While in popular usage the terms "safety culture" and "safety climate" are often seen as interchangeable, they have specific and distinct meanings and therefore need to be measured differently. The committee used the following criteria to guide the development of the safety culture and safety climate definitions presented in the report:

- Clarify the distinctions between culture and climate
- Facilitate assessment as well as intervention development and implementation
- Reflect that safety is not separate from but rather is integrally related to overall organizational operation and performance
- Account for the particular characteristics of the construction industry.

The resulting three definitions are:

(Organizational) Safety Culture: Deeply held but often unspoken safety-related beliefs, attitudes, and values that interact with an organization's systems, practices, people, and leadership to establish norms about how things are done in the organization. Safety culture is a subset of, and clearly influenced by, organizational culture. Organizations often have multiple cultures or subcultures, and this may be particularly true in construction.

(Organizational) Safety Climate: The shared perceptions of safety policies and procedures by members of an organization at a given point in time, particularly regarding the adequacy of safety and consistency between actual conditions compared to espoused safety policies and procedures. Homogeneous subgroups tend to develop shared perceptions while between-group differences are not uncommon within an organization.

Project Safety Climate: Perceptions of occupational safety and health on a particular construction project at a given point in time. It is a product of the multiple safety climates from the different organizations involved in the project including the project owner, construction manager/general contractor, and subcontractors. Project safety climate may be heavily influenced by local conditions such as project delivery method, schedule and planning, and incentives.

Future research needs to be conducted to develop common indicators and measures of safety climate. This will help standardize safety climate and safety culture measurement, advance intervention implementation and allow for better evaluation of intervention effectiveness across the diverse sectors of the construction industry, including smaller contractors.

In summary, on behalf of the meeting organizers and the workshop participants that shared their perspectives and experiences, we hope this report provides a useful resource for construction practitioners and researchers alike. More attention is needed on this important topic, which is so relevant to improving safety and health conditions for the nation's construction workers.

Introduction

Both researchers and practitioners have identified safety culture and safety climate as key to reducing injuries, illnesses and fatalities on construction worksites. Many construction contractors are trying to improve these indicators as a way to move closer to a goal of achieving zero injury worksites. Unfortunately, neither the industry nor the scientific literature have reached a consensus on how to define these concepts, how they should be measured, or which interventions designed to improve them are likely to succeed. If we are to ever understand the degree to which safety culture and safety climate contribute to improving safety outcomes, we need to 1) agree on what safety culture and safety climate mean, 2) develop reliable and valid ways to measure them so we can identify and target sites needing improvement, and 3) design, implement, and evaluate interventions that, based on the research metrics, actually improve them.

In 2008, the Construction Sector Council of the National Occupational Research Agenda (NORA), sponsored by NIOSH, developed a research agenda. One of the 15 strategic goals identified for research was "Construction Culture." It specified the need to better understand safety culture in construction and how it impacts construction safety and health. The overarching strategic goal and related intermediate goals are presented below:

STRATEGIC GOAL 8.0: Increase understanding of factors that contribute to safety culture and climate in the construction industry and improve sector capabilities to evaluate and improve practices at the policy, organizational, and individual level. Promote increased attention to safety culture and climate as a way to improve the effectiveness of safety and health programs and practices.

- **Intermediate Goal 8.1:** Create a working definition and framework for construction industry safety and health culture and improve understanding of the factors that contribute to a positive or negative safety and health culture in the construction industry.
- **Intermediate Goal 8.2:** Develop and expand the use of validated measurement methods for evaluating safety culture and safety climate in the construction industry.
- **Intermediate Goal 8.3:** Partner with construction stakeholders to develop and disseminate effective intervention measures for improving safety and health culture in the construction industry.

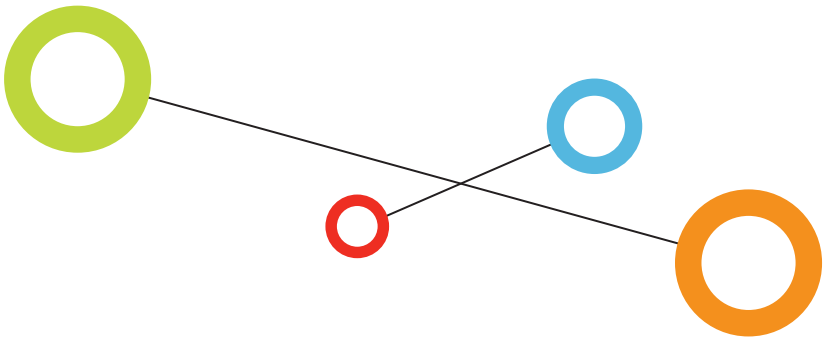
To help address these needs and move the NORA Construction Sector Council research agenda forward, The Center for Construction Research and Training (CPWR) and The National Institute for Occupational Safety and Health (NIOSH) convened a 1½ day workshop June 11-12, 2013. The construction-focused workshop was part of a larger Safety Climate and Safety Culture workshop co-hosted by the National Institute for Environmental Health Sciences (NIEHS) and CPWR. While there were shared plenary and closing sessions, there were two separate tracks, each attended by a different target audience (NIEHS report can be found at http://tools.niehs.nih.gov/wetp/). See Appendix 1 for the construction track agenda.

Seventy-two invited construction stakeholders representing the following constituency groups participated in the construction track:

Contractors	25%
Employer Associations	12%
Labor Organizations	14%
Researchers/Academics	40%
Consultants	6%
Insurance	4%

The planning committee designed the construction track to have short trigger sessions followed by small group discussions to ensure it would be an interactive experience. Participants were strategically assigned to one of six small groups to guarantee a balanced mix of invited constituent groups in each group. Prior to the workshop, group facilitators were trained to use a structured set of topics and questions as a way to maximize discussion and obtain report-out material from each session. The planning committee developed a facilitator handbook (available upon request) along with relevant and useful handout materials to use during the various workshop sessions. A brief literature review containing important background material pertaining to safety culture and safety climate in construction as well as in other industries was prepared by two of the members (Hecker and Goldenhar) and distributed to participants. Participant evaluations and post-workshop feedback indicated a great deal of enthusiasm for the meeting and in some cases offered ideas for potential follow-up activities.

This report describes the overall progression of the workshop, output from the discussion groups and the workshop as a whole, and poses additional critical questions and action items for follow-up. The content reflects the current debate and discussion about safety culture and climate, particularly as applied to the unique construction work environment. This workshop was intended to be the beginning of, and this report to be a stimulus for, ongoing discussions that will lead to fundamental improvements in construction safety culture and safety climate and ultimately construction worker safety and health.



Chapter 1: Defining and Framing Safety Culture and Climate for the Construction Industry

The primary objectives of this session were to:

1. **Orient participants to the workshop structure and specific session activities; acquaint them with the handout and evaluation materials and Audience Response System (ARS) multi-voting processes.**
2. **Review key considerations that frame safety culture and climate in construction.**
3. **Discuss and vote on, both as a group and as individuals, the specific definitions of safety climate and safety culture.**

Trigger speaker - Steve Hecker, Associate Professor Emeritus at the University of Oregon, was the first trigger speaker and began his talk by asking the construction track participants to consider if and how the unique characteristics of the construction industry might influence the safety culture and safety climate concepts and ideas he presented during the earlier combined workshop plenary session. The specific characteristics he mentioned include a mobile and transient workforce, craft acculturation and norms, distinct craft cultures, the role of the construction foreman, multi-employer worksites, employer culture vs. project culture, project delivery methods that can facilitate or hinder steps to a more positive culture, the segmentation of the construction industry, and the preponderance of small employers. He referenced ideas from the literature review summary that pertain specifically to the construction industry. Below are a few key points. (Presentations and Literature Review Summary are available at http://www.cpwr.com/safety-culture).

- Approximately 50 construction-specific studies of safety culture or climate have been published in English. A majority were conducted by academics outside the United States including Hong Kong, Taiwan, United Kingdom, Scandinavia, and Australia. Most of the measurement tools were not construction specific or were adapted from instruments designed for general industry application.
- The value of safety climate metrics for predicting safety outcomes has been supported by t wo meta-analyses that included a number of construction studies (Nahrgang et al. 2010; Christian et al. 2009). Safety behaviors and injuries were typically measured via self-reports, observations, or administrative processes. Most studies were cross-sectional so causal relationships cannot be determined. A few of the longitudinal studies supported a relationship between safety climate and injury severity (Johnson 2007).
- While consensus does not exist, findings from construction safety climate/culture studies suggest a set of core safety climate dimensions: management safety priority, safety management, safety communication, and workgroup safety involvement (Seo et al. 2004). A Swedish qualitative study of foremen and union safety representatives found that four main factors contributed to high safety standards: project characteristics and nature of work; organizations and structures; collective values, norms, and behaviors; individual competence and attitudes (Torner & Pousette 2009). Respondents believed that these factors likely interact with and mutually reinforce each other.

- Safety climate survey instruments were administered on two construction mega-projects in the US (Las Vegas City Center) and UK (London Olympic Park). Data from the Las Vegas City Center project, a site plagued by high fatality rates, revealed significant gaps in safety perceptions among craft, foremen, superintendents, and executives. Data-driven recommendations included greater involvement and visibility on safety by project management and greater empowerment of workers (Gittleman et al. 2010). On the London Olympic Park construction project, safety climate data across all contractors was extremely positive and was attributed to strong owner involvement, the scale and duration of the project which allowed adequate time for safety initiatives to become embedded in standard processes, consistent messaging, follow-through, and empowerment of tier one contractors to establish their own processes and systems to meet goals (Healy & Sugden 2012).
- Multiple cultures exist on construction sites and both trade acculturation/norms and the presence of many smaller contractors and subcontractors complicate measurement and improvement of safety culture and climate. Therefore, it is important to consider the level at which safety climate data are aggregated and analyzed, because while there may be within group homogeneity there is likely to be between group heterogeneity (Lingard et al. 2009).

Process - Organizers distributed a handout containing 10 safety culture and 10 safety climate definitions obtained from both the peer-reviewed academic literature and from interviews recently conducted with contractors and safety practitioners (See Figures 1a and 1b). Workgroups reviewed and discussed each definition and were asked to select one for climate and one for culture that they thought was most relevant for construction. Workgroups also had the option of writing their own definition or modifying the ones provided. The groups reported back their favorite definitions, and individual participants used an electronic audience response system to vote on which they thought best reflected the concepts within the construction industry.

Figure 1a. Handout: Definitions of Safety Culture

1. Safety culture incorporates the values and norms and beliefs of a particular company.
2. Safety culture is a group's initiatives, actions, exercises, processes, habits, training and education and relationships, etc., that pool to establish the core principles and values of the group.
3. Safety culture is the overall mindset of what folks think about safety on the job site, that yes, we want to be a safe company.
4. Safety culture is how people act when nobody's watching.
5. Safety culture is a subset of the culture of the organization. It represents not necessarily well articulated expressions of how and why things are done within the organization.
6. The safety culture of an organization is 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. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures.
7. Shared values (what is important) and beliefs (how things work) that interact with a company's people, organizational structures and control systems to produce behavioral norms (the way we do things around here).
8. Safety cultures reflect the attitudes, beliefs, perceptions, and values that employees share in relation to safety.

(continued on next page)

9. Safety culture is the set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimizing the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injurious.
10. Safety culture is the concept that the organization's beliefs and attitudes, manifested in actions, policies, and procedures, affect its safety performance

Figure 1b. Handout: Definitions of Safety Climate

1. Safety climate is what happens on a day to day basis, sort of a snapshot of what's actually happening and how employees perceive how the company is actually implementing safety on the ground.
2. Safety climate is how things are being done, you know how it really is right now, and is it really being practiced? Is safety a major concern for the company, do they really care about safety or are they just talking about it?
3. Safety climate is more of an encouragement, enabling and giving people the tools and education. It is very much about support for the ability for people to perform their work safely.
4. Safety climate is the shared perceptions of the workforce at a given point in time as to the extent hazard identification and injury performance are important to the organization as perceived by their interactions with their direct supervisors.
5. The safety climate is the environment in which a company puts its safety culture to work. Like providing the tools and equipment necessary, maybe the resources on our job sites to create that environment in which people are allowed to work safely.
6. Safety climate is a leading indicator. It reflects how well the espoused safety program is ultimately integrated into the organization to support safe effective practices at the point of operation.
7. Safety climate is the objective measurement of attitudes and perceptions toward occupational health and safety issues.
8. Safety climate is a subset of organizational climate that measures through members' perceptions the degree of congruence between an organization's espoused values and policies and enacted practices.
9. Safety climate is the shared perceptions of organizational members about their work environment and, more precisely, about their organizational safety policies.
10. Safety climate reflects shared perceptions of the relative priority of safety compared to other competing organizational priorities.

Results - The safety culture definitions receiving the most votes were the original #7 and #8 from Figure 1a and their preferred safety climate definitions were the original #6 and #10 in Figure 1b. (See Tables 1 and 2)

Table 1. Participants' top ranked choices for safety culture definition

Shared values (what is important) and beliefs (how things work) that interact with a company's people, organizational structures and control systems to produce behavioral norms (the way we do things around here).	30%
Safety culture reflects the attitudes, beliefs, perceptions, and values that leadership and employees share in relation to safety.	29%
Safety culture reflects the stakeholders' 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.	14%
Safety culture is the concept that the organization's beliefs and attitudes, manifested in actions, policies, and procedures, affect its safety performance.	11%
Safety culture reflects the attitudes, beliefs, perceptions, and values that leadership and employees share in relation to safety. [Integrating safety into organizational and cultural operations]	9%
The safety culture of an organization is 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. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures.	7%

Table 2. Participants' top ranked choices for safety climate definition

Safety Climate is a leading indicator. It reflects how well the espoused safety program is ultimately integrated into the organization to support safe effective practices at the point of operation.	33%
Safety climate reflects shared perceptions of the relative priority of safety compared to other competing organizational priorities.	23%
The safety climate is the environment in which a company puts its safety culture to work. Like providing the tools and equipment necessary, maybe the resources on our job sites to create that environment in which people are allowed to work safely.	19%
Safety climate is the shared perceptions of organizational members about their work environment and, more precisely, about their organizational safety policies.	16%
Safety climate is a subset of organizational climate that measures through members' perceptions the degree of congruence between an organization's espoused values and policies and enacted practices.	9%

Summary - Defining safety culture and climate is essential for at least two reasons: 1) the terms are used loosely and often in contradictory ways, and 2) it is not possible to accurately measure ill-defined concepts. The primary goals of the framing session were to explore a variety of definitional issues and attempt to identify agreed-upon working definitions for both safety culture and safety climate. While the process did not meet the second goal, one-third of the participants did agree on one definition for each concept and between a quarter and a third agreed on a second one.

In an effort to move us closer to having a useful and measurable definition for both safety culture and safety climate, we examined the voting results from the workshop and reviewed the definitions presented in the published literature and provided by stakeholders during one-on-one

interviews. We found that although safety culture is more widely used, it is often used as a catchall term to reflect organizational norms and members' perceptions, attitudes and behaviors. While in popular usage the terms "safety culture" and "safety climate" are often seen as interchangeable, they have specific and distinct meanings and therefore need to be measured differently. These concerns led us to develop the definitions of safety culture and safety climate presented below that meet the following criteria:

- Clarify the distinctions between culture and climate
- Facilitate assessment as well as intervention development and implementation
- Reflect that safety is not separate from but rather is integrally related to overall organizational operation and performance
- Account for the particular characteristics of the construction industry.

(Organizational) Safety Culture: Deeply held but often unspoken safety-related beliefs, attitudes, and values that interact with an organization's systems, practices, people, and leadership to establish norms about how things are done in the organization. Safety culture is a subset of, and clearly influenced by, organizational culture. Organizations often have multiple cultures or subcultures, and this may be particularly true in construction.

(Organizational) Safety Climate: The shared perceptions of safety policies and procedures by members of an organization at a given point in time, particularly regarding the adequacy of safety and consistency between actual conditions compared to espoused safety policies and procedures. Homogeneous subgroups tend to develop shared perceptions while between-group differences are not uncommon within an organization.

