ASSESSING THE SAFETY CULTURE OF UNDERGROUND COAL MINING: RESULTS AND RECOMMENDATIONS

C. L. Kosmoski, Office of Mine Safety and Health Research, Pittsburgh, PA

INTRODUCTION

In recent years, coal mining safety has attained national attention due to several highly publicized disasters. Despite these threats to worker safety and health, the U.S. relies on the mining of coal to meet its need for electrical power, with 42% of electricity in the U.S. generated through the burning of coal (U.S. Energy Information Administration, 2012b; United Mine Workers of America, n.d.). Furthermore, the production of coal continues to increase and reach record levels every year (National Mining Association, 2012; U.S. Energy Information Administration, 2012a). For this reason, the coal mining industry must continue to find ways to protect its workers while maintaining productivity.

One potential approach to protecting workers while maintaining productivity is through improving the safety culture at coal mines. In order to achieve this culture, operators, employees, the inspectorate, etc. must share a fundamental commitment to safety as a value. This type of culture is known in other industries as a "safety culture," and can be defined as the characteristics of the work environment (such as the norms, rules, and common understandings) that influence facility personnel's perceptions of the importance that the organization places on safety.

Fundamental to improving safety culture within an organization is understanding the existing safety culture; improvements cannot be made without first elucidating areas that require improvement. This manuscript details the process undertaken by researchers at the National Institute for Occupational Safety and Health (NIOSH) Office of Mine Safety and Health Research (OMSHR) to assess the safety culture at five underground coal mines across the United States. The purpose of this manuscript is to present the aggregated results from those five safety culture assessments conducted at underground coal mines. Additionally, some general recommendations for areas where coal mines might focus their attention as part of their attempts to improve safety culture are offered.

BACKGROUND ON SAFETY CULTURE ASSESSMENTS

Since its inception, the concept of safety culture has been a key topic in discussions of safety across many industries. There is "a recognition that, while having engineered safeguards and formal management systems to control risks is essential, it is equally important to win the commitment of the workforce to treat safety as a priority through a genuine corporate commitment to achieve high levels of safety" (International Nuclear Safety Advisory Group, 2002, Foreword). However, evaluating the safety culture of a particular organization poses some challenges. Cultural assumptions, which influence behavior and, therefore, safety performance, are not always clearly observable.

Safety culture can be aptly described using Schein's (1992) model of organizational culture. According to Schein, organizational culture consists of three levels: artifacts, espoused values, and basic assumptions. *Artifacts* are "all the phenomena that one sees, hears, and feels when one encounters a new group with an unfamiliar culture" (Schein, 1992, p. 17). For example, artifacts of the safety culture in a coal mine might include personal protective equipment such as hard hats and hearing protection as well as the communication practices between a continuous miner operator and a shuttle car operator. *Espoused values* are the strategies, goals, and philosophies of the

organization (Schein, 1992) and may become known through examples such as the company's mission statement, other organizational literature, training for new hires or longtime employees, or even through direct communication from organizational members. In a coal mine, espoused values might be reflected through mottos such as "Safety first." The third level of organizational culture, *basic assumptions*, are, according to Schein, "unconscious, taken-for-granted beliefs, perceptions, thoughts, and feelings" (p. 17) that guide the behavior of group members as well as their expectations for and judgments of others' behavior. This level is the most difficult to detect because often these "core" assumptions are so ingrained that employees do not realize they have them. In a coal mine, these could include assumptions such as "Everyone follows safety regulations," or "You never leave someone behind in the mine." In an organization that holds these basic assumptions, it would be viewed as inconceivable that someone would violate a safety regulation or leave a coworker behind. Schein suggests that artifacts and espoused values develop and are sustained based on the underlying basic assumptions. Thus, safety culture can be assessed by examining elements of each of the three levels.

Artifacts, claimed values, and basic assumptions can be evaluated to identify the presence or absence of the characteristics that have been found to be important for the existence of a positive safety culture (International Atomic Energy Agency, 2006). These characteristics include:

- Safety is a clearly recognized value in the organization.
- Accountability for safety in the organization is clear.
- Safety is integrated into all activities in the organization.
- A safety leadership process exists in the organization.
- Safety culture is learning-driven in the organization.

A sixth characteristic can be added to this framework to specifically evaluate the absence or presence of a Safety Conscious Work Environment (SCWE). A Safety Conscious Work Environment is one in which individuals feel free to raise concerns of any type without the fear of reprisal. A healthy SCWE is a critical subset of a healthy safety culture and ensures that problems can be identified before they become significant events. Adding this sixth element to the framework results in this characteristic:

- A process for establishing a strong and effective SCWE is in place.