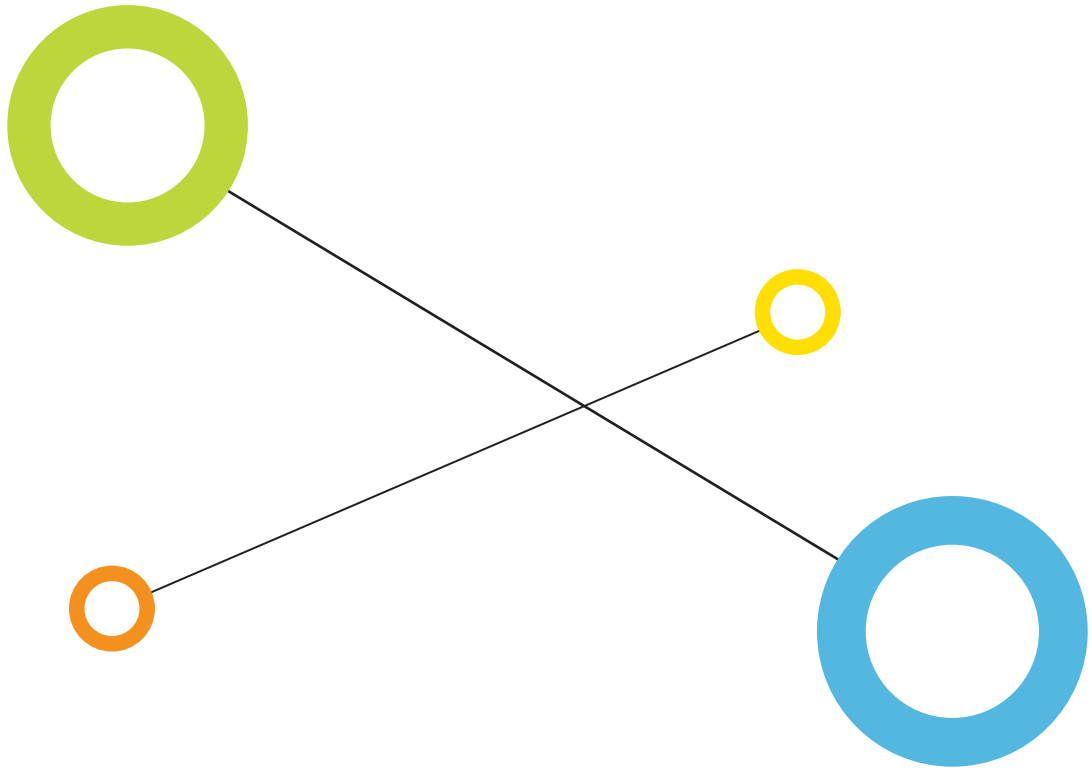
Project Safety Climate: Perceptions of occupational safety and health on a particular construction project at a given point in time. It is a product of the multiple safety climates from the different organizations involved in the project including the project owner, construction manager/general contractor, and subcontractors. Project safety climate may be heavily influenced by local conditions such as project delivery method, schedule and planning, and incentives.

We chose not to define project safety culture here because it is more complicated. That is, an owner or general contractor can attempt to transfer its internal safety culture onto a project, but without pre-existing relationships with subcontractors, craft workers, and other project collaborators it can be challenging to align values and norms. Beyond the construction-specific references in the definitions themselves, we offer an additional caveat. The multi-employer and multi-trade nature of the construction industry requires paying special attention to the presence of multiple, possibly competing, cultures.

The two main concepts of safety culture and safety climate can be distinguished by how each is measured and evaluated as discussed later in Chapters 2 and 3. One can obtain a superficial understanding of an organization's safety culture by doing an audit of the types of safety-related programs and policies it implements (i.e., safety management systems). However, to obtain an in-depth appreciation of the unspoken safety-related beliefs, attitudes, and values, more in-depth methods -- such as case studies or ethnography -- are required. On the other hand, safety climate is more easily measured by administering surveys to organizational members to assess their perceptions of how well safety-related programs and policies are being implemented and enforced to determine the congruence between espoused and enacted safety values. While people tend to agree that safety culture, safety climate, and safety management systems are different, they are

related. That is, having a culture where leaders are engaged is separate from effectively implementing specific systems, but in practice the two are likely to be highly correlated.

In the remainder of this report we will use the term safety climate when discussing issues pertaining to assessment and intervention because we believe it reflects the definitions above and actual practice in construction. We also avoid implying that culture can be measured and changed quickly and easily. In the conclusion section we return to using both terms as we propose action steps to address them within the construction industry.



Chapter 2: Leading Indicators: Key Factors that Contribute to Safety Climate

The primary objectives of this session were to:

1. **Describe current thinking on which leading indicators (i.e., factors) can reliably predict safety climate and the relationship between safety climate and safety outcomes.**
2. **Describe the most critical factors comprising safety climate for the construction industry.**

Academic researchers and practitioners use different terms to describe the various influential aspects of organizational or worksite safety climate. In academic parlance, both terms are considered to be constructs or theoretical ideas that encompass one or more factors; sometimes called dimensions, determinants, antecedents, or drivers. We decided to use the term 'factor' in the workshop. Individual factors can be measured, often using surveys, and the results obtained can be combined to reflect the strength of the construct.

In the construction industry, the more typical gauge of a company's commitment to safety and health was their injury and illness rate, also called lagging indicators. Over the last 10 years or so, the practice in some, particularly larger, companies has shifted to relying on 'leading indicators'. This term comes from the field of economics and is defined as: Measurable factors of economic performance that change ahead of the underlying economic cycle starts to follow a particular direction or trend. ….Major leading indicators include orders for durable goods, orders for plant and equipment, new housing starts, change in raw material prices, corporate profits and share prices, business formation and failures, and money supply.(www.BusinessDictionary.com accessed 12/30/13). While the leading indicators (i.e., factors) of safety climate are different than those in this definition, the underlying premise is the same; they are used to forecast end outcomes. In our case we are not talking about economic climate, but rather safety climate and ultimately safety and health outcomes (injury/illness). While there is yet to be agreement on the specific leading factors/indicators that comprise or predict a positive safety climate, we gained some insight from our trigger speakers and from the workshop participants.

Trigger speaker - Dr. Ben Amick, Professor at the University of Texas and the Institute for Work and Health in Ontario Canada, kicked off the session by speaking about current perspectives and research on leading indicators for safety and health and how safety culture and climate fit into this bigger picture.

There has been a big push towards using leading indicators as organizational performance metrics. He suggested that the questions to pose about methods for measuring indicators include: How much do we want the measurement instrument to be evidence-based? What does that mean? Are we looking for instruments that will work across industries and trades? Do we want to use them to conduct gap analyses? Answering these questions requires research.

Dr. Amick reported that the research he has been conducting to develop an instrument to measure safety climate has been quite humbling. He presented eight questions for identifying leading indicators that were developed by Ontario safety and workers' compensation practitioners (Institute for Work and Health 2011). He noted that they were the same ones that emerged from his more "rigorous, painstaking" research. He has also concluded that it will be critical as we move forward in this area to develop and test safety climate indicators that can help direct changes to

improve safety climate. For example, safety audit findings should be discussed within organizations to help guide their follow-up intervention activities. Regarding the difference between safety climate and culture, Dr Amick noted that safety culture is more complicated and therefore more difficult to understand and measure, that currently there is no good science on how best to change a culture, and that while it takes time to develop a positive organizational (and safety) culture, it can be destroyed quickly. (A link to the Institute for Work and Health report and leading indicators is provided in Appendix 4)

Process - Participants were asked to share their thoughts on the most important factors they believed influenced construction safety climate. Each workgroup generated a list of factors, then multi-voted to select the six they believe were most important and relevant for the construction industry. Each workgroup reported back their top six factors at the end of the session (see Table 3). Individual participants were then given the opportunity to review the full list of factors and vote on the ones they believe were most important for influencing a company's safety climate.

Results - Due to overlap, the planning committee was able to combine the initial 36 factors reported out by the workgroups into 13 overarching ones (see Table 3). The reader will notice there is still some overlap in meanings provided but there was enough dissimilarity that we chose not to group the factors any further.

Table 3. Unique factors identified by the six workgroups

Factor	Factor meaning or components that would be measured
Communication	• Active engagement, continuously facilitated • Two-way open communication • No fear of reprisal, no filtering • Multilingual • Safety metrics visible and shared with everyone • Up, down, and lateral among hierarchy, colleagues, peers, and subcontractors • Experienced-to-inexperienced peer communication • Communicates early wins throughout organization
Accountability at all levels	• Walking the walk and talking the talk, even when no one is watching • Actions speak louder than words • Being authentic • Is shared across the organization, with discipline to follow accountability
Safety valued and aligned with production	• Shared vision, with everyone on the same page • Clear roles and responsibilities • Safety is valued equal to or greater than production, and everyone in the organization provides that answer from the top of the organization all the way down • Behaviors reinforce values – such as supporting stopping work if not meeting safety rules. • Won't low bid work if it compromises safety • Embracing good practice such as Prevention through Design (PtD) • Safety is integrated into planning and is "part of everything we do".
Employee involvement/ empowerment	• Integral part of team – empowered and involved in hazard assessment and pre-task planning. • Engaging those closest to the risk • Collaborative environment and being each other's' keepers (active caring) and willingness to interact • No retaliation • Have stop work authority • Involvement is backed up by policy • Effective safety committees

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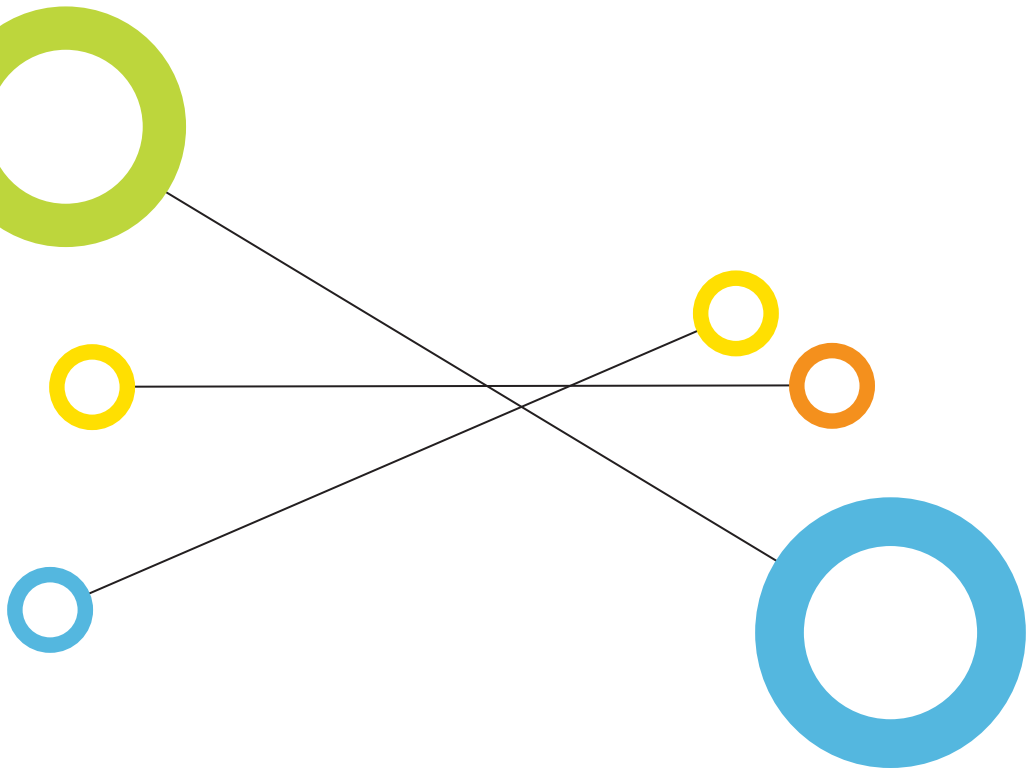
Factor	Factor meaning or components that would be measured
Training/Education at all levels	• Education provided to employees • Supportive environment for training • Continual verification of training • Making sure that training is communicated to all workers and that training is assessed correctly • Training includes supervisors and workers
Mutual trust	• Consistent response and fair treatment • Free and transparent flow of information • No fear of recrimination • Employees trust that supervisors do not dismiss safety and health • Employees trust supervisors to do what they say they will do, to back them up when they are right, and to tell them when they are doing something wrong.
Leadership involvement	• Leaders are visible on safety and provide needed resources • Are involved with creating safety goals and metrics, and performance evaluation includes safety • Are aware of true impact on safety • Leaders are competent and creative on safety • Safety becomes part of the corporate strategy • Upper management sends safety signals to supervisors • Site leadership and foremen/crew leaders are involved with safety and set an example • Leadership is clearly engaged in managing changes in process • Leadership defines vision, explains the need for change, and provides tools to implement changes • Measures the results of change and makes adjustments where needed • Superintendent and foremen have safety support and provide safety leadership to the crew. • The foremen sets the safety tone on the jobsite • The foremen is selected or promoted for safety skills, training, attitude and model safety behavior
Management commitment	• Management is committed to a shared vision of safety and health • Management is committed to integrating productivity, safety, and quality
Programs, policies, procedures, practices	• Safety systems are established and institutionalized • Programs and policies show commitment to safety • Policies and practices – the "rules of the game" support safety and health
Job planning	• Safety requires involvement in the planning of the phases of construction
Safety and health programs/systems activity	• The Safety and Health program or system is clearly defined, and is uniformly implemented and enforced • It is communicated to employees • It provides proper safety training to employees • It is proactive, not reactive • Regular audits with clear action plans are used • There are clear learning indicators as part of accountability • It focuses on near misses • It encourages employee involvement
Owner/client involvement	• The owner sets expectations for safety • The owner includes safety in bid specifications • The owner provides for adequate resources and an adequate schedule to support safety • The owner supports Prevention through Design (e.g., Design for safety)
General contractor/ construction manager management of subcontractors	• The GC/CM sets safety expectations with subcontractors • Includes safety in selecting subcontractors • Communicates/empowers subs on safety • Instills pride and provides adequate resources for safety

The six receiving the most votes and thus identified for further elaboration and discussion in subsequent sessions are listed in Table 4.

Table 4. Factors voted on for further discussion

Factor	Average percent of vote over three votes
Employee involvement/empowerment	26.0% (Top 2nd and 3rd choice)
Management commitment	22.6% (Top 1st choice)
Safety valued and aligned with production	11.6%
Owner/Client involvement	9.3%
Site safety (supervisory) leadership	9.3%
Accountability at all levels	8.0%

Summary - Workshop groups and then individual participants voted on safety climate related factors they believe most influence construction safety climate. Most mirrored the core dimensions presented by Seo (2004) mentioned above: management safety priority, safety management, safety communication, and workgroup safety involvement. While there is overlap and although two -- employee involvement and management commitment – were considered by a third of the group to be the top influences on safety climate, none received a majority of votes. This suggests that not only do a variety of factors influence safety climate on construction projects, there may be definitional issues whereby participants assigned similar meanings to different concepts and constructs or vice versa. This will be discussed further in the conclusion section.



Chapter 3: Assessing Safety Climate

The primary objectives of this session were to:

1. **Discuss safety climate assessment in construction.**
2. **Describe how safety climate can be used as a leading indicator of safety performance.**
3. **Explain the difference between surveys and rubrics and when it may be more useful to use one rather than the other.**

As mentioned above, while a company's safety culture and its' safety climate are typically highly related, climate is the more visible of the two constructs. It is discernible via the enactment of programs and policies, is more easily measured and is often conceptualized as taking safety culture's "temperature." Safety climate is typically measured using perception surveys containing question items that are comprised by specific factors. Safety climate surveys are often used to quickly assess safety culture at a particular point in time. Some even refer to these findings as a measure of safety culture.

Trigger speakers - Mr. Tony O'Dea, VP for Safety at Gilbane Construction provided a large general contractor/construction manager's perspective on techniques and tools his company has used to measure safety climate or culture on job sites and company-wide. He described two key questions that guide his efforts: 1) How do you recognize if you have a positive safety culture? 2) How do you know if it is getting results? The presentation mentioned senior leadership activities such as participating in an "Incident and Injury Free CEO forum" as well as foremen safety communication workshops, audits of daily Safety Task Assignments, and craft engagement efforts. (Presentation available at http://www.cpwr.com/safety-culture).

The second speaker, Mr. Tony Barsotti, Director of Safety and Quality Assurance at Temp Control Mechanical (TCM), provided the perspective of a medium-sized firm active in improving its safety culture and climate. He shared three working assumptions that guide his efforts: 1) Construction organizations cannot create a strong safety culture without aligning all project delivery systems and organizational objectives; 2) Leadership alignment across roles is critical to strategic change; and 3) Assessing safety culture/climate maturity level may be helpful to organizational change but is not sufficient in and of itself. He also described how TCM has worked with academic researchers on safety and safety culture issues and described recent initiatives to improve task planning and active safety leadership. He shared the results of TCM safety climate surveys. (Presentation available at http://www.cpwr.com/safety-culture).

The third and final speaker for the session, Dr. Tahira Probst from Washington State University-Vancouver, provided a researcher's perspective on climate and culture measurement in which she raised a number of thought-provoking issues:

- The difference between safety culture and safety climate is substantive, not simply semantic. Culture is the assumptions, values, and philosophies that permeate multiple facets of an organization, while climate is what we measure and reflects the shared perceptions of what is rewarded, expected, valued, and reinforced in the workplace.

- There is a difference between the level of safety climate perceptions (e.g., positive or negative), and the strength (intensity) of those perceptions, and that to detect these types of per-

ception differences, it's important to collect data from across the organization but to analyze them at the appropriate level – organization, department, workgroup, rather than combine data to obtain one result.

- Global measures of safety climate tend to be validated, provide generalizable information across industries, and can be used for benchmarking however they may be too broad to provide actionable information. Organization-specific measures are expensive to create, tend to be idiosyncratic and have unknown reliability and validity, but are more useful for providing companies with actionable data for making improvements.

- Practitioners typically want to use safety climate/culture data to improve safety or address a particular safety concern within a specific organization, while researchers may be more interested in contributing generalizable knowledge that will increase our scientific understanding of safety and potentially benefit all organizations.

(Presentations are available at http://www.cpwr.com/safety-culture).

Rubrics provide a qualitative description of a company's safety climate activities.

Process - The workgroup discussions for this session began by reviewing the hand-out titled: "Selected Safety Culture/Climate Assessment Tools" (see Appendix 4), which lists 12 tools and surveys representing a variety of assessment approaches. Next, participants were asked to react, share and discuss the issues raised by the trigger speakers about evaluation and measurement by answering and discussing the following questions:

- Has anyone in the group done evaluation of safety culture and climate?
- If so, what did they do and how did it go?
- Are there construction-specific evaluation issues? What are they? How can they affect evaluation?
- What do you think are key evaluation issues that deserve to be shared with the larger construction community?

Next, a group exercise introduced the idea of using a 'rubric' approach for assessing a company's safety climate. For workshop purposes, a rubric was defined as: A scoring tool that includes a set of criteria for assessing achievement of a particular type of work or performance.

The value of the rubric approach is that it provides a qualitative description of the various elements or activities that reflect a company's improving safety climate rather than thinking of it as a simple binary outcome of present or absent. The levels of the rubric reflect the maturity of a company with respect to specific factors, or aspects, of safety climate. The maturity levels used in the exercise were based on a 2006 article by Diane Parker and colleagues in the UK which was based on earlier work by Westrum (Parker et al. 2006). The modified labels and meanings are as follows:

- Dysfunctional - Who cares about safety as long as we are not caught?
- Reactive - Safety is important: we do a lot every time we have an accident.
- Compliant - We have systems in place to manage all hazards.
- Proactive - We try to anticipate safety problems before they arise.
- Exemplary - Health and Safety is just how we do business around here.

Two handouts provided participants with examples of already developed rubrics. Appendix 2 contains the Parker rubric and Appendix 3 contains the OSHA I2P2 questionnaire designed to evaluate construction safety and health programs reformatted into a rubric rather than a multiple-choice survey.

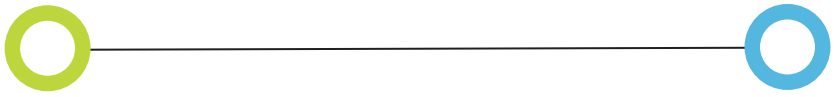
Each group was assigned two of the top factors voted for in Session 2 (some groups identified others they wanted to discuss). They developed a rubric for each factor by: 1) creating a list of activities or criteria that illustrate key aspects of the factors and 2) articulated gradations of those activities to describe either the levels of quality (ranging from bad to good) or development (ranging from beginning to mastery). They were also asked to consider and articulate how the activities/criteria would change as a company demonstrated a more positive safety climate.

Results - The workgroups took different approaches to these exercises. Some spent more time on general discussions about evaluation instead of, or in addition to, creating the rubric for their assigned factors. Others focused only on developing the rubric. Table 5 combines the individual groups' efforts into a comprehensive rubric text. While communication, training, trust, and espoused/enacted safety values did not make the top 6 factors voted on in Session 2, some of the groups chose to create a rubric for them anyway. We decided to present all of the workgroup's efforts rather than limit it to the rubrics developed for the top 6 factors.

Table 5. Rubric developed by workshop groups for top ranked factors

Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Accountability at all levels				
Leaders have no formal safety training. They are not held accountable for safety. Their safety-based performance is not included in management performance reviews. Bonuses are dictated by injuries reported, which discourages reporting.	Projects with poor safety performance have some consequences for supervisors.	Safety performance information is collected but not communicated to supervisors. Safety goals are set to OSHA BLS	Safety-focused curriculum, developed and provided internally, is directed towards supervisors and other leaders. Injury rate goals are set and measured. Safety goals set to better OSHA recordable rate. Managers are rewarded or recognized for superior safety performance.	Leaders hold themselves accountable for safety program conformance and communicate commitment and expectations to all business partners. Performance is evaluated based on leading as well as trailing measures. Safety metrics are benchmarked against peers and internal CQI. Safety is the determining factor in hiring managers and sub-contractors, and promotions.
Communication				
Management discourages safety suggestions and safety-related reporting (injuries, hazards).	Management responds to employee complaints when expressed. Employees are sporadically provided with informal feedback on hazard reports and accident/injury information.	Supervisors pass on safety information as required by management. Injury reports are filed as required. There is no overt reprisal for employees who report injuries or hazards.	Employees are encouraged to report safety concerns and issues. Employees participate in incident reviews. Supervisor actively initiates safety discussion with employee	Employees actively engaged in communicating about safety. They are rewarded for raising concerns and reporting near misses, and they get timely feedback after action. Employees and supervisors actively plan all tasks including safety. There is a formal system to share incident information.

Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Employee involvement/ empowerment				
Management isn't interested in involving workers in safety discussions. There is no safety committee.	Safety committee meets only when someone is hurt and safety messages are passed down to employees from management. Interest diminishes over time.	Management shares information with workers and does a lot of talking but there are few engagement opportunities with workers. Standing safety committee may exist but the meetings last only a few minutes.	Management realizes the importance of involving employees in solving safety problems and reducing hazards. There is a management-labor standing safety committee that provides suggestions and makes recommendations.	Standing safety committee focuses on solving specific problems identified by workers and others, communicates with workers about resolutions, and workers are able to observe changes and provide additional feedback
Management Commitment				
Management is mostly not visible on site. They don't participate in safety audits. When they are on-site, they are oblivious to safety and don't follow safety rules or role-model good safety behavior.	Management gets involved after injury and may suspend or fire employees who get injured. Management enforces safety rules only after an incident or when audit results are negative	Managers conform to OSHA regulations and participate in safety audits. Safety compliance based on owner or regulatory directives	Management initiates and actively engages in participation with safety audits. Management meets with craft workers to ask for advice regarding hazard reduction. Management conducts spontaneous site visits and rewards safe behavior. Leadership participates in safety program development and provides safety resources	Management addresses safety in every meeting and is constantly working to improve conditions and reduce hazards. External auditing of top management, management involvement, and analyzing safety trends and formulating corrective actions
Safety as value/ Safety Alignment				
Safety is simply a cost and considered a necessary evil. Focus is on productivity. There is no safety budget. All errors are bad and are punished. Perception that employees are unsafe vs. the environment in which they work. Believe that construction is inherently dangerous and nothing can be done to change it. The bid actually includes a budget for OSHA fines.	Safety is important except when fall behind (and on Saturdays – on the theory that no OSHA inspectors work on Saturdays.)	Meeting minimum OSHA requirements. They measure lagging indicators only.	Safety and health included in the bid. Company does not use low bid for subcontractor selection. Subcontractor selection is based on their S&H program. Principles of Prevention through Design (PtD) are used.	Vertically and horizontally integrated. Everything (meetings, etc.) starts with safety. Safety is never compromised for productivity. There are effective policies and procedures and H&S is fully integrated into operational programs. Company measures and uses leading indicators to improve safety climate on worksites. Prevention through Design (PtD) is seamless.



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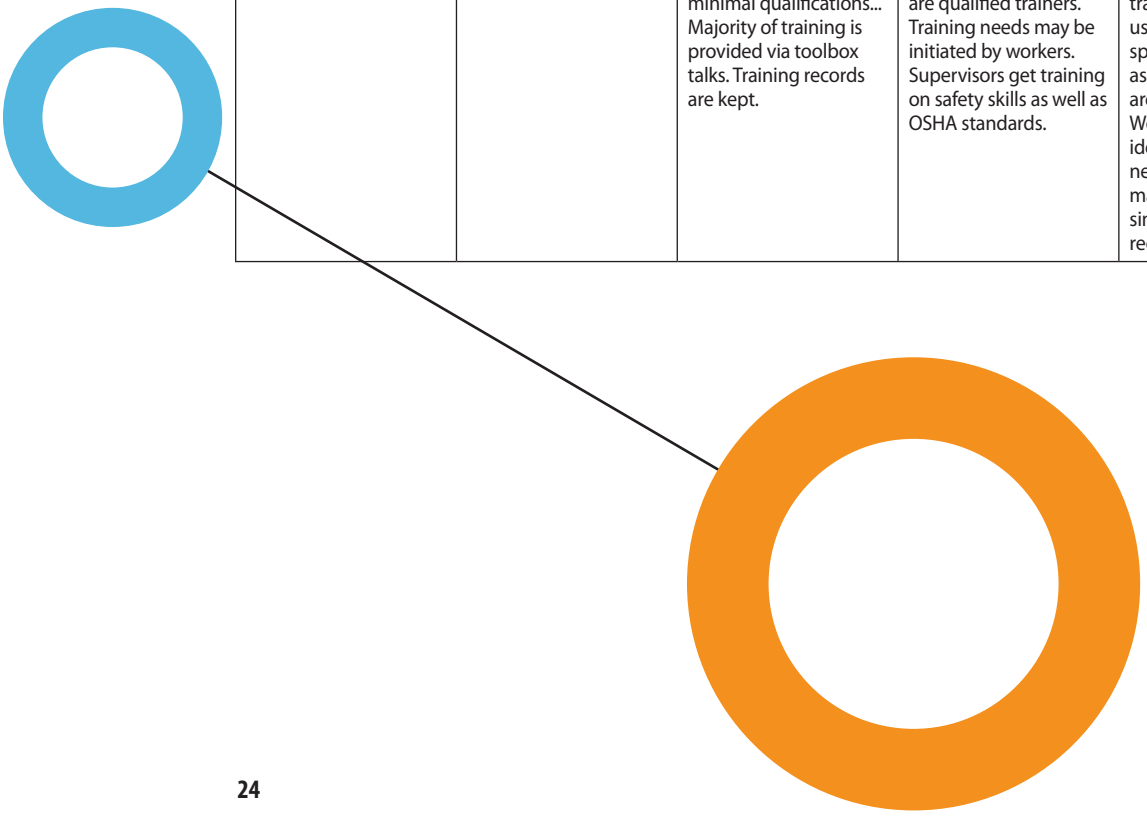
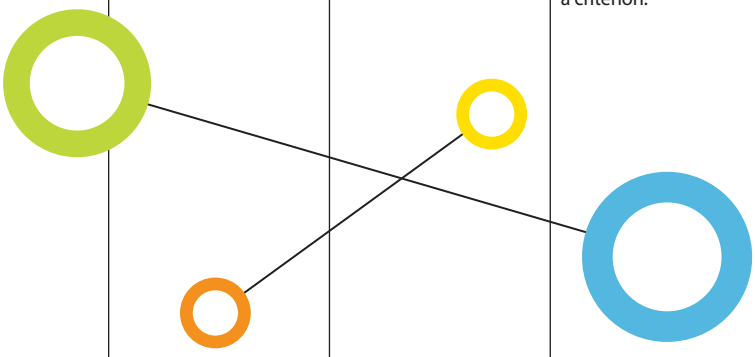
Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Supervisory leadership				
Manage and punish through intimidation. The focus is on the individual not the process. There is no safety-related vision or leadership. Blame game is often played vs. root cause analysis. Employees are easily replaced if injured and there is no understanding or knowledge of regulatory requirements.	Management concerned with safety only after accident/ incident. Supervisors focus on individual behaviors.	Management supports safety program and policies.	Supervisor participates in and initiates safety program activities for continuous improvement. Seeks advice from and includes workers in all aspects.	Supervisors show deep commitment to safety and inspire/motivate worker to share that level of commitment. Establishes clear roles and responsibilities for safety but instills a sense of safety ownership at all levels – horizontally and vertically. Supervisor conveys personal vision for safety at start of meetings, and safety is a major component at meetings. Supervisors are effective communicators and are able to coach and teach safety to workers. Encourages changes and continuous learning. Leads by example
Training				
Company doesn't care about training. Fraudulent training cards are accepted.	Leaders required to obtain OSHA 10-hour certificate. Training is implemented after accident only. Training is aimed at the individual worker. Training effort diminishes over time.	Leaders required to obtain OSHA 30-hour certificate. An off-the-shelf curriculum is used to meet OSHA and management system training requirements. Instructors have minimal qualifications... Majority of training is provided via toolbox talks. Training records are kept.	Leadership acknowledges the importance of training and testing knowledge and skills obtained. Safety Curriculum developed and administered by the company. Instructors are qualified trainers. Training needs may be initiated by workers. Supervisors get training on safety skills as well as OSHA standards.	Companies implement a Safety Trained Supervisor program certification. Comprehensive training using adult learning principles (interactive) is provided on an on-going basis. Highly trained instructors are used. Supervisor-specific training as well as peer-to-peer training are implemented. Workers are integral to identifying training needs and developing materials rather than simply passive recipients.



Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Owner/Client involvement				
Owners/clients do not require safety qualification from sub-contractors (and GC/CM?) and only use the lowest bid as selection criterion.	Contractors excluded from bidding after safety incident or poor safety performance	Prequalification using 'par' or industry average lagging indicators only. GC and SC must comply with all federal, state and local safety rules. Have conventional insurance (not owner supplied); low bid is still a criterion.	Owner safety expectations communicated to GC and SCs and enforced on site through owner oversight. There is a site specific safety template for each job	There is a company rep onsite to monitor and assist with safety program implementation. Unlimited resources for safety. Safety is an integral part of the bid specs. Owner is involved in daily planning meetings. Owner is onsite and makes connection with employees. Owner participates in employee orientation. Design for safety (prevention through design). Building Information Modeling (BIM) enabled and includes workers. Prequalifying General contractors and Subcontractors on safety replaces low bid. There is a formal mechanism for submitting anonymous complaints.
Trust				
Workers do not trust that supervisor will take care of them and they don't believe what is said. Injury reporting is discouraged or suppressed. Workers are afraid to report hazards for fear of getting fired.	When an accident happens, I trust that there will be an investigation. Reports of hazards will be responded to but perhaps not in a timely manner.	Near miss reporting encouraged. Workers are encouraged to report hazardous conditions and those reports are taken seriously	Workers trust that supervisors and the company care for their safety. Injury and near-miss reporting is strongly encouraged. Hazard identification is a joint labor-management effort and hazards are corrected quickly before someone gets hurt. Workers have the right to stop work if they feel it is unsafe.	Supervisors and workers work as a team and have mutual trust and caring for each other. Injury and near miss reporting is expected because it is the norm. When a supervisor identifies an unsafe behavior the worker trusts him/her to correct it without reprisal. Workers are encouraged to stop work whenever they feel unsafe conditions exist and rewarded for doing so.
Espoused/ enacted safety values				
We don't know what the rules are and we don't care. There is no safety management system.	If somebody makes us we will do it or if there is an accident or inspection. System is activated only after an incident. Enactment deteriorates over time	We have a low bar and we go above that bar. May have a safety management system but it meets the bare requirements by laws.	Company enacts safety values through programs, policies and works on continuously improving safety climate.	Management system elements are clearly defined and communicated and implemented beyond requirements. Management and workers go beyond system to keep improving. Requirements/policies are well defined and performance is verified and implemented.