METHODOLOGY

The methodology described below was originally developed with the support of the U.S. Nuclear Regulatory Commission (Haber & Barriere, 1998) to assess the influence of organization and management on safety performance within the nuclear power industry. Overall the methodology has been implemented in over 50 different organizations, across 5 different countries, representing industries as diverse as nuclear power, fossil energy, research, mining, transportation, health care, and chemical reprocessing.

The methodology entails collecting a variety of information that is largely based upon the attitudes and perceptions of the individuals in an organization, as well as conducting structured observations of individuals performing work activities. Behavioral research has shown that attitudes and perceptions factor largely into determining behavior (Ajzen & Fishbein, 1980; Ajzen, 1991). Therefore, the data collected

regarding individuals' perceptions and attitudes are critical to this type of evaluation.

A multiple-method approach was utilized to assess the safety culture of underground coal mines for this project. The methods included (1) functional analysis, (2) in-depth interviews, (3) behavioral anchored rating scales (BARS), (4) organizational and safety culture (paper and pencil) surveys, and (5) behavioral observations. Each methodology offers a unique insight into a mine's safety culture, and the use of all methodologies combined offers the most comprehensive and complete assessment of a mine's safety culture. The five methodologies will be explained in detail below.

Functional Analysis

The purposes of the functional analysis in this study were: (1) to clearly identify the organizational units of the mines, (2) to gain an understanding of each organizational unit's functions and interfaces, (3) to examine the way in which information flows among and within units, and (4) to identify the key supervisory and managerial positions of each organizational unit. Information to support this activity was obtained primarily through the review of documentation as well as preliminary discussions with mine staff. The following are examples of documents that were reviewed at the mine sites studied as part of the functional analysis:

- Mine Safety and Health Administration (MSHA) Mine Data Retrieval System entries related to that particular mine.
- Any comprehensive safety program, which includes all safety policies and practices.
- Employee handbooks.
- Organizational structure charts.
- Mine maps.
- Records of MSHA violations.
- Ventilation plans.
- Roof control plans.
- Foremen's pre-shift reports.
- Incident investigation report templates.
- Completed incident investigation reports.
- Performance review templates.

Functional Analysis Sampling

The sample of documents analyzed for the functional analysis was determined based on what documents and information were publicly available and what documents and information were voluntarily provided by the mine. The MSHA Mine Data Retrieval System information is publicly available; therefore, information contained in the MSHA database relating to incidents, accidents, violations, and citations was gathered for each mine site. Once on site at a mine, researchers were given access to the mine maps, ventilation plans, and roof control plans. All mine sites also allowed researchers access to the previous year's MSHA citation narratives. Organizational safety programs, employee handbooks, organizational structure charts, incident report templates and actual incident reports, and performance review templates were requested at each mine site, but they were not provided at all sites. The mines cited proprietary information or absence of information as reasons for not providing these requested documents.

In-Depth Interviews

The structured interview protocol for each in-depth interview was derived from a database of interview questions. A particular subset of questions can be selected to provide a predefined focus to an interview session. The assessment team members selected a set of questions (see Appendix A for an example) to gather information related to the safety culture characteristics. Each interview consisted of two introductory questions designed to make the interviewee comfortable and get him or her used to talking. Then the interview focused on gathering information about four organizational behaviors randomly selected from the following eight organizational behaviors that were investigated during each safety culture assessment (Haber & Barriere, 1998):

Attention to Safety. Attention to safety refers to the characteristics of the work environment, such as the norms, rules, and common understandings that influence personnel's perceptions of the importance that the organization places on safety. It includes the degree to which a critical, questioning attitude exists that is directed toward organizational improvement.

Communication. Communication refers to the exchange of information, both formally and informally, primarily between different departments or units. It includes both the top-down (management to staff) and bottom-up (staff to management) communication networks.

Formalization. Formalization refers to the extent to which there are well-identified rules, procedures, and/or standardized methods for routine activities as well as unusual occurrences.

Goal Setting/Prioritization. Goal setting/prioritization refers to the extent to which facility personnel understand, accept, and agree with the purpose and relevance of goals.

Organizational Learning. Organizational learning refers to the degree to which individual personnel and the organization as a whole use knowledge gained from past experiences to improve future performance.

Performance Quality. Performance quality refers to the degree to which facility personnel take personal responsibility for their actions and the consequences of the actions. It also includes commitment to and pride in the organization.

Problem Identification and Resolution. Problem identification and resolution refers to the extent to which the organization encourages facility personnel to draw upon knowledge, experience, and current information to identify and resolve problems.

Training. Training refers to the degree to which personnel are provided with the knowledge and skills required to perform tasks safely and effectively. It includes personnel's perceptions regarding the general usefulness of the training program.

Three to five interview questions were asked about each of the four randomly selected organizational behaviors. The interviewer asked each of the pre-selected questions verbatim, but was given the latitude to probe and explore other lines of information when deemed necessary. Finally, each interview concluded with two summary questions. Interviews lasted no longer than 50 minutes and were typically conducted with one research team member interviewing one interviewee. Interviews were not recorded and the interviewer took handwritten notes during the interview. At times, a second research team member would sit in on interviews to assist with note taking.