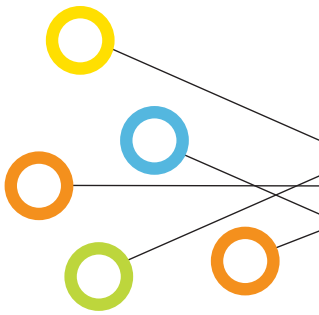
Summary - As noted by Dr. Probst, although general safety climate surveys are the dominant method for collecting data to measure safety climate, they may not be ideal for learning where change is needed to improve safety climate and to see if it improves after a change is made. It is important to look at the relative merits of surveys, rubrics, and other methods when deciding the best approach to use.

A simple audit tool could be used to check-off whether or not an organization is implementing safety related programs and policies such as a near-miss reporting system, stop-work authority to empower workers, etc. But such a tool would not allow one to measure organizational member's perceptions of how well these programs are being enacted and the degree to which they improve the safety climate on site.

The first critical steps to measuring safety climate are to identify the most important factors or leading indicators that comprise it, and also the specific characteristics or aspects of those indicators. The activities in Session 1 gave participants the experience of taking these critical steps. For example, they identified communication as being an important factor/indicator and then determined that: active engagement, continuously facilitated, two-way open communication, no fear of reprisal, no filtering, multilingual, safety metrics visible and shared with everyone, up, down, and lateral among hierarchy, colleagues, peers, and subcontractors and experienced-to-inexperienced peer communication were the aspects of communication that would need to be present for a positive safety climate. Additional work still needs to be done by researchers in partnership with construction industry practitioners to determine and agree on the most critical factors and related aspects for an ideal or exemplary safety climate, and then to develop reliable and valid survey items to measure them.

This session also provided participants with a method for measuring an organization's level of maturity with respect to safety. An audit tool with numeric ratings could be developed to measure the various elements of the qualitative rubric. Ratings could be combined to provide companies with an overall maturity rating as well as point out specific issues they could improve to move up to become a more exemplary company with respect to their safety culture and climate.

Chapter 4: Interventions to Improve Safety Climate



The primary objectives of this session were to:

1. **Identify interventions to improve safety climate factors/indicators.**
2. **Discuss practical considerations and tips for successfully implementing identified interventions, including barriers to successful implementation.**

Trigger speaker - Carl Heinlein, Senior Safety Consultant for the American Contractors Insurance Group (ACIG), works with over 40 member construction companies helping them improve their safety performance. He spoke about the ACIG Strategic Safety Initiative which includes developing a contractor action plan (CAP) based on data collected using Safety Benchmarking, a Life-Saving Commitment Survey, and a third party Safety Culture Survey. As an outcome of these efforts, ACIG has identified a top ten "best practices" for improving safety performance including:

1. Executive level support- high level of expectation
2. Pre-task planning for every task
3. Management visibility
4. Supervision involvement and accountability
5. Root cause analysis of incidents
6. Measurement and frequent review of key indicators
7. Active Risk Management Committee
8. Pre-project planning
9. Subcontractor safety management
10. Employee engagement/involvement.

Mr. Heinlein noted that at least four of the top ten practices (1,3,4,and 10) were viewed as strongly related to improving safety climate and that the others could be indirectly linked as well. (Presentations are available at http://www.cpwr.com/safety-culture)

Process - First, each workgroup reviewed a categorized list of potential interventions developed for the workshop (see Appendix 3) and identified those they believe could address the factors they had worked in in the previous session. The group was asked to look at the interventions from both an implementation and program maturity perspective related to the rubrics they developed earlier. Specifically, they were asked: 1) Think about how intervention implementation could be made easier. 2) What steps would an organization need to make to be able to implement the intervention(s) and thus become more mature from a safety climate perspective? 3) What are the "lessons learned" about successful implementation that are worth sharing with the larger construction community? Finally, participants were asked to discuss specific issues related to their solutions including;

- How the interventions could be promoted throughout the industry, both for large and small contractors (i.e., Possible methods and channels for getting the word out about particular solutions)
- How contractors could be motivated to adopt the interventions, and
- How adoption could be made easier? (i.e., barrier reduction or elimination)

Results - Table 6 lists the interventions the groups discussed for the factors identified in earlier session.

Table 6. Interventions to address factors and improve safety climate

Factor	Interventions
Supervisory Leadership	• Include safety in the strategic planning process • Define safety roles and responsibilities • Lead by example • Promote a continuous learning environment • Hold people accountable for safety • Have senior leaders visible on safety issues, • Safety communications from leadership • Supervisors "walking the talk"
Safety as a value/ safety alignment	Safety behavior/attitude used in hiring and promotion decisions. • Safety as an objective at all levels of the organization • Safety included in the planning and bidding process • Safety should never be compromised by production • Positive reinforcements for safety and metrics to show continuous improvement. • Aligning safety and productivity • Including safety at production and planning meetings
Management commitment	• Safety addressed as the first item on the agenda at every meeting. • Adequate budget for safety • Safety always included in pre-task planning. • Reward safety processes, not outcomes. • Management should make spontaneous safety visits.
Employee empowerment /and involvement	• Safety committees that can address a wide range of issues. The right people must be chosen. The committee must have clear objectives, a role in planning, communicate expectations to management and have the authority to make decisions. • Stop work authority • No fear of reporting • Participation in JSA/JHA preparation and audits. • Employees involved in tailgate problem solving sessions.
Accountability	• Fairness of the system • Consistency of enforcement. • Accountability for near misses • External audits of top management safety involvement • Using leading indicators was stressed • Benchmarking against others • Active surveillance of injuries and hazards by field supervisors • Accountability/performance reviews of interactions
Communication	• Engage employees in communication • Supervisors actively initiate discussions about safety • Formally share incident information • Give timely feedback on reports. • Venues include JHA/toolbox talks, new employee orientation, crew level meetings • Mentoring and storytelling • Employers should identify informal leaders to help in communicating and address any issues with literacy levels • Transparency, (e.g., a safety communications newsletter)

Factor	Interventions
Training	• Empowerment training for workers • Leadership training for foremen and supervisors as well as coaching • Training for senior management • Joint safety committee training. Training on solutions (solving safety problems) is useful. Training should consider the point of view of "what's in it for me?" Transfer of the training to others may be an issue. The amount of training is not as important as the quality of the training. • Coaching supervisors • Train supervisors on communication skills and leadership, listening skills
Owner/Client Involvement	• Owner Controlled Insurance Program (OCIP) gives owner "skin in the game." • Owners representative on site and be involved in orientation training • Include safety in bid specs • Focus on design for safety/Prevention through Design • Use safety performance as a prequalification for bids. • Hold a pre-job meeting on safety with the GCs, subs and labor. • Owner audits safety performance on site • Leading metrics should be used in evaluating bids. • Owners can solicit anonymous complaints to ensure no retaliation for raising safety issues.

Notes: Items are not in ranked order; Solutions for the Trust and Espoused/enacted safety values factors identified earlier were not addressed by any of the groups.

In addition to the interventions, some barriers believed to inhibit implementation of proposed solutions were also noted (see Table 7). Some are well known, such as resource constraints in the industry. For example, while the value of root cause investigations is widely acknowledged, it is a difficult program to implement due to barriers such as lack of time and resources. Or, if low bid is the sole or primary criterion for selection of a general contractor, construction manager, or subcontractors, it becomes more difficult to insist on safety-related activities that require upfront investment. Smaller companies often feel the pinch of resource demands more than larger organizations, although smaller contractors also have advantages in terms of lesser distance and fewer layers between management and frontline workers. Table 7 contains the barriers to implementing safety climate interventions raised by workshop participants.

Table 7. Barriers to implementing interventions to improve safety climate

Construction schedules	Perceived lack of time and resources
Organizational silos	Company size
Short-term perspective	Lack of supervisor expertise and knowledge
Low-bid contracts	Complacency
Misperception that safety hurts profits	Lack of management support

Summary - Simply assessing safety climate is not enough. Once an issue related to one or more of the factors is identified, it needs to be addressed and improved. For example, if workers say they do not feel comfortable raising safety issues, even though they have been told the policy to do so is in place, then it is critical that management intervene to make them feel more comfortable. It requires more than just policy pronouncements to improve safety climate. For example, workers

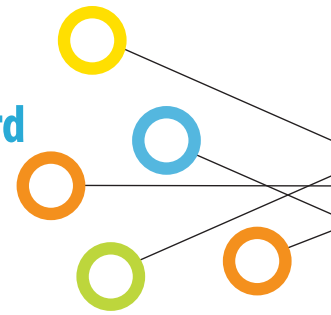
need to see that reporting injuries and hazards is rewarded rather than punished. Some interventions may be new, some may arise out of existing safety program elements, and others may address larger organizational issues.

A number of the interventions, including planning for safety, came up across several factors and are worth discussing a bit more. By including safety early in the planning process, safety climate and safety related outcomes are likely to improve. The workshop participants recommended including safety in the design phase, in the bid specifications, in production and planning meetings, in pre-task planning and even in pre-job meetings with the owners. Some of the barriers presented in Table 7 clearly provide challenges to incorporating safety into planning. Personnel can communicate and work across intra-organizational lines on a day-to-day basis in the immediate work of construction, but to achieve true integration of safety into operations and long-term planning management must insist on and support such collaborations. Because construction projects involve multiple organizations, owners play an important leadership role as reflected in factors identified and listed in Table 6. Case studies of how strong owners overcome some of the barriers can provide models to promote throughout the industry.

Another cross-cutting intervention is for contractors to provide a continuous learning environment and be open to new ideas on how to improve safety. One way to do this is through training and education. The types of training recommended included: empowerment training for workers; leadership education for supervisors, including communication, listening, and coaching skills; training for senior management to understand how safety fits in to and affects quality and production, and their own critical role in leading the safety effort; joint safety committee training; and training in safety interventions. Participants noted that quality of training was much more important than quantity and considerable time is wasted on mandatory but poor quality training classes. Trainers should consider the point of view of the trainee ("what's in it for me?"). In the dynamic environment of a construction project, having everyone on the site up to speed with the needed knowledge and experience is a constant challenge. This heightens the need for frontline supervision to have the training and expertise to manage, supervise, and engage their crews with respect to safety.

Communication was identified as critical to creating and maintaining a positive safety climate. Safety-related communication from the company and from supervisors was perceived as very important, and forums for this to happen include toolbox talks, employee orientations, and crew level meetings. Safety newsletters can be used to share timely information about incidents and actions taken. Regardless of mode used, workers' language and literacy level need to be taken into consideration.

Chapter 5: Next Steps for Bridging the Gap and Moving Forward



The primary objectives of this final session were to:

1. **Summarize the earlier discussions and identify:**
   a. **areas of agreement, disagreement and uncertainty,**
   b. **current and future needs,**
   c. **steps to carry the workshop discussion forward toward action.**

Process - Steve Hecker facilitated an open discussion based on the following trigger questions:

A. What are the most important questions that remain unanswered?

B. Are there industry-researcher partnerships that can help answer these questions?

C. Are there new ideas for promoting the use of leading indicators?

Comments were recorded and some illustrative quotes are presented below.

Results - *A. Unanswered questions*

The participants believed that the most important unanswered questions about safety culture and safety climate in construction are:

- How can safety-related changes be made and maintained in individual organizations and in the industry as a whole?
- What are some strategies for convincing CEOs to invest in integrating safety into the business?

A few illustrative quotes from participants addressing this include:

"There is a salesmanship element to it. Concept of entrepreneur to sell safety within the organization."

"Organizations are on a bell curve in terms of safety culture and safety. Those at this workshop are at one tail of the curve because we're talking about it at all. You have to start with organizations that do 'get it.' It's important to help good organizations get better and identify the things that are succeeding, and we can help define and articulate those things. The rubric may be a useful tool because it helps explain what different levels look like in organizations vis-a-vis particular practices or structures."

"Organizational and cultural change take time. Academics like to take one small intervention at a time and study it, but that's not how organizations change. It's more complex and multi-dimensional, but you have to have management systems in place and you have to measure meaningful things in terms of programs, practices, and leadership. We don't have to have all the answers from the start, but when proposing changes to leaders they [the changes] need to at least have face validity."

(continued on next page)

"Culture is complex and takes time to change, but it is also dynamic and gets reinvented all the time by changing small things. Small things do add up to larger change."

"CEOs do listen to other CEOs, probably more than to safety professionals in their own organizations. Use all opportunities for CEOs who get it to speak to those further back on the curve."

B. Academic-Industry partnerships

Participants thought academics need to partner with industry to test out interventions and demonstrate their effectiveness at improving safety climate. Many were eager to help.

[Industry partner] "We do need more intervention effectiveness research to demonstrate that particular solutions are effective and practical. It also has to be shown to be scalable for smaller contractors. Best approach to this may be mentoring from early adopters."

[industry partner] "Some of us have senior management and CEOs to help move things. We can take particular action items and try them out, but we need products from the workshop to do this."

C. Leading indicators

Participants wanted to focus on addressing leading indicators and showing how safety climate can be useful (e.g., does it improve safety outcomes like injuries).

"As safety practitioners we are still guilty of using lagging indicators. We do it by default without clearly stating the limitations. We need to move the dialogue on acceptable risk for the firm, segment, and industry level with valid measures of hazard identification and control. There are tools like ConstructSecure but we need to go further."

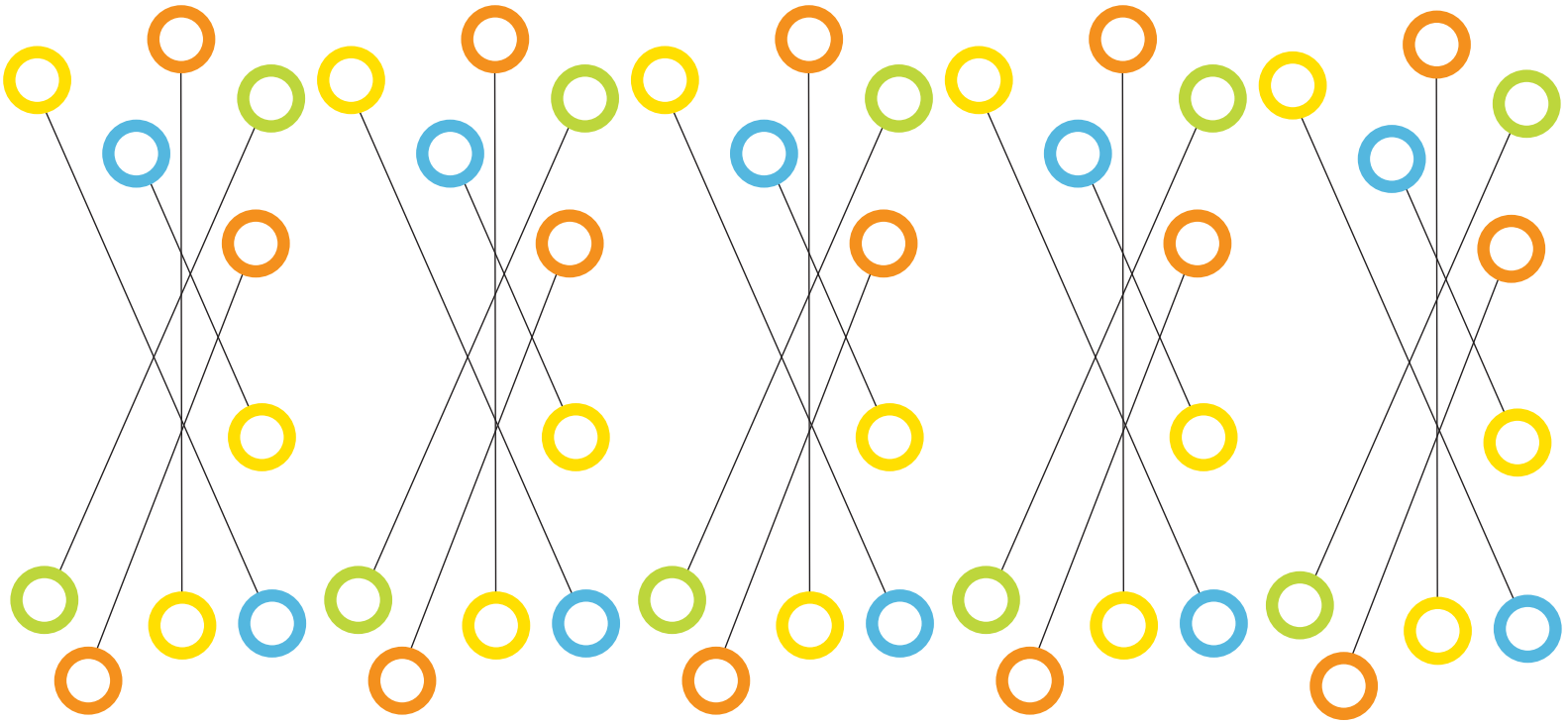
"We need to figure out how to put culture into the equation."

"Get input from CEOs to make sure we're on the right track."

"Pay attention to demographic shifts in the workforce. It's a good time to promote new ideas and ways of doing things." "Put out a work product from this workshop for those organizations that are ready to move on this." "Create case studies that can be shared."

Expected Products from the Workshop - The planning committee has identified a number of workshop products:

- This workshop report.
- Posting of all workshop materials on CPWR's website (http://www.cpwr.com/safety-culture).
- Two publications:
  - A review of the safety climate and culture literature specific to construction.
  - Results from a qualitative interview study of construction industry stakeholders about safety climate and safety management systems.
- Findings from a 4-month post-workshop follow-up survey to assess the degree to which participants have used the information obtained at the workshop.
- A listserv and/or working group designed to keep the dialogue going and to identify ways for researchers to partner with industry to keep the research grounded in the reality of the construction industry.



Chapter 6: Recommendations and Conclusions

Recall that a primary impetus behind the workshop was the National Occupational Research Agenda's (NORA) strategic and intermediate goals pertaining to "Construction Culture," which are:

STRATEGIC GOAL 8.0: Increase understanding of factors that contribute to safety culture and climate in the construction industry and improve sector capabilities to evaluate and improve practices at the policy, organizational, and individual level. Promote increased attention to safety culture and climate as a way to improve the effectiveness of safety and health programs and practices.

- **Intermediate Goal 8.1:** Create a working definition and framework for construction industry safety and health culture and improve understanding of the factors that contribute to a positive or negative safety and health culture in the construction industry.
- **Intermediate Goal 8.2:** Develop and expand the use of validated measurement methods for evaluating safety culture and safety climate in the construction industry.
- **Intermediate Goal 8.3:** Partner with construction stakeholders to develop and disseminate effective intervention measures for improving safety and health culture in the construction industry.

The committee designed the workshop so that the session-specific activities would at least begin to address each of the intermediate goals. For continuity, this final chapter is divided into the three sections mirroring the goals and workshop sessions: Definitions, Measurement, and Interventions.

DEFINING SAFETY CULTURE, SAFETY CLIMATE, SAFETY MANAGEMENT SYSTEMS

The workshop provided an excellent vehicle for researchers and practitioners to share their understanding of what safety climate and safety culture mean vis-à-vis the construction industry. While there was broad agreement that both concepts add value to industry efforts to reduce the toll of injuries, illnesses, and fatalities, participants' definitional preferences were spread over several of the candidate definitions provided. Still, it was clear from workshop discussions that participants thought it would be useful to have a set of construction specific working definitions for both safety culture and safety climate. The planning committee agrees, and indeed believes it is necessary if we want to obtain a better understanding of the underlying factors (i.e., leading indicators) that together create a positive (or negative) safety climate at the worksite. Therefore, as noted in Chapter 1, we propose the following working definitions that we believe can help us move forward:

(Organizational) Safety Culture: Deeply held but often unspoken safety-related beliefs, attitudes, and values that interact with an organization's systems, practices, people, and leadership to establish norms about how things are done in the organization. Safety culture is a subset of, and clearly influenced by, organizational culture. Organizations often have multiple cultures or subcultures, and this may be particularly true in construction.

(Organizational) Safety Climate: The shared perceptions of safety policies and procedures by members of an organization at a given point in time, particularly regarding the adequacy of safety and consistency between actual conditions and espoused safety policies and procedures. Homoge-

neous subgroups tend to develop shared perceptions while between-group differences are not uncommon within an organization.

Project Safety Climate: Perceptions of occupational safety and health on a particular construction project at a given point in time. It is a product of the multiple safety climates from the different organizations involved in the project including the project owner, construction manager/general contractor, and subcontractors. Project safety climate may be heavily influenced by local conditions such as project delivery method, schedule and planning, and incentives.

Because construction is conducted on a project by project basis, we believe the project safety climate definition is particularly important due to the influence of project owners, general contractors, subcontractor relationships, and overall project conditions (e.g., project delivery, joint ventures, schedule and incentives). As mentioned in Chapter 2, it may be more difficult to align the deeply held, and sometimes competing, values and norms (i.e., safety culture) of the multiple employers and trades that come together to work on a particular jobsite.

It is clear from the data reviewed that the term safety culture is more widely recognized, however it is often inaccurately used as a catchall term. This is particularly true when people talk about safety culture surveys or measurements. Perception surveys are typically designed to measure safety climate rather than safety culture. Survey results, however, may reflect to some degree the underlying safety culture. Without definitional agreement, reliable and valid measurement won't be possible and organizations won't have the data they need to understand their own safety climate and how best to improve it.

MEASURING CULTURE AND SAFETY CLIMATE

The workshop devoted significant time to the topic of safety climate (vs. culture) assessment. Workshop participants unanimously acknowledged that the industry remains much too dependent on lagging indicators (e.g., injury and illness rates) to measure the effectiveness of worksite safety activities. Addressing safety should not be reactive or backward looking; rather our approach must be proactive and anticipatory. Whether we use surveys, rubrics, focus groups, or less formal discussions, organizations and project managers need to understand members' perceptions of the effectiveness of safety efforts and obtain ideas for how to improve them.

The goal of more general safety climate assessments is to understand how safety climate is perceived at the organization or project level and to compare perceptions across different groups (e.g., frontline workers vs. supervisors vs. top managers). This is often referred to as a "gaps analysis." Even employers with strong safety programs may be surprised by the gap in safety climate perceptions between managers and frontline workers. This type of evaluation can be repeated at some specified interval to examine changes over time, but the results won't necessarily answer the question why things have changed.

Reliable and valid targeted assessments are needed to answer the questions "What are the specific leading indicators (factors) of safety climate that need to be improved and how will I know if the change I implement actually leads to improvement?" Workshop participants identified a number of safety climate leading indicators that could be measured and ultimately targeted for interventions. For example, if supervisory safety-related communication skills were identified by a general assessment as being inadequate, the organization would design and implement a program to train supervisors to communicate more competently and consistently about various aspects of safety. Baseline data using a targeted survey that asks questions about their supervisor's communication skills (e.g., Does your supervisor: provide a consistent message about safety; transmit that safety is valued as much as production; get input from you about problems and solutions?) would be collected from workers before intervention implementation. A follow-up evaluation using that

same targeted survey would be conducted with those same workers to determine how effective the program was at improving the supervisor's safety-related communication skills. Another example would be a general assessment showing that workers perceive that safety is a priority until there is a schedule crunch. A targeted survey including questions about this could be administered at baseline. A new planning process or a strategy for supervisors to buffer their crews from schedule pressures are interventions that might address this problem, and the survey could be re-administered to assess the effectiveness of the new process.

Safety and health professionals or others responsible for improving safety climate may wish to use outside academics/researchers or consultants to assist in developing or conducting the evaluation approach that will work best for their organization. Outside assessment may be more trusted by workers and thus get a more accurate response. It is often the case, however, that not enough time or money is allocated for intervention evaluation. Thus, we want to strongly encourage safety and health practitioners and construction company owners to devote adequate resources to conducting well designed evaluations of their intervention efforts. Evaluation findings can benefit both the company and the industry as a whole.

The committee believes that additional research is needed to develop a common set of items to measure a common set of leading indicators/factors that comprise safety climate. Evaluations also need to be designed to take into account variations in work unit and supervisor characteristics when analyzing and interpreting safety climate data, particularly the level at which data should be aggregated.

INTERVENTIONS TO IMPROVE SAFETY CLIMATE FACTORS (LEADING INDICATORS)

Each workgroup identified a number of promising interventions that could be used to improve safety climate factors. Unfortunately there wasn't enough time during the workshop to explore each idea in depth or to compare and prioritize them for use in construction. Therefore, after the workshop the meeting's organizers reviewed the results of the workgroup discussions, the peer-reviewed scholarly and trade literatures, interviews with stakeholders, and used our collective experience to more fully develop some of the more promising intervention ideas that could be used to address each of the critical factors identified during the workshop. We present these below. As with all safety and health recommendations, interventions are most effective when tailored to specific employer and worksite circumstances. Also, as mentioned above, it is important to evaluate the effectiveness of interventions to determine the degree to which they resolved the identified safety climate issue.

A. Improve site safety leadership

Front-line supervisors are the linchpin of any safety program and how they lead and communicate are among the most important factors in determining safety climate on the jobsite. These individuals have the power to make changes and get hazards corrected before anyone gets hurt. Interventions to improve safety climate via supervisory leadership include additional emphasis on selecting and rewarding supervisors based on their safety performance (not just on productivity and quality measures), and ensuring that supervisors receive the proper safety training, not just on hazards but on the leadership and communication skills needed to create a positive safety climate on the jobsite. A supervisor's ability to incorporate these types of skills on the jobsite can be evaluated by asking workers directly and by observational methods.

Other levels of project leadership can also take greater ownership of safety. Large companies typically employ and then rely on a safety professional for most safety-related activity.

However, companies large or small with exemplary safety cultures and climates tend to distribute safety responsibilities across project superintendents and other field leadership. Safety professionals can still serve as a resource to the field personnel but should not be perceived as the only person who can "fix" safety problems. Moving to this model requires that foremen and other site leaders receive quality safety and leadership training, mentoring, and feedback. Organizations that implement this approach are likely to see improved integration of safety with planning and production as well as having more responsible, proactive, and safer field leadership.

B. Align and integrate safety as a value

Interventions are most effective when tailored to specific employer and worksite circumstances.

When safety is aligned and integrated throughout an organization it is seen by organizational members as being a core company value rather than an additional burden or diversion from "normal" operations. Strong safety and health policies and procedures are an important foundation, but unless they are actually implemented and integrated throughout the organization, meaningful and measurable safety improvement may be elusive.

Suggested interventions for moving towards this goal include gaining a better understanding of how safety is implemented within the various areas and functions of an organization including engineering and design, communication, planning, quality control, human resources, and subcontractor management. Safety should be integrated into all reward and recognition programs for workers, front line supervisors, and also top managers. Integrating safety into processes such as schedule and production meetings can help management appreciate that it is a regular and necessary part of the process with benefits beyond safety.

Interventions to improve alignment might involve building relationships between various departments and groups and finding opportunities to improve "fit" among competing activities. A good practice would be to integrate safety into the design and planning phases of a construction project by performing "safety design reviews" and "constructability safety reviews". Encouraging discussions between planners/designers and construction workers builds relationships, and these new communication channels can lead to improved safety culture and climate. Breaking down traditional barriers can help alleviate problems that workers often experience on jobsites, like one trade having to work around or under another because the work was not scheduled or sequenced properly. Materials may not be delivered where and when they are needed creating logistical bottlenecks and posing manual handling risks. These experiences may be so frequent as to seem normal (e.g., "that's construction"), but they should not and need not be the norm. Production planning that incorporates safety concerns reduces the need to compensate and cut corners when time pressures increase.

C. Optimize management commitment

Management commitment is the "motherhood and apple pie" of safety culture and safety climate, but defining it, demonstrating it, and measuring it are essential for moving culture and climate in a positive direction. At its most basic level actions like providing the proper personal protective equipment, including safety as a top agenda item at all meetings, or requiring that all workers are OSHA-10 trained reflect management's commitment to worker safety. Similarly providing an adequate budget to ensure worker safety and health is a critical indicator of management commitment.

Specific interventions to engage top management will likely depend on the size and structure of the firm. To move forward on achieving zero injuries, companies should gather data on leading indicators using job hazard analysis audits or other tools to help predict and prevent

exposures and adverse safety outcomes before they happen. Companies can begin doing this on their own using simple forms and Excel spreadsheets or they can hire outside consultant firms.

Some contractors facilitate regular interaction among corporate managers, project management, and craft workers by requiring that managers conduct frequent site walkthroughs and have safety-related conversations with workers on-site. Others establish open communication pathways so that every time there is a safety-related incident a report is funneled from the worksite through project managers to top executives, and the steps taken to address the incident are reported back down to project managers and workers. Contractor leadership should give safety and productivity messages equal status at site orientations and other regularly held meetings. Rather than lofty statements like "Safety is our number 1 priority," specifics like the expectation that employees are empowered to stop work when they see a hazard or if they feel uncomfortable continuing to work in a particular situation should be made clear. Alternative pathways need to be created for employees to report safety-related issues if they are not resolved through the supervisor.

Use safety stand-downs to proactively address safety topics of concern and relevance.

Safety "stand-downs" are becoming more common on construction projects but typically conducted only after a serious injury or mishap occurs. Contractors might consider using them more proactively to address safety topics of concern and relevance to front-line employees or supervisors. Such periodic stand-downs would send strong positive prevention messages, and structuring them to maximize worker participation would demonstrate that management believes that safety is a participatory activity and that workers play a critical role.

D. Empower and involve workers

Underlying the various factors of safety climate is the need for mutual trust between workers and management about safety. Workers need to trust that management will create a safe worksite and not penalize those who raise safety concerns. Management can demonstrate their level of trust by involving and empowering workers in worksite safety and health and even sharing power and responsibility (e.g., joint safety committees). Actively listening to workers' suggestions and quickly responding to their concerns further engenders trust.

Setting the expectation and explicitly giving workers the authority to stop work if they have a safety concern empowers workers to become proactively involved in their own and their co-workers' safety. It is critical that when there is a safety situation, management takes the employee's concern seriously and acts accordingly. If they don't, or if there is any reprisal, workers will quickly lose trust in the system and stop reporting. Fear of speaking up, fear of reporting, and fear of retaliation are conditions that work against a trusting, just, learning, and safe climate. Rewarding workers for reporting injuries, hazards, and close calls demonstrates that safety is a priority and not just words written on paper.

Involving workers in pre-task planning and job hazard analyses (JHA) are excellent procedures for empowering workers and both have the added benefit of being proactive and preventive safety activities. When these activities are included as a regular part of craft workers' jobs, the message is reinforced that safety is an inherent part of every procedure, not an add-on.

E. Ensure accountability

Everyone involved in a construction project should be held accountable for safety: owners, management, safety personnel, supervisors, and workers. Supervisors' performance evaluations should reflect the safety-related leadership skills discussed above, as well as safety outcome performance. Conducting a root-cause analysis after an incident is critical for ensuring blame-free accountability. High reliability organizations (HROs) use incidents and near misses as opportuni-

ties for learning and prevention. Most incidents are combinations of environmental, organizational, and human factors. Nothing will hamper the development of a positive safety climate and the free flow of information more than an investigation process that seeks to blame rather than learn. Cursory investigations can be counterproductive to achieving a positive safety climate if they focus on blaming front line worker behaviors and do not sufficiently consider organizational contributions. "Human errors" are in fact often provoked by "latent conditions" such as time pressure, understaffing, inadequate equipment, fatigue, inexperience, unworkable procedures, or unanticipated conditions (Reason 2000).

A variety of simple interventions can be considered to improve incident investigations and to minimize negative impacts on safety climate. For example, the safety and health program's investigation forms should include the appropriate boxes to consider all relevant system safety as well as latent conditions, and those boxes should be listed on the forms prior to human error factors to ensure they get due consideration. Front line supervisors should be trained to conduct blame-free incident investigations and mechanisms must be put in place for sharing findings across the whole organization. Finally, there need to be accountability mechanisms for following through on findings including specifics on how system and latent conditions will be addressed.

F. Improve communication

Communication is an important aspect of all the safety climate factors. Both words and actions communicate safety-relevant messages and it's not just what is said but also how it is said. This section, therefore, addresses both enhancing overt two-way communication about safety and increasing awareness about implicit messaging that the organization or project may be sending.

Structures should be created that ensure two-way communication. One example is to establish a joint safety and health committee where employee and employer representatives problem-solve safety issues. Tailgate or other pre-shift crew meetings provide a venue where more localized issues can be raised and addressed. Beyond formal structures and meetings, research demonstrates that having supervisors actively initiate safety discussions with their employees is a simple but important communication mechanism for improving safety climate.