In-Depth Interview Sampling

A sample of 10-20% of the employee population was selected to participate in the in-depth interviews. A purposive, stratified sampling method was utilized in order to ensure that the sample included participants from all shifts, all portal locations, all job classifications, and all levels of the organizational hierarchy. In order to conduct this type of sampling, the lead researcher requested organizational hierarchical charts as well as job rosters from each mine site well in advance of the data collection. The job rosters provided information about how many of each job classification worked on each shift and from each portal. For example, a job roster might indicate that on the day shift (7:00 am to 3:00 pm) there would be four continuous miner operators and they all entered the mine through the North portal. The lead researcher would compile a list of job positions that were selected to be interviewed and that list would be provided to the mine prior to data collection. The mine would then provide an employee who filled that job and designate him or her as an interview participant. The number of interviews conducted at each mine depended on the total population of the mine and ranged from a low of 26 (13% of that mine's employee population) to a high of 68 (15% of that mine's employee population) in-depth interviews.

Behavioral Anchored Rating Scales (BARS)

The Behavioral Anchored Rating Scales (see Appendix B for an example) were administered to all of the individuals who participated in the in-depth interviews during each safety culture assessment. Each interviewee was administered BARS associated with the four

organizational behaviors that were randomly selected as focus behaviors for the interview. The BARS provide the opportunity to quantitatively summarize qualitative data associated with the interviewee's perceptions of the organization. At the culmination of each in-depth interview, the interviewee was presented with four sheets of paper, one sheet for each of four behavioral anchored rating scales. At the top of each sheet of paper was an organizational behavior and its definition. Below that on the page were five statements that described how that behavior could be manifested in an organization. Participants had the option of reading and filling out the BARS on their own or having the interviewer read the BARS to them. Each participant was instructed to read or listen to the name of the behavior and its definition and then read or listen to each of the five statements below the definition and choose the one statement that most accurately described how that behavior was manifested at the mine.

Behavioral Anchored Rating Scales (BARS) Sampling

Behavioral anchored rating scales were administered in conjunction with the in-depth interviews. Therefore, the sampling was consistent with the sampling procedures outlined above for the in-depth interview sampling.

Organizational and Safety Culture Survey

The primary purpose of administering an employee survey is to measure, in a quantitative and objective way, topics related to safety culture, coordination of work, job satisfaction, communications, work group cohesion, organizational commitment, perceived hazardous nature of work, and the safety consciousness of the work environment (see Appendix C for definitions of these survey scales). By conducting a survey, a broad sample of the individuals in the organization can be obtained, and it is possible to gather information from a larger number of personnel than can be reached through the interview process alone.

Organizational and Safety Culture Survey Sampling

The organizational and safety culture survey was administered to all personnel at each participating mine site. Typically, the survey was administered in the "ready room" where employees gathered before entering the mine for each shift. The survey was administered to employees on all shifts and all portals at each mine. Additionally, surveys were administered to salaried workers who might not gather in the "ready room" before a shift. This was done by distributing the surveys to individuals in their offices or the mine foremen's office. Survey response rates ranged from a low of 54% to a high of 98% with an average response rate of 70% across all five mines.

Behavioral Observations

The use of behavioral observations provides an unobtrusive assessment of particular organizational behaviors and structured observations of critical processes including shift changes, training, management and work unit meetings, and responses to planned or unplanned events. Behavioral observations also allow researchers to objectively view "how things really work" at a mine site. During the course of each safety culture assessment, observations of various work activities were made. These activities included:

- Ongoing work being conducted in surface areas at the mine.
- Ongoing work being conducted underground in the mine.
- Ongoing work being conducted at the preparation plant.
- Training to prepare to go underground.
- General conditions on the surface at the mine.
- 8-hour annual refresher training.
- Foremen's meetings.
- Incident investigations.
- Daily safety talks prior to each shift.
- Daily management roundtable meetings.
- Weekly safety meetings.
- Safety kickoff meals.

Behavioral Observation Sampling

Behavioral observations were conducted on a convenience basis. The only formal requirement that was made of the mine was that the research team was given access to the underground working environment at least one time during the data collection. Otherwise, assessment team members simply requested permission to observe any activity that took place while the team was at the mine site for data collection. Generally, permission was granted for observation of all activities taking place.