It is also important to look beyond the direct communication of safety information to examine other channels where conflicting messages may be sent and received. Safety discipline policies, injury reporting and investigation procedures, and site orientations are all examples of safety program elements that could benefit from a review for mixed messages. For example, if the overriding message from a project superintendent is that the project is behind schedule and crews need to pick up the pace, any mention of safety practices might be seen by workers as just lip service. Another form of implicit messaging may be via the project's reward structure. If the overt message is that all injuries should be reported but worker and supervisor rewards and incentives are based on achieving zero accidents, an unintended consequence may be under- or non-reporting. On the other hand, a hazard-reporting based incentive program communicates to all involved that prevention and increased information flow are rewarded.

G. Train to improve safety climate

The issue of training has been mentioned in many of the prior sections and therefore training interventions to improve safety climate will only be discussed briefly here. Providing supervisors with safety, communication, and leadership skills training is critical for improving worksite safety climate. Some construction companies have policies that require OSHA 30-hour training for supervisors and managers, and some go beyond this by requiring them to become certified as "Safety-trained Supervisors". Safety training for employees in departments such as planning and

design and for senior managers provides important opportunities to align and integrate safety into the organization and thus improve safety climate. Some design-build firms provided "Prevention through Design" (PtD) training for in-house architects and engineers.

Most construction companies require orientation safety training as a pre-condition for craft workers to begin working on the jobsite. The content of the training should be reviewed to ensure it contains clear positive safety messages and includes expectations of how safety will be handled and supported on the site.

H. Encourage owner/client involvement

Owners can drive project safety performance for better or for worse. Partly it's what they are willing to pay for, but more specifically it includes what they value in bid decisions, how they reward and track project progress after bids are let, and what they demand of contractors and workers. One idea is to have owners participate in Owner Controlled Insurance Programs (OCIPs). An OCIP is a self-insurance program where owners pay out of pocket for health care and lost time costs, which gives them a financial stake in maintaining safety on their sites. So, rather than each contractor and sub purchasing insurance (including Workers' Comp) separately and charging the owner for those costs, an OCIP involves the owner purchasing the insurance for all parties on the site. Thus, the owner will save money if the job is done safely but will incur costs if not. Another idea is for owners to have a safety representative involved in all project audits.

Owners can also be encouraged to integrate safety into the front end of the construction delivery process by using Prevention through Design (PtD) approaches during design reviews, ensuring that safety is a substantive part of sub-contractor pre-qualification, mandating safety specifications, holding pre-job safety planning meetings, and establishing project-wide safety-related metrics of both leading and lagging indicators with accountability.

A final suggestion for facilitating increased owner involvement in safety is to develop incentives that encourage them to adopt a range of best practices, similar to how owners have embraced "green construction". An example of this strategy is the Australian government's "Model Client: Promoting Safe Construction" program intended to ensure that federal construction is performed using best practices, including PtD and safety pre-qualifications. Interested owners and other stakeholders can access The Model Client materials at: http://www.fsc.gov.au/sites/fsc/engageaccredited/modelclient/pages/modelclient)

Conclusions

Some say that safety culture and safety climate represent "just how we do business." This workshop began the process of changing "how business is done" by creating a vibrant dialogue among practitioners and researchers, industry professionals, and union representatives about what these concepts are, how they should be measured, and ideas for how they can be improved. This was a good start. What's next? We hope this report will provide the impetus to continue this dialogue. We need a safe space for workers and employers to come together to openly address these core safety-related issues. We also must focus on implementing and evaluating interventions to test their effectiveness, while acknowledging that more research on how to measure and improve safety climate in construction is needed, including a continuing effort to use common indicators and measures across projects. Publicizing such evaluations and lessons learned will help move the industry in the right direction.

We also understand that different segments of the construction industry are at different stages and have varying needs regarding safety culture and climate improvement. This is not to say that workers at the smallest residential firm don't deserve the same protection from injury, illness, and death as workers on large commercial or civil projects. However, contracting companies of different sizes and in different sectors (e.g., residential vs. commercial) will need to work with their employees to adapt the various intervention ideas to their circumstances.

While the workshop fostered a valuable exchange of views and ideas to help promote a broader understanding of the current needs and opportunities and helped identify a number of tangible actions that construction industry stakeholders can take to improve safety culture/climate and performance, more research is needed on how to measure and improve both safety climate and safety culture in construction. To do this effectively, the dialogue that began at the workshop needs to continue.

Reference List

Christian MS, Bradley, J C, Wallace JC. Burke MJ. 2009. Workplace safety: A meta-analysis of the roles of person and situation factors. *Journal of Applied Psychology*, 94, 1103–1127.

Dekker S. 2006. The field guide to understanding human error. Aldershot UK: Ashgate.

Gittleman J, Gardner PC, Haile E, Sampson, JM, Cigularov, KP, Ermann, ED, Stafford P., Chen PY. 2010. CityCenter and Cosmopolitan Construction Projects, Las Vegas, Nevada: lessons learned from the use of multiple sources and mixed methods in a safety needs assessment. *Journal of Safety Research* 41: 263–1.

Goldenhar LM, Brady PW, Sutcliffe KM, Meuthing, S. 2013. Huddling for high reliability and situation awareness. *BMJ Quality & Safety*; 22: 899–906.

Hansell, C. 2012. *Accelerate Corporate Social Responsibility Results: Link and Leverage Your Safety, Health and Environmental Culture.* Seattle, Washington: Cathy A. Hansell (Amazon Kindle Edition); pp. 3-7, 17-26.

Healy N, Sugden C. 2012. Safety culture on the Olympic Park. London: HSE Books, Research report 942.

Institute for Work and Health 2011. Benchmarking organizational leading indicators for the prevention and management of injuries and illnesses. Toronto: Institute for Work and Health.

Johnson SE. 2007. The predictive validity of safety climate. *Journal of Safety Research* 38: 511–521.

Kohn LT, Corrigan J, Donaldson MS. 2000. To err is human: building a safer health system. Washington, DC: National Academy Press.

Lingard H, Cooke T, Blismas N. 2009. Group-level safety climate in the Australian construction industry: within-group homogeneity and between-group differences in road construction and maintenance. *Construction Management and Economics* 27: 419–432.

Nahrgang JD, Morgeson FP, Hofmann DA. 2010. Safety at Work: A Meta-Analytic Investigation of the Link Between Job Demands, Job Resources, Burnout, Engagement, and Safety Outcomes. *Journal of Applied Psychology* 95:1-24.

Parker D, Lawrie M, Hudson PA. 2006. Framework for understanding the development of organisational safety culture. *Safety Science*, 44, 551 – 562.

Reason J. 1997. Managing the risks of organizational accidents. Aldershot UK: Ashgate.

Reason J. 2000. Human Error: models and management. *British Medical Journal*. Volume 320:768-770.

Seo DC, Torabi MR, Blair EH, Ellis NT. 2004. A cross-validation of safety climate scale using confirmatory factor analytic approach. *Journal of Safety Research* 35(4): 427-445.

Törner M, Pousette A. 2009. Safety in construction: a comprehensive description of the characteristics of high safety standards in construction work, from the combined perspective of supervisors and experienced workers. *Journal of Safety Research* 40(6): 399-409.

Weick K, Sutcliffe K. 2007. Managing the unexpected: Resilient performance in an age of uncertainty. 2nd edn. San Francisco: Jossey-Bass.

Zohar, D. 2010. Thirty years of safety climate research: Reflections and future directions. *Accident Analysis and Prevention*, 42:1517-1522.

Appendix 1

CONSTRUCTION TRACK AGENDA

June 11	
11:00 am -noon	**Safety Culture and Climate: Defining and Framing the issues for the Construction Industry** Presentations and multi-voting MODERATOR: Matt Gillen
Noon – 1:00	Lunch
1:15 – 3:00	**Leading Indicators: Key factors that contribute to Safety Climate** Presentations and small group discussions MODERATOR: Matt Gillen
3:00 – 3:15	Break
3:15 – 5:00	**Assessing Safety Climate** Presentations and small group discussions MODERATOR: Linda Goldenhar
5:00 pm	Adjourn for the day
June 12	
8:30 – 10:15 am	**Interventions for Improving Safety Climate** Presentations and small group discussions MODERATOR: Scott Schneider
10:15 – 10:45	Break
10:45 – 11:45	**Needs and Next Steps for Bridging the Gap and Moving Forward** • Collaboration • R2P2R • Dissemination across a segmented industry MODERATOR: Steven Hecker
11:45	Evaluation of construction track **Adjourn**

Construction track workshop planning committee: Matt Gillen, CIH, Associate Director of the NIOSH Office of Construction Safety and Health; Dr. Linda Goldenhar, Director, Research and Evaluation, CPWR - The Center for Construction Research and Training; Steve Hecker, Associate Professor Emeritus, University of Oregon; Scott Schneider, CIH, Director of Occupational Safety and Health, Laborers' Health and Safety Fund of North America; Dr. Alberto Caban-Martinez, DO, PhD, MPH, CPH, Research Associate and Chief Research Fellow, Harvard University, School of Public Health

Appendix 2

The rubric below appeared in the journal *Safety Science* in the 2006 article, "A framework for understanding the development of organisational safety culture," by Dianne Parker and Matthew Lawrie of the University of Manchester, UK, and Patrick Hudson of Leiden University, The Netherlands. Permission to use this table has been granted by the lead author, Dianne Parker, and by the publisher, Elsevier. See * at the end of Appendix 2 for more information.

*DYSFUNCTIONAL	REACTIVE	*COMPLIANT	PROACTIVE	*EXEMPLARY
Benchmarking, Trends and Statistics				
Compliance with statutory HSE reporting requirements, but little more. Benchmarking only on finance and production.	Try to respond as other companies do, and worry about the cost of accidents, and their placing in the 'safety league'. Statistics report the immediate causes of accidents.	Benchmark on incidents and accidents. Display lots of data publicly throughout the organization. Focus on current problems that can be measured objectively and summarized numerically.	Benchmark against others in same industry, driven by management. Try to be the best in the industry. Look for trends, understand them and use them to adapt strategy. Explain findings to supervisors.	Benchmark outside the industry, using both 'hard' and 'soft' measures. Involve all levels of the organization in identifying action points for improvement.
Audits and Reviews				
Unwilling compliance with statutory inspection requirements. Audits are mainly financial. HSE audits are unstructured, and only after major accidents.	Accept being audited as inescapable, especially after serious or fatal accidents. No schedule for audits and reviews, as they are seen as a punishment.	There is a regular, scheduled audit program. It concentrates on known high hazard areas. Happy to audit others, but being audited is less welcome. Audits are structured in terms of management systems.	Extensive audit program including cross-auditing within the organization. Management and supervisors realize that they are biased and welcome outside help. Audits are seen as positive, if painful.	Full audit system running smoothly with good follow up. Continuous informal search for non-obvious problems with outside help when needed. There are fewer audits of hardware and systems, and more at the level of behaviors.
Incident/accident reporting, investigation and analysis				
Many incidents are not reported. Investigation only takes place after a serious accident. Analyses don't consider human factors or go beyond legal requirements. Protect the company and its profits.	There is an informal reporting system and investigation is aimed only at immediate causes, with a paper trail to show an investigation has taken place. Investigation focuses on finding guilty parties. There is little systematic follow up and previous similar events are not considered.	There are procedures producing lots of data and action items, but opportunities to address the real issues are often missed. The search for causes is usually restricted to the level of the local workforce.	There are trained investigators, with systematic follow-up to check that change has occurred and been maintained. Reports are sent companywide to share information and lessons learned. There is little creativity in imagining how the real underlying issues could affect the business.	Investigation and analysis driven by a deep understanding of how accidents happen. Real issues identified by aggregating information from a wide range of incidents. Follow up is systematic, to check that change occurs and is maintained.
Hazard and Unsafe Act reports				
There are no reports.	Reporting is simple and factual. Focus is on determining who or what caused the situation. The company does not track actions after reports.	Reports follow a fixed format for categorization and documentation of observations. Number of reports is what counts. The company requires complete forms without blanks.	Reporting looks for 'why' rather than just 'what' or 'when'. Quick submission of reports is appreciated, and blanks in forms can be filled in later. Management sets reporting goals.	All levels actively access and use the information generated by reports in their daily work.

*DYSFUNCTIONAL	REACTIVE	*COMPLIANT	PROACTIVE	*EXEMPLARY
Work planning including PTW, Journey Management				
There is no HSE planning and little planning overall. What work planning there is concentrates on the quickest, fastest, and cheapest execution.	HSE planning is based on what went wrong in the past. There is an informal general planning process, based primarily on managing the time taken for a job.	There is a lot of emphasis on hazard analysis and Permit To Work. There is little use of feedback to improve planning, but people believe that the system is good and will prevent accidents.	Planning is standard practice, with work and HSE integrated in the plan. Plans are followed through and there is some evaluation of effectiveness by supervisors and line management.	There is a polished planning process with both anticipation of problems and review of the process. Employees are trusted to do most planning. There is less paper, more thinking, and the process is well known and disseminated.
Contractor management				
Get the job done with minimum effort and expense.	The company only pays attention to HSE issues in contracting companies after an accident. The primary selection criterion is price, but only poor safety performance has consequences for choice of contractors.	Contractors meet extensive pre-qualification requirements based on questionnaires and statistics. HSE standards are lowered if no contractor meets requirements. Contractors have to get up to speed on their own.	HSE issues are seen as partnership. Pre-qualification is on the basis of proof that there is a working HSE-management system. Joint company-contractor safety efforts are observed and the company helps with contractor training.	No compromises to work quality. Find solutions together with contractors to achieve expectations even if this means postponing the job until requirements are met.
Competency/training – are workers interested?				
Training is seen as a necessary evil. Attend training when it is compulsory by law. Workers don't mind exchanging a harsh working environment for a couple of hours training off the job.	Training is aimed at the person - "If we can changes their attitude everything will be all right". After an accident money is made available for specific training programs. The training effort diminishes over time.	Competence matrices are present and lots of standard training courses are given. Acquired course knowledge is tested. There is some on-the-job transfer of training.	Leadership fully acknowledges the importance of tested skills on the job. The workforce is proud to demonstrate their skills in on-the-job assessment. Training needs start to be identified by the workforce.	Issues like attitudes become as important as knowledge and skills. Development is seen as a process rather than an event. Needs are identified and methods of acquiring skills are proposed by the workforce, who are an integral part of the process rather than just passive receivers.
Work-site job safety techniques				
There are no techniques applied. Look out for yourself.	After accidents a standard work-site hazard management technique is bought in, but there is little systematic use after initial introduction.	A commercially available technique is introduced to meet the requirements of the management system, but leads to little action. Quotas are used to demonstrate that the system is working. Nothing else is used.	Job safety analysis/job safety observation techniques are accepted by the workforce as being in their own interest and they regard such methods as standard practice.	Job safety analysis, as a work-site hazard management technique, is revised regularly in a defined process. People (both workers and supervisors) are not afraid to tell each other about hazards.