RESULTS

The results presented below summarize the insights gained from the assessment team's analysis of the functional analyses, structured interviews, behavioral anchored rating scales (BARS), survey data, and behavioral observations across the five participating mine sites. A concern at the commencement of this project was that NIOSH researchers would only be invited to assess the safety culture at mines with pre-existing strong, positive safety cultures – in other words, the "best of the best" mines. This situation would be less than ideal because the best data and information for this project would come from a sample of mines that have safety cultures significantly different from one another. This would allow researchers to observe examples of best practices, examples of less desirable practices, and also trends that appear across the mines even though the safety cultures differ. A one-way ANOVA was conducted to determine if there were differences in the 11 safety culture survey dimensions across the five participating mines (for a detailed discussion of the one-way ANOVA statistical test, including information on how to interpret results, please see Sprinthall, 2003). Results from the ANOVA[1] indicated significant differences for:

- Communication accuracy ($F_{(4, 1341)} = 10.119$, $p < .001$, $\eta^2 = .029$)
- Communication interaction ($F_{(4, 1335)} = 3.541$, $p < .01$, $\eta^2 = .010$)
- Communication satisfaction ($F_{(4, 1332)} = 25.063$, $p < .001$, $\eta^2 = .070$)
- Job satisfaction ($F_{(4, 1325)} = 21.528$, $p < .001$, $\eta^2 = .061$)
- Commitment to the organization ($F_{(4, 1349)} = 83.229$, $p < .001$, $\eta^2 = .198$)
- Coordination ($F_{(4, 1349)} = 26.304$, $p < .001$, $\eta^2 = .072$)
- Workgroup cohesion ($F_{(4, 1348)} = 9.417$, $p < .001$, $\eta^2 = .027$)
- Hazard ($F_{(4, 1348)} = 15.842$, $p < .001$, $\eta^2 = .045$)
- Attention to safety ($F_{(4, 1348)} = 6.488$. $p < .001$, $\eta^2 = .019$)
- Safety conscious work environment ($F_{(4, 1346)} = 32.970$, $p < .001$, $\eta^2 = .089$)

There were not significant differences across the mines for the safety culture dimension communication trust:

- ($F_{(4, 1346)} = 1.538$, $p = .189$, $\eta^2 = .005$)

A second one-way ANOVA was conducted to determine if there were differences in the eight behaviors investigated by using the behavioral anchored rating scales across the five participating mines. Results from this ANOVA indicated significant differences for all behaviors, including:

- Attention to safety ($F_{(4, 127)} = 9.845$, $p < .001$, $\eta^2 = .237$)
- Formalization ($F_{(4, 136)} = 5.646$, $p < .001$, $\eta^2 = .142$)
- Goal setting and prioritization ($F_{(4, 134)} = 6.568$, $p < .001$, $\eta^2 = .164$)
- Communication ($F_{(4, 150)} = 7.586$, $p < .001$, $\eta^2 = .168$)
- Organizational learning ($F_{(4, 124)} = 10.960$, $p < .001$, $\eta^2 = .261$)
- Performance quality ($F_{(4, 126)} = 9.255$, $p < .001$, $\eta^2 = .227$)
- Problem identification and resolution ($F_{(4, 137)} = 6.173$, $p < .001$, $\eta^2 = .153$)
- Training ($F_{(4, 123)} = 7.187$, $p < .001$, $\eta^2 = .189$).

The results for the six safety culture characteristics (defined in the Background on Safety Culture Assessments section) are detailed next

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[1] Due to the large sample size, η^2, a measure of effect size, has been included in the presentation of the ANOVA results. Conventional rules of thumb for interpreting η^2 are: .01 = small effect, .06 = medium effect, and .14 = large effect (Sprinthall, 2003).

under the "Assets" and "Areas for Improvement" subheadings for each characteristic:

CHARACTERISTIC 1: SAFETY IS A CLEARLY RECOGNIZED VALUE IN THE ORGANIZATION

Assets

At the five mine sites assessed, documentation that describes the importance and role of safety in the operation of the organization exists. Some examples of this documentation include employee handbooks, comprehensive safety programs, and risk calculators. Additionally, assessment results indicated that at the mines, multiple mechanisms exist to communicate the value of safety throughout the organization. Some of these mechanisms include preshift safety talks, weekly safety meetings, monthly safety kickoff meals, quarterly communication meetings, message centers and bulletin boards, video screens, safety status "traffic lights," email messages, and paycheck inserts. Assessment team members observed artifacts related to safety (including decals and posters) displayed and distributed throughout the mines that participated in this project.

All of the mines that were assessed had a safety incentive program in place. These programs varied from mine to mine, but most are corporate-driven and focus on reducing lost-time accidents (LTAs). Some mines also have a safety recognition program in place. Through these programs, individuals can be recognized for performing safe behaviors, reporting unsafe conditions and behaviors, and for suggesting innovative ways to improve safety at the mine. Many of the employees that were interviewed described that safety and production are well-balanced at their mines.