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*DYSFUNCTIONAL	REACTIVE	*COMPLIANT	PROACTIVE	*EXEMPLARY
Who checks safety on a day-to-day basis?				
There is no formal system ,so individuals take care of themselves as they see fit.	External inspectors check sites after major incidents. Cursory site checks are performed by line supervision/ management when they are visiting, mostly after incidents or inefficiencies. There is no formal system for follow up.	Site activities are regularly checked by the line management, but not on a daily basis. Inspections aim at compliance with procedures.	Supervisors encourage work teams to check safety for themselves. Managers doing walk-rounds are seen as sincere. They engage employees in dialogue. Internal cross-audits take place, involving managers and supervisors.	Everyone checks for hazards, looking out for themselves and their work-mates. Supervisor inspections are largely unnecessary. There is no problem with demanding shutdowns of operations.
What is the size/status of the HSE department?				
If there is a department, it consists of one person or a small staff in the HR department.	The department is small and has little power. It is seen as a career backwater, and once in it is hard to get out. The staff is on call constantly, but usually very much in the background. The department is seen as a police force.	HSE positions are given to middle managers with good backgrounds who can't be placed elsewhere. It is a large department with some status and power, mainly performing number crunching and sending people on training courses. The HSE manager reports to someone in a position of operational authority.	HSE seen as an important job, given to high fliers. HSE professionals are recruited directly and advisors are appreciated by the line. All senior people in operations must have HSE experience. The HSE manager reports directly to the top management of the company.	There may not be an HSE department because it is not needed, as the safety culture is right. HSE responsibilities are distributed throughout the company. If there is a department it is small but powerful, having equal status with other departments.
What are the rewards of good safety performance?				
None is given or expected – staying alive is reward enough. There are only punishments for failure.	There are disincentives for poor HSE performance. The understanding that positive behavior can be rewarded has not yet arrived. Managers' bonuses tied to LTI performance.	Some lip service is paid to good safety performance. Safety awards such as T- shirts or baseball hats are made. There are safety competitions and quizzes. TRCF is used when calculating bonuses.	There are some rewards and good performance is considered in promotion reviews. Evaluation is process-based rather than on outcomes.	Recognition itself seen as high value. Good HSE performance is intrinsically motivating.
Who causes accidents in the eyes of management?				
Individuals are blamed, and it is believed that accidents are a part of the job. Responsibility for accidents is seen as belonging to those directly involved.	There are attempts to remove 'accident-prone' individuals. It is believed that accidents are often just bad luck. The responsibility of The System for accidents is considered but has no consequences.	Faulty machinery and poor maintenance are identified as causes as well as people. There are attempts to reduce exposure. Management has a Them, rather than Us, mentality and takes an individual rather than a systems perspective.	Management looks at the whole system, including processes and procedures when considering accident causes. They admit that management must take some of the blame.	Blame is not an issue. Management accepts it could be responsible when assessing what they personally could have done to remove root causes. They take a broad view looking at the interaction of systems and people.
What happens after an accident? Is the feedback loop being closed?				
After an accident the focus is on the employee, and they are often fired. The priority is to limit damage and get back to production.	Line management is annoyed by 'stupid' accidents. After an accident reports are not passed up the line if it can be avoided. Warning letters sent by management.	Workforce reports their own accidents but maintain distance with contractor incidents. Management goes ballistic when they hear of an accident – "What does this do to our statistics?"	Management is disappointed, but asks about the well-being of those involved. Investigation focuses on underlying causes and the results are fed back to the supervisory level.	Top management is seen amongst the people involved directly after an accident. They show personal interest in individuals and the investigation process. Employees take accidents to others personally.

*DYSFUNCTIONAL	REACTIVE	*COMPLIANT	PROACTIVE	*EXEMPLARY
How do safety meetings feel?				
Meetings, if any, are seen as a waste of time. They are run by the boss or a supervisor, and are felt to be a case of going through the motions. Conversation often turns to sport.	Meetings are attended reluctantly. They provide opportunities to point the finger of blame for incidents, and form a standard response to an accident. Toolbox meetings may be dominated by non-work issues.	Meetings are like textbook discussions about company policy with limited interaction. The regular scheduled meetings feel like overkill. Toolbox meetings are run on a strict agenda.	Meetings feel like a genuine forum for interaction across the company. At lower levels all meetings are safety meetings and are used to identify problems before they occur.	Meetings can be called by any employee, taking place in a relaxed atmosphere, and may be run by employees with managers attending by invitation. Toolbox meetings are short and focused on ensuring everyone is aware of what problems might arise.
Balance between HSE and profitability				
Profitability is the only concern. Safety is seen as costing money, and the only priority is to avoid extra costs.	Cost is important, but there is some investment in preventative maintenance. Operational factors dominate.	Safety and profitability are juggled rather than balanced, with the line spending most of its time on operational issues. Line managers know how to say the right things, but do not always walk their own talk. Safety is seen as discretionary expenditure. If all contractors are unacceptable, the least bad is taken.	The company tries to make HSE the top priority, while understanding that HSE contributes to financial return. The company is quite good at juggling the two, and accepts delays to get contractors up to standard in terms of safety. Money still counts.	There are in balance, so that this becomes a non-issue. Management believes that HSE makes money. The company accepts delays to get contractors up to standard in terms of safety.
Is management interested in communicating HSE issues with the workforce?				
Management is not interested apart from telling workers not to cause problems.	The 'flavor of the month' safety message is passed down from management. Any interest diminishes over time as things get 'back to normal'.	Management shares a lot of information with workers and has frequent safety initiatives. Management does a lot of talking but there are few opportunities for bottom-up communication.	Managers realize that dialogue with the workforce is desirable and so a two-way process is in place. Asking as well as telling goes on. The emphasis is on looking out for each other in the workplace.	There is a definite two-way process in which management gets more information back than they provide. The process is transparent. It's seen as a family tragedy if someone gets hurt.
Commitment level of workforce and level of care for colleagues				
"Who cares as long as we don't get caught?" Individuals look after themselves	'Look out for yourself' is still the rule. There is a voiced commitment to care for colleagues, after accidents, by both management and workforce, but this diminishes after a period of good safety performance.	There is a trickle down of management's increasing awareness of the costs of failure. People know how to pay lip service to safety, but practical factors may prevent complete follow through.	Pride is beginning to develop, increasing the workforce's commitment to HSE and their care for colleagues, but the feeling is not universal.	Levels of commitment and care are very high and are driven by employees who show passion about living up to their aspirations. Standards are defined by the workforce.

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*DYSFUNCTIONAL	REACTIVE	*COMPLIANT	PROACTIVE	*EXEMPLARY
What is the purpose of procedures?				
The company makes HSE procedures out of necessity. They are seen as limiting peoples' activities to avoid litigation or harm to assets.	The purpose of HSE procedures is to prevent individual incidents recurring. They are often written in response to accidents and their overall effect may not be properly considered in detail.	There are many HSE procedures, serving as 'barriers' to prevent incidents. It is hard to separate procedures from training.	HSE procedures spread best practice but are seen as occasionally inconvenient by a competent workforce. A limited degree of non-compliance is acceptable.	There is trust in employees that they can recognize situations where compliance should be challenged. Non-compliance to HSE procedures goes through recognized channels. Procedures are refined for efficiency.

*Adapted rubric: The authors replaced three of the original Parker headings for use at the Workshop. Pathological was replaced with Dysfunctional, Calculative was replaced with Compliant, and Generative was replaced with Exemplary.

Appendix 3

OSHA I2P2 Tool for a Safety and Health Program Assessment*

I. MANAGEMENT LEADERSHIP AND EMPLOYEE INVOLVEMENT

Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Clear worksite safety and health policy				
There is no policy.	There is a written (or oral, where appropriate) policy.	There is a S&H policy and some employees can explain it.	There is a S&H policy and majority of employees can explain it.	There is a S&H policy and all employees accept, can explain, and fully understand it.
Clear goals and objectives are set and communicated				
There are no safety and health goals and objectives.	There are written (or oral, where appropriate) goals and objectives.	Some employees can explain results and measures for achieving them.	Majority of employees can explain results and measures for achieving them.	All employees are involved in developing goals and can explain desired results and how results are measured.
Management Leadership				
Safety and health is not a top management value or concern.	There is some evidence that top management is committed to safety and health.	Some employees can give examples of management's commitment to safety and health.	Majority of employees can give examples of management's active commitment to safety and health.	All employees can give examples of management's commitment to safety and health.
Management example				
Management does not follow basic safety and health rules.	Management generally follows basic safety and health rules.	Management follows the rules and occasionally addresses the safety behavior of others.	Management follows the rules and usually addresses the safety behavior of others.	All employees recognize that management always follows the rules and addresses the safety behavior of others

Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Employee involvement				
Employee involvement in safety and health issues is not encouraged nor rewarded.	Employees generally feel that their safety and health input will be considered by supervisors.	Some employees feel that they have a positive impact on safety and health.	Majority of employees feel they have a positive impact on identifying and resolving safety and health issues.	All employees have ownership of safety and health and can explain their roles.
Assigned safety and health responsibilities				
Specific job responsibilities and performance expectations are generally unknown or hard to find.	Performance expectations are generally spelled out for all employees.	Some employees can explain what performance is expected of them.	Majority of employees can explain what performance is expected of them.	All employees can explain what performance is expected of them.
Authority and resources for safety and health				
All authority and resources come from supervision and are not delegated.	Authority and resources exist, but most are controlled by supervisors.	Authority and resources are spelled out for all, but there is often a reluctance to use them.	Majority of employees believe they have the necessary authority and resources to meet their responsibilities.	All employees believe they have the necessary authority and resources to meet their responsibilities.
Accountability				
There is no effort towards accountability.	There is some accountability, but it is generally hit or miss.	Personnel are generally held accountable, but consequences and rewards do not always follow performance.	Accountability systems are in place, but consequences used tend to be for negative performance only.	Personnel are held accountable and all performance is addressed with appropriate consequences.
Program Review (Quality Assurance)				
There is no program review process.	Changes in programs are driven by events such as accidents or near misses.	A program review is conducted, but it doesn't drive all necessary program changes.	A comprehensive review is conducted at least annually and drives appropriate program modifications.	In addition to a comprehensive review, a process is used which drives continuous correction.

II. WORKSITE ANALYSIS

Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Hazard identification (Expert survey)				
No comprehensive surveys have been conducted.	Expert surveys in response to accidents, complaints, or compliance activity only.	Comprehensive expert surveys are conducted, but corrective actions sometimes lag.	Comprehensive expert surveys are conducted periodically and drive appropriate corrective action.	Comprehensive expert surveys are conducted regularly and result in corrective action and updated hazard inventories.
Hazard identification (Change analysis)				
No system for hazard review of planned or new facilities exists.	Hazard reviews of planned or new facilities, processes, materials, or equipment are problem driven.	High hazard planned or new facility, process, material or equipment are reviewed.	Every planned or new facility, process, material, or equipment is fully reviewed by a competent team.	Every planned or new facility, process, material, or equipment is fully reviewed by a competent team, along with affected workers.

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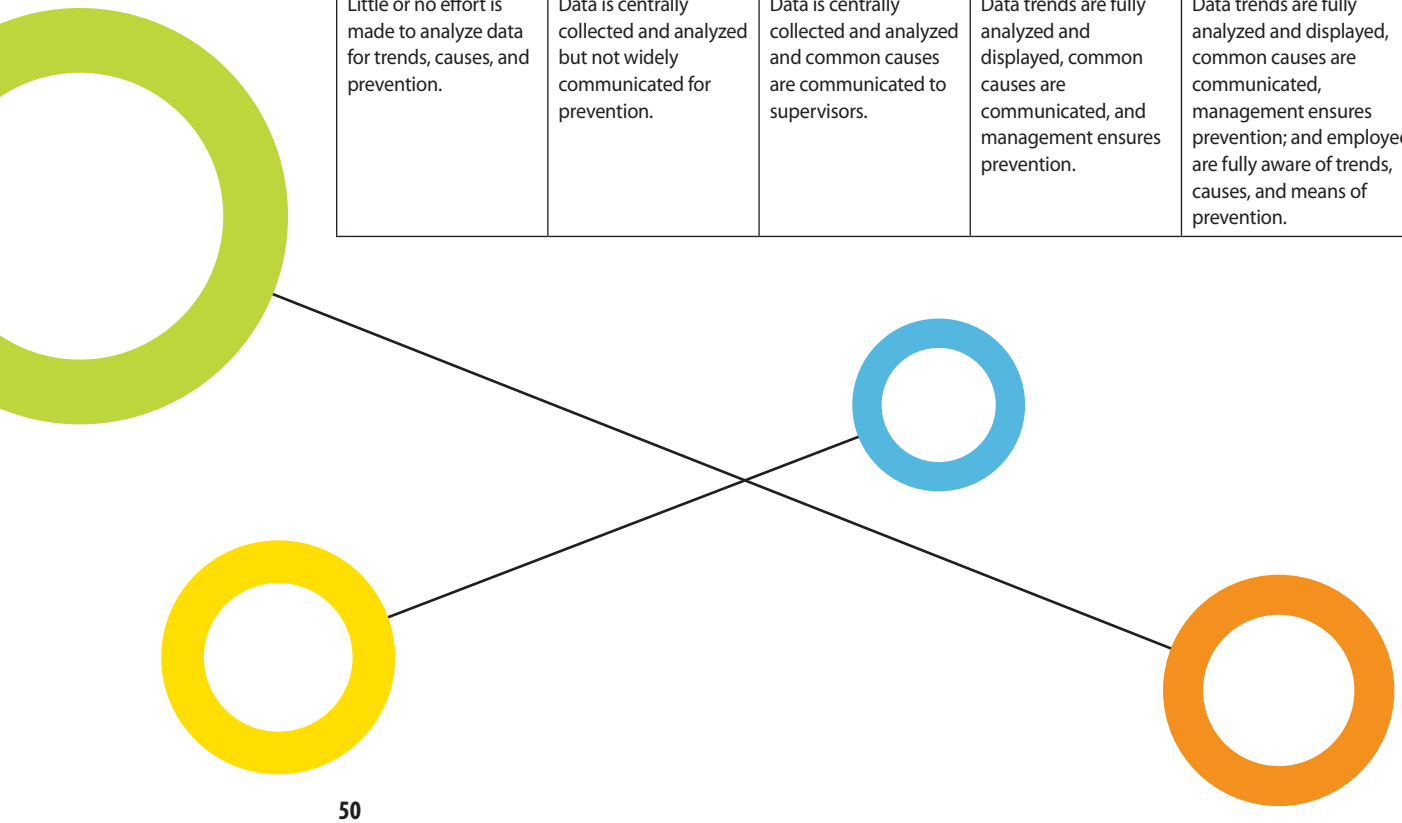
Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Hazard identification (Job and process analysis)				
There is no routine hazard analysis system in place.	A hazard analysis program exists, but few are aware of it.	A current hazard analysis exists for all jobs, processes, or phases and is understood by many employees.	A current hazard analysis exists for all jobs, processes, and material and it is understood by all employees.	A current hazard analysis exists for all jobs, processes, and material; it is understood by all employees; and employees have had input into the analysis for their jobs.
Hazard identification (Inspection)				
There is no routine inspection program in place and many hazards can be found.	An inspection program exists, but corrective action is not complete; hazards remain uncorrected.	Inspections are conducted and most items are corrected, but some hazards are still uncorrected.	Inspections are conducted and all items are corrected; repeat hazards are seldom found.	Employees and supervisors are trained, conduct routine joint inspections, and all items are corrected.
Hazard Reporting System				
There is no hazard reporting system and/or employees are not comfortable reporting hazards.	A system exists for hazard reporting but employees find it unresponsive or are unclear how to use it.	A system exists for hazard reporting and employees feel they can use it, but the system is slow to respond.	A system exists for hazard reporting and employees feel comfortable using it.	A system exists for hazard reporting, employees feel comfortable using it, and employees feel comfortable correcting hazards on their own initiative.
Accident/Incident Investigation				
Injuries are either not investigated or investigation is limited to report writing required for compliance.	Some investigation of incidents takes place, but root cause is seldom identified and correction is spotty.	OSHA-reportable incidents are generally investigated; accident cause and/correction may be inadequate.	All OSHA-reportable incidents are investigated and effective prevention is implemented.	All loss-producing incidents and near-misses are investigated for root cause with effective prevention.
Injury/illnesses analysis				
Little or no effort is made to analyze data for trends, causes, and prevention.	Data is centrally collected and analyzed but not widely communicated for prevention.	Data is centrally collected and analyzed and common causes are communicated to supervisors.	Data trends are fully analyzed and displayed, common causes are communicated, and management ensures prevention.	Data trends are fully analyzed and displayed, common causes are communicated, management ensures prevention; and employees are fully aware of trends, causes, and means of prevention.



III. HAZARD PREVENTION AND CONTROL

Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Timely and effective hazard control				
Hazard control is not complete, effective, and appropriate.	Hazard controls are generally in place, but there is heavy reliance on personal protective equipment.	Hazard controls are fully in place, but there is some reliance on personal protective equipment.	Hazard controls are fully in place with priority to engineering controls, safe work procedures, administrative controls, and personal protective equipment (in that order).	Hazard controls are fully in place, known and supported by work force, with concentration on engineering controls and safe work procedures.
Facility and Equipment Maintenance				
There is little or no attention paid to preventive maintenance; break-down maintenance is the rule.	A preventive maintenance schedule is in place but is often allowed to slide.	A preventive maintenance schedule is in place and is usually followed except for higher priorities.	An effective preventive maintenance schedule is in place and applicable to all equipment.	Operators are trained to recognize maintenance needs and perform and order maintenance on schedule.
Emergency Planning and Preparation				
Little effort is made to prepare for emergencies.	There is an effective emergency response plan, but training and drills are weak and roles may be unclear.	There is an effective emergency response plan and team, but other employees may be uncertain of their responsibilities.	There is an effective emergency response plan and employees have a good understanding of responsibilities as a result of plans, training, and drills.	There is an effective emergency response plan and employees know immediately how to respond as a result of effective planning, training, and drills.
Emergency Equipment				
There is little or no effort made to provide emergency equipment and information.	Emergency phones, directions, and equipment are in place, but employees show little awareness.	Emergency phones, directions, and equipment are in place, but only emergency teams know what to do.	Facility is well equipped for emergencies with appropriate emergency phones and directions; majority of personnel know how to use equipment and communicate during emergencies.	Facility is fully equipped for emergencies; all systems and equipment are in place and regularly tested; all personnel know how to use equipment and communicate during emergencies.
Medical Program (Health Providers)				
Occupational health assistance is rarely requested or provided.	Occupational health providers are available, but normally concentrate on employees who get hurt.	Occupational health providers are consulted about significant health concerns in addition to accidents.	Occupational health providers are involved in hazard assessment and training.	Occupational health providers are regularly on-site and fully involved.
Medical Program (Emergency Care)				
Neither on-site nor community aid can be ensured at all times.	Personnel with basic first aid skills are usually available, with community assistance nearby.	Either on-site or nearby community aid is always available on day shift.	Personnel with basic first aid skills are always available on-site, all shifts.	Personnel fully trained in emergency medicine are always available on-site.