Conservative decisionmaking with respect to safety was evident at the participating mine sites. Some examples of this include the use of rib bolts in excess of the approved plan, use of wire screening on the mine roof even when not required, use of "pizza pans" in conjunction with roof bolts, use of tilt bolters instead of jacks when bolting corners, installation of a proximity detection system on the continuous miner, installation of lifeline reflectors and indicators in excess of requirements, increased fan efficiency to move more air to the face, and noise reduction technology on the fans. The assessment team observed that physical resources, including personal protective equipment (PPE) and proper tools and equipment, were generally readily available to employees.

Quantitative data from the survey results (Figure 1) show that the Attention to Safety scale was the highest rated survey scale across all five mines. This indicates that, in general, mine employees understand the behaviors important to safety in their work activities. More specifically, behaviors identified as "being alert to the potential for serious accidents," "paying attention to potential danger," and "doing one's job well" were perceived to be very highly valued, according to survey results.

Areas for Improvement

Although there were many positive examples demonstrating that safety is a clearly recognized value at the five mine sites, performance on behaviors indicative of the value of safety must still be improved, consistently demonstrated, and understood by all members of each organization. Some examples observed across the five mines include:

- Basic safety issues that exist with respect to housekeeping and condition of materials must be addressed. Observations by the assessment team indicated areas in the mine where debris and waste were scattered about.
- Although some personal protective equipment (PPE) is required to be worn by all personnel, e.g., safety glasses, the optional use of other equipment, e.g., hearing protection and respirators, needs to be reinforced.
- Safety messages, while regularly communicated during preshift safety talks, may not always be immediately relevant to planned work activities and should be regularly reinforced to ensure importance.
- Some observations by the assessment team indicated a lack of attention to detail that needs to be improved. For example,

reflectors on lifelines were often covered in rock dust and additional reflectors could be used, signs in the escapeway were covered in rock dust, warning lights on proximity detection systems were covered in mud.
- Safety significance of having inexperienced personnel operating underground equipment needs to be reinforced. For example, some interviewees indicated that inexperienced people have operated equipment during longwall moves.
- Interviewees reported that shortcuts are taken while working (e.g., lifting a buggy with a scoop to change a tire). These shortcuts tended to be more common on production sections and when mines were running behind in production.

Another finding that indicates an area for improvement is that personnel tend to have the perception that management places the value of safety over production or that there is a balance between safety and production, but certain policies and practices do not reinforce the perception. Some examples of this possible contradiction between safety and production include:

- Having both a longwall move bonus given for completion date (reward for speed) and an injury-free move bonus (reward for safety) presents a conflicting message to miners.
- Bonuses for production are much larger than bonuses for safety.
- Production goal charts were displayed throughout the portal, but there were no charts documenting safety goals.
- Many of the messages displayed on the break room televisions were production based, including information about lost production due to down time.
- Some interviewees indicated that young or new foremen tend to stress production over safety in an effort to impress upper management.

Many of the five mines had a tendency to be reactive instead of proactive, which indicates a focus area for improving safety culture. Some interviewees expressed that their mine tends to be reactive to incidents, but the root problem is not always solved, as shown in the following examples:

- Requiring everyone to wear shower shoes in the bath house after a slip and fall instead of creating a floor surface that will not get slippery.
- Putting sand on an icy buildup by the warehouse door instead of doing something to prevent the ice buildup.
- Running equipment until it breaks and is out of service, then fixing the equipment instead of using preventative maintenance to keep equipment in good working order at all times.
- Miners repeatedly reported to management that there were not enough SCSRs available; however the problem was not remedied until the mine was issued a citation.
- Miners repeatedly reported to management that there were clogged sanders on the mantrip, but the problem was not addressed until the mine received a citation.

A practice that was common at all five of the participating mines was the utilization of incentive programs that reward employees for working for periods of time with no injuries or lost-time accidents. However, these incentive programs often have the effect of discouraging employees from reporting incidents and injuries. Some interviewees indicated the presence of negative peer pressure during long runs of time without injuries as well as employees working or attending work (without doing any work) when they should not have been (due to injury) because they did not want to break the "streak" of no injuries.

Quantitative results from the BARS for Goal Setting and Prioritization indicated that only 40.3% (Figure 2) of employees who were interviewed across the five mines feel that site personnel understand, accept, and agree with the purpose and relevance of goals to an extent consistent with a high-performance safety culture.

CHARACTERISTIC 2: ACCOUNTABILITY FOR SAFETY IN THE ORGANIZATION IS CLEAR

Assets

There were many examples of accountability for safety being clear in the five organizations that participated in this study. A majority of employees who were interviewed indicated that mine management's commitment to safety is either perceived positively across the organization or is perceived as improving. Front-line supervisors (e.g., section foremen) have the authority to address issues as they arise. They are only required to escalate the problem upward through the hierarchy when they cannot solve the problem at their level. Employees at the mines typically know what the responsibilities of their jobs are. Employees are trained that safety is the personal responsibility of everyone, not just members of the Safety Department. Foremen hold individuals accountable for safety by talking to them when they observe unsafe behavior (e.g., not wearing personal protection equipment). Employees typically take responsibility for making sure work is performed correctly and safely. Many interviewees indicated that they would feel comfortable correcting another employee if a job task was being performed incorrectly or unsafely.

Areas for Improvement

Interviewees at some mines described seeing members of upper management rarely, if ever, underground. This lack of management presence underground in the working areas may give employees the perception that they are not being held accountable for performing their work correctly or safely.

Although most employees know what their responsibilities are for performing their job, many indicated that they do not have a formal job description or that their roles and responsibilities are not formally documented. It is difficult to hold an employee accountable for safely and correctly performing his/her job if formal documentation of the roles and responsibilities of each job does not exist.

Interviewees indicated that they believe there is often inequity when dealing with employees on self-reporting incidents. The idea that the consequence for an action "depends on who you are" is prominent within the workforce. Additionally, employees indicated that they are held responsible for safe work performance through a hierarchical disciplinary system. However, there seemed to be some confusion about the exact process.

Standards and expectations for taking personal responsibility and accountability for safety need to be developed and communicated to all employees. Many interviewees indicated that it was someone else's (e.g., the fireboss's) job to identify and fix safety-related problems (e.g., derail devices, condition of the ribs). Several interviewees indicated a lack of clear understanding about who was responsible for performing certain tasks—e.g., whether equipment operators or maintenance personnel were responsible for cleaning equipment.

Quantitative results from the BARS (Figure 3) show that Performance Quality was one of the lowest scoring organizational behaviors investigated during the five safety culture assessments, indicating a low level of employee pride and ownership in performance. Pride and ownership in one's work can be linked to accountability (Haber & Barriere, 1998).

CHARACTERISTIC 3: SAFETY IS INTEGRATED INTO ALL ACTIVITIES IN THE ORGANIZATION

Assets

Safety standards and norms exist for several different aspects of mine operations, including, but not limited to:

- Use of personal protection equipment
- Meters and tracers for detection of electrical currents
- Meters for detection of gas and dust levels
- Checklists for equipment prior to startup
- Reporting of all injuries, including minor ones
- Lock-out/tag-out policy and procedures
- Seatbelt use policy

- Discussion of the Mine Plan before each shift and availability of the plan for the section being worked
- At least one, but usually two, Emergency Medical Technicians available in each working section
- An onsite mine rescue team
- An onsite fire brigade

Additionally, employees are given an employee handbook, safety policy, and other company information when first hired. Mines also encourage employees to use a procedure where they "step back" and "take a second look" at potential risks before doing a job. Many of the participating mines require the completion of risk assessments when employees have to perform a new task or a task under new conditions.

Quantitative data obtained from the Behavioral Anchored Rating Scales for Formalization (Figure 3) indicate that personnel have an overall favorable perception of their company's documentation and standardization process. Results from the survey (Hazard, Figure 1) indicate that employees' perceptions of how well informed they are of the risks in their work environment are generally good.

Areas for Improvement

Although there were many illustrations of safety being integrated into all mine activities at the five participating mine sites, the safety culture assessments also revealed numerous opportunities for improvement. Efforts to implement some valuable safety processes are undermined by a lack of formality (e.g., no standard forms for documenting near misses, no written plan to carry out existing emergency procedures, informal or arbitrary personnel selection for job postings). Interviewees reported numerous exceptions to mine policy being made, including:

- The speed limit inside the mine is rarely followed.
- Miners rarely follow the procedure for calling into and out of sections when traveling through the mine.
- Numerous miners do not obey the mine's seatbelt use policy.
- When encountering a red light on the track, some miners call to see if there are other vehicles nearby and, if not, go through the red light instead of waiting for it to turn green.
- Continuous miner (CM) operators are supposed to have miner helpers (according to that individual mine's policy), but one CM operator did not have one with him and had been working without a helper for a number of days.
- Work orders have safety procedures and hazards sections, but most of the time miners do not see the actual work order until the job has been completed.
- Lock-out/tag-out are not always used or enforced.

Based on the interview results, there is a need for more strategic and big-picture thinking and understanding of integrating safety into all activities—e.g., considering the safety implications when deciding to order and install a heavier conveyor belt and how the installation should be carried out, or considering the safety implications when deciding not to install concussion doors in a new longwall panel.

Many interviewees indicated that they normally worked overtime each week. Although they describe the overtime as voluntary, they indicated that individuals are expected to work the overtime.

Additionally, some individuals indicated that the regulatory requirements for emergency response training were excessive—e.g., walking escapeways every quarter. The reasons and expectations for this additional training need to be better communicated and understood by all personnel.

Quantitative data from responses on the Coordination of Work Survey Scale (Coord, Figure 1) indicate that the overall perception of how work is coordinated at underground coal mines is that it could be greatly improved. Coordination of Work was the second lowest scoring survey scale across the five mines.