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IV. SAFETY AND HEALTH TRAINING

Dysfunctional	Reactive	Compliant	Proactive	Exemplary
Employees Learn Hazards (How to Protect Themselves and Others)				
Facility depends on experience and informal peer training to meet needs.	Training is provided when the need is apparent; experienced employees are assumed to know the material.	Facility provides legally required training and makes effort to include all employees.	Facility is committed to high-quality employee hazard training, ensures all participate, and provides regular updates.	Facility is committed to high-quality employee hazard training, ensures all participate, and provides regular updates; in addition, employees can demonstrate proficiency in, and support of, all areas covered by training.
Supervisors Learn Responsibilities and Underlying Reasons				
There is no formal effort to train supervisors in safety and health responsibilities.	Supervisors make responsible efforts to meet safety and health responsibilities, but have limited training.	Supervisors have received basic training, appear to understand and demonstrate importance of worksite hazard analysis, physical protections, training reinforcement, discipline, and knowledge of work procedures.	Most supervisors assist in worksite hazard analysis, ensure physical protections, reinforce training, enforce discipline, and can explain work procedures based on the training provided to them.	All supervisors assist in worksite hazard analysis, ensure physical protections, reinforce training, enforce discipline, and can explain work procedures based on the training provided to them.
Managers Learn Safety and Health Program Management				
Managers generally show little understanding of their safety and health management responsibilities.	Managers are generally able to describe their safety and health role, but often have trouble modeling it.	Managers generally show a good understanding of their safety and health role and usually model it.	All managers follow, and can explain, their roles in safety and health program management.	All managers have received formal training in safety and health management responsibilities.

* This is a revision of the questionnaire developed for the I2P2 program Construction Safety and Health Outreach Program (OSHA, 1996): http://www.osha.gov/doc/outreachtraining/htmlfiles/evaltool.html

Appendix 4

SELECTED SAFETY CULTURE/CLIMATE ASSESSMENT TOOLS

Name of tool or survey Author Source	Used in construc-tion?	# of Qs	Number and name of included factors (and other notes)
Institute of Work & Health 2011 Benchmarking Organizational *Leading Indicators for the Prevention and Management of Injuries and Illnesses: Final Report.* http://www.iwh.on.ca/benchmarking-organizational-leading-indicators	Utilities	8	Not divided into factors Leading indicator tool developed for Ontario workplaces
Dedobbeleer & Beland 1991 *A safety climate measure for construction sites.* Journal of Safety Research 22(2): 97-103 http://www.sciencedirect.com/science/article/pii/002243759190017P	Yes	9	2 - Management commitment - Worker involvement
DeArmond et al. 2011 *Individual safety performance in the construction industry: Development and validation of two short scales.* Accident Analysis and Prevention 43 (948–954) http://www.sciencedirect.com/science/article/pii/S0001457510003647	Yes	10	2 - Safety compliance - Safety participation
Zohar & Luria, 2005 *A Multilevel Model of Safety Climate: Cross-Level Relationships Between Organization and Group-Level Climates.* Journal of Applied Psychology 2005, Vol. 90, No. 4, 616–628 http://psycnet.apa.org/journals/apl/90/4/616.html	Yes	16	6 3 Organizational Level - Active practices (monitoring,enforcing) - Proactive practices (promoting learning, development) - Declarative practices (declaring, informing) 3 Group Level - Active practices (Monitoring, controlling) - Proactive practices (Instructing, Guiding) - Declarative practices (Declaring, Informing)
Parker et al, 2006 *A framework for understanding the development of organizational safety culture.* Safety Science 44 (2006) 551 562 http://www.sciencedirect.com/science/article/pii/S0925753505001219	No (oil industry)	18	Uses 5 descriptions (text-based rubrics) reflecting level of organizational safety culture maturity Descriptions divided into 2 categories: - Concrete organizational aspects - Abstract organizational concepts

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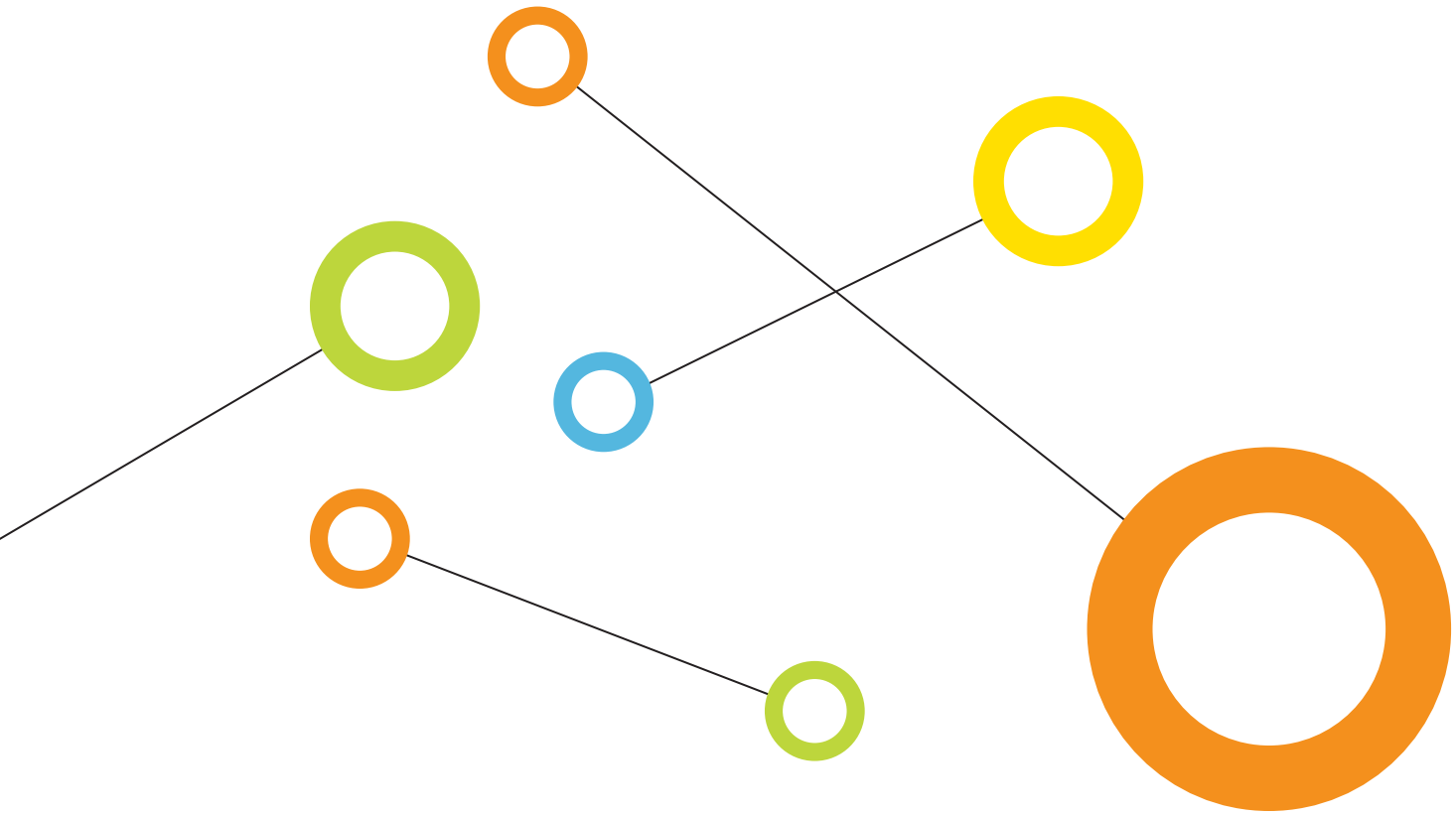
Name of tool or survey Author Source	Used in construc-tion?	# of Qs	Number and name of included factors (and other notes)
Seo et al. 2004 *A cross-validation of safety climate scale using confirmatory factor analytic approach.* Journal of Safety Research 35 (2004) 427– 445 http://www.sciencedirect.com/science/article/pii/S0022437504000817	No	30	5 - Management commitment to safety - Supervisor safety support - Coworker safety support - Employee participation in safety-related decision making and activities - Competence level of employees with regard to safety
Pousette et al. 2008 *Safety climate cross-validation, strength and prediction of safety behavior.* Safety Science 46 (2008) 398–404 http://www.sciencedirect.com/science/article/pii/S0925753507000926	Yes Swedish tunnel workers	33	4 - Management safety priority - Safety management - Safety communication - Workgroup safety involvement
Neal, Griffin & Hart 2000 *The impact of organizational climate on safety climate and individual behavior.* Safety Science, 34, 99-109, 2000 http://www.sciencedirect.com/science/article/pii/S0925753500000084	Yes but not published	35	8 - Management values - Communication - Training - Physical Work Environment - Safety Systems - Knowledge - Motivation - Behavior
Zohar, 1980 *Safety Climate in Industrial Organizations: Theoretical and Applied Implications* Journal of Applied Psychology 1980, Vol. 65, No. 1, 96-102 http://psycnet.apa.org/journals/apl/65/1/96.pdf	Yes	40	8 - Management attitude toward safety - Work pace and safety - Effects of safe conduct on promotion - Effect of safe conduct on social status - Perceived risks - Perceived importance of safety training - Perceived status of safety officer - Perceived status of safety committee
UK HSE Safety Climate Tool 1997 http://www.lboro.ac.uk/departments/sbe/downloads/pmdc/safety-climate-assessment-toolkit.pdf	Yes (2012 London Olympics)	43	8 - Organizational commitment - Health and Safety oriented behavior - Health and Safety Trust - Usability of Procedures - Engagement in health and safety - Peer group attitude - Resources of health and safety - Accidents and near miss reporting

Name of tool or survey Author Source	Used in construc-tion?	# of Qs	Number and name of included factors (and other notes)
Gittleman et al. CPWR survey, 2010 *[Case Study] CityCenter and Cosmopolitan Construction Projects, Las Vegas, Nevada: Lessons learned from the use of multiple sources and mixed methods in a safety needs assessment.* Journal of Safety Research Volume 41, Issue 3, June 2010, Pages 263–281 http://www.sciencedirect.com/science/article/pii/S0022437510000447	Yes (Las Vegas City Center Project)	44	Not divided into factors Survey includes separate questions for general contractor and subcontractors
Nordic occupational safety climate questionnaire Kines, et al. http://www.arbejdsmiljoforskning.dk/en/publikationer/spoergeskemaer/nosacq-50	Yes	50	7 - Management safety priority, commitment, and competence - Management safety empowerment - Management safety justice - Workers' safety commitment - Workers' safety priority and risk non-acceptance - Safety communication, learning, and trust in co-workers safety competence - Trust in the efficacy of safety systems Currently translated into 25 languages.



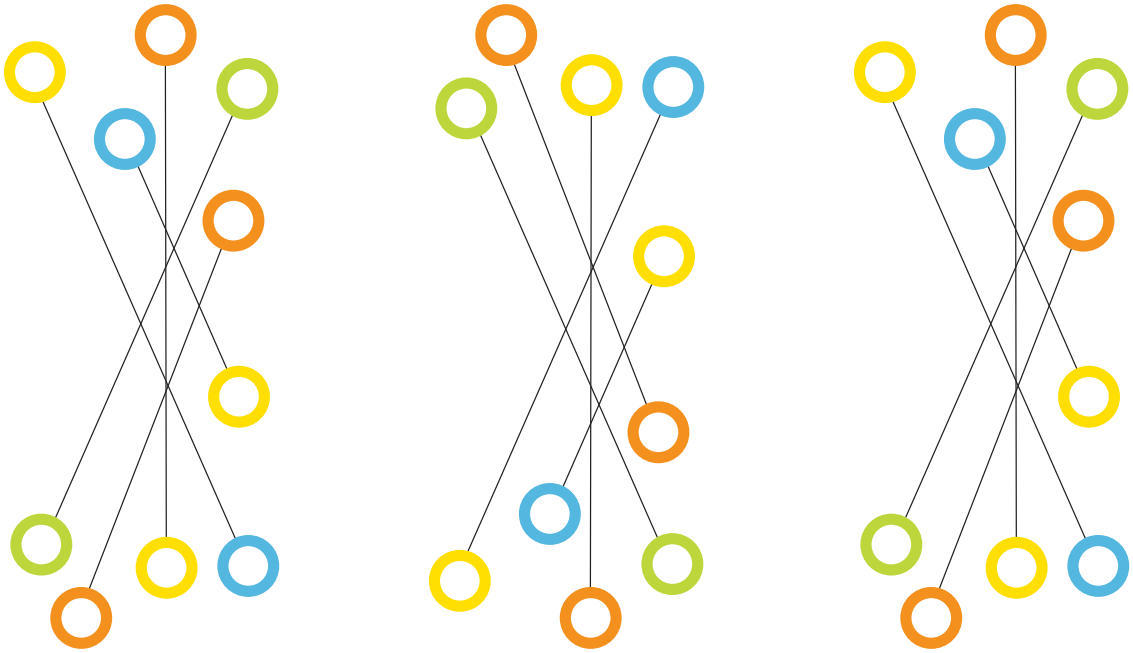
Appendix 5

PARTICIPANTS' EVALUATION OF THE WORKSHOP

In the last 10 minutes of each session participants were asked to retrieve from their folder a color-coded session-specific evaluation form. On each were 3 or 4 close-ended questions that asked for their perceptions of how valuable the session was for their current and on-going work related to safety climate and culture. There were also 2 open-ended questions for each session asking them to name the most and least valuable aspects of the session. The number of respondents varied somewhat due to people leaving, and forgetting to complete the evaluation, although it never dipped below 60% (the workshop planning team did not complete the evaluations making the total number of possible respondents 65). The results in the Table show that across all sessions, the majority of respondents found the activities to be extremely or mostly valuable and only a very small % finding any session to be not at all valuable.

	Extremely Valuable	Mostly Valuable	Somewhat Valuable	Not at all Valuable
Framing session				
How valuable was the presentation for framing the current safety culture/ climate issues in construction? (N=55)	20.0%	60.0%	18.2%	1.8%
How valuable was having the group select working definitions of safety culture and safety climate? (N=55)	32.7%	29.1%	32.7%	5.5%
Session 1				
How valuable was the activity where you listed and mapped factors that contribute to safety climate/culture? (N=54)	53.7%	37.0%	9.3%	0.0%
How valuable was discussing and agreeing on the top 5 factors that contribute to safety climate/culture? (N=54)	55.6%	37.0%	5.6%	1.9%
Session 2				
How valuable was it working as a group to develop rubrics for the factors? (N=42)	42.9%	38.1%	19.0%	0.0%
How valuable were the "igniter" presentations for setting the stage for this session? (N=38)	44.7%	42.1%	13.2%	0.0%
Session 3				
How valuable was this session for giving you new ideas of solutions to improve safety culture and climate? (N=46)	34.8%	43.5%	19.6%	0.0%
How valuable was this session for giving you ideas of how to effectively implement solutions? (N=46)	26.1%	37.0%	34.8%	2.2%
How valuable was this session for discussing specific barriers and facilitators to effective implementation? (N=46)	37.0%	28.3%	30.4%	4.3%

The vast majority of comments were positive and the one most often mentioned was having the opportunity to discuss and share ideas with stakeholders representing other constituencies. The vast majority of negative comments had to do with the limited amount of time for discussion. A few also mentioned that there was some overlap across the sessions.



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