CHARACTERISTIC 4: A SAFETY LEADERSHIP PROCESS EXISTS IN THE ORGANIZATION

Assets

There were numerous examples and illustrations of safety leadership processes in place at the five participating mines. Interviewees describe seeing mine management and Safety Department members, primarily during the day shift, participating in safety meetings and conducting periodic underground observations. Most individuals who were interviewed expressed that they are well informed about safety issues at their mine. Foreman's meetings and/or daily management team meetings are excellent opportunities for interdepartmental communication to take place. Additionally, several mechanisms are used to convey information, including daily safety talks, video screens, message center, interaction with line management (foreman), interaction with the Safety Department.

Most interviewees indicated that they would feel comfortable going to their immediate supervisor, shift supervisor, or a member of the Safety Department to express concerns about safety issues. At many of the participating mines, mine management boasts an open-door policy.

Quantitative data obtained from survey scores on the Work Group Cohesiveness Scale (Cohesion, Figure 1) were very positive, indicating that employees tend to have a strong identification and involvement with their respective workgroups. Survey results indicate that employees' satisfaction (Job Sat, Figure 1) with their jobs is quite high. The survey results (Figure 1) indicate that workers' commitment to the organization (Commit) is sufficiently high.

Areas for Improvement

With regard to safety leadership processes, some areas for improvement were elucidated. Interviewees indicated that they rarely see senior mine management participating in safety meetings or conducting underground observations. Also, interviewees indicated that shift-to-shift communication can be problematic. It was also discovered that mine management generally does not seem to be aware of the impact that change of any magnitude can have on the workforce and the importance of effectively managing all changes implemented. Therefore, the current processes to manage change being used by mine management to effect behavioral change is usually an informal one.

Quantitative data obtained from survey results (Figure 1) indicate that respondents are generally dissatisfied with communication. Communication trust (Com Trust), communication satisfaction (Com Sat), and communication accuracy (Com Acc) are three of the four lowest rated survey scales across all five mines. Scores on the BARS for Communication (Figure 3) were consistent with the survey results, indicating an overall dissatisfaction with communication. Consistent with scores from the survey and BARS, many interviewees felt that there is a general lack of information, a tendency for last-minute information, or a great deal of misinformation at their mine.

CHARACTERISTIC 5: SAFETY CULTURE IS LEARNING-DRIVEN IN THE ORGANIZATION

Assets

The five participating mines demonstrated that safety culture is learning-driven in their organization in numerous ways. Information, both internal and external to the mines, is collected and distributed by various mechanisms (e.g., safety talks, accident grams, reports, meetings, and training). Events and violations at other mine locations, as well as events at nonmining locations, are discussed at the preshift safety talks. Individuals are encouraged to report problems through their line management, and most indicated that they would do so. Most interviewees indicated that serious safety concerns get addressed quickly and that mine management is supportive when it is sometimes necessary to pull back and stop cutting coal. Immediately convening accident investigation boards and dissemination of their subsequent reports help with understanding and identifying incident causes.

Quantitative data obtained from the BARS for Problem Identification and Resolution (Figure 3) indicated that respondents perceive those processes very favorably.

Training activities are generally perceived to be effective and plentiful by most individuals. Examples include, but are not limited to:

- New miner training
- Annual 8-hour retraining
- Diesel 8-hour refresher training
- Mentor training
- Quarterly emergency evacuation training including use of SCSRs and escapeway drills
- Annual refuge chamber training
- Fire extinguisher training
- Smoke expectations training
- Lifeline training
- Annual electrical training
- First-aid training

The mines have formalized training in place for production-related activities including task training, new employee training programs, and new supervisor classes (e.g., fundamentals of supervision). Additionally, some mine trainers consistently strive to provide unique and relevant training. Examples of this include incorporating stories and lessons learned from the trainer's mining experience and conducting "blind" SCSR switchover training. Some mine safety departments schedule new and different presentations and trainings in order to provide novel information to workers.

Quantitative data from ratings on the BARS for training indicated that 62.0% (Figure 2) of employees interviewed had a favorable perception of the training activities that take place at their mine.

Areas for Improvement

The effectiveness and role of operational experience information as part of a learning process at the mines needs to be enhanced. Many individuals indicated that the examples of accidents or events presented in the preshift safety talks are not always relevant to their own activities and tasks. Additionally, the assessment team observed that often the presentation of information about accidents and events from other mines does not initiate discussion or include a question-and-answer period. Some interviewees indicated that their individual mine will learn from its mistakes, but then become complacent and the mistakes recur.

Quantitative data from ratings on the BARS for Organizational Learning (Figure 3) were not as high as the other organizational behaviors investigated during the five safety culture assessments, indicating that personnel overall have a less than favorable perception of the organizational learning processes in place at their mines.

Although most interviewees expressed the belief that individuals were not afraid to raise problems, organizational inhibitors exist that may limit the opportunities for the organization to learn from its employees. A few examples to illustrate this include:

- Few formal programs exist for the identification of problems. Issues are usually addressed immediately by the individual who identifies them or are brought to the attention of the Foreman or the Maintenance Department. In the case of the Foreman, the issue may or may not be entered in the Foreman's Log.
- Some mines employ a suggestion box, but some interviewees indicated that no one in management ever takes their suggestions seriously. Some questioned whether or not the suggestions are even reviewed by management.
- Although employees are encouraged to share near-misses at weekly safety meetings, there is no formal process for documenting these near-misses. Therefore, there is no way to track these incidents to determine if patterns are occurring.

Although interviewees indicated that training is viewed favorably, some training issues are in need of attention. These include:

- Annual refresher training consists of the same material presented in the same manner year after year. Interviewees indicated that they found this boring and uninformative.
- There is often no formal process for providing task training on specific equipment; anyone, regardless of their level of experience, can provide task training to others.
- Some specialized training is not relevant to all employees (e.g., fall protection training).
- Many interviewees indicated that training is conducted too quickly and is done just to satisfy MSHA regulations. Training should be more in-depth.
- There is little training for workers who assume new jobs at the mine to orient them on how to perform the new job.
- Some mines do not offer management training for individuals assuming mid-management positions to prepare them for managing workers.
- There is no formal process for assessing training effectiveness that is consistently used across the organization.

CHARACTERISTIC 6: A PROCESS OF ESTABLISHING A STRONG AND EFFECTIVE SCWE IS IN PLACE (SEE FIGURE 4)

Assets

Information pertaining to the safety-conscious work environment present at the five participating mines was obtained from survey results. Most survey respondents (85.8%) expressed the belief that they are responsible for identifying problems at their respective mines. Of the survey respondents, 67.9% indicated that they are able to approach management at their mine to express safety concerns. More than half of all survey respondents (60.6%) indicated that they felt that the management at their mine wanted concerns to be reported and listened to employees when reports were made. Of the survey respondents, 55.7% reported that the management at their mine ensures that safety concerns are addressed after they have been reported.

Areas for Improvement

Fewer than half of survey respondents (49.7%) felt that they were able to openly challenge decisions made by management. Only 49.5% of survey respondents indicated that helpful criticism is encouraged at their mine.

RECOMMENDATIONS

Based on the conclusions of NIOSH researchers with regard to the existing safety culture at the participating mines, the following recommendations are presented for consideration in further enhancing efforts for continuous improvement of safety performance.

- **Improve communication.**

  Communication at a mine site can be difficult; 24-hour operations, multiple shifts, numerous workgroups, reliance on oral and posted communications, and limited opportunities to address large groups of or the entire employee population at once all contribute to the challenges of effectively communicating. Communication is critical because, not only is it a means of passing on information, it also plays a crucial role in the coordination of work, management of change, and emphasis of core organizational values. The importance of communication and the barriers to effective communication in the work environment require that mines place heavy emphasis on striving to improve communication processes. Some suggestions for improving communication at mines include:

  o Holding meetings (such as preshift meetings) with employees as often as possible and on a regular basis.
  o Documenting the information that is to be communicated to employees during meetings to ensure that the same information is presented in the same manner to all groups of employees.
  o Making information available in multiple formats (e.g., postings on bulletin boards, inserts in paychecks, emails, company newsletters, etc.) to increase the number of opportunities an employee has of receiving the information.
  o Providing feedback to employees in a timely manner if they report a problem or make a suggestion.
  o Holding employee meetings as soon after an unusual event as possible in order to reduce the potential for rumors and misinformation.

- **Make safety a clearly recognized value.**

  Although the message that safety is a clearly recognized value is communicated through several different mechanisms—primarily artifacts and claimed values (as categorized by Schein (1992)—the basic assumptions (beliefs and attitudes) behind this message are less definitive from the data collected through the research project described in this document. Many employees are not certain that an environment where reporting mistakes, challenging or questioning decisions, or providing constructive criticisms is really desired by their mine management. Responses to many of the safety-conscious work environment (SCWE) questions on the survey revealed employees' reluctance to engage in low-level reporting. Additionally, during interviews, employees expressed concerns about the way some decisions are made.

  Behaviors that may help to improve the basic assumptions that safety really is a clearly recognized value include:

  o Encouraging greater employee involvement and ownership in problem solving and decisionmaking as appropriate
  o Fostering greater perceived trust and accuracy in communication
  o Promoting and facilitating those behaviors by a leadership team that models and exhibits actions consistent with the goal of developing safety as a clearly recognized value

- **Implement and use a formal change management system.**

  Informality in the implementation of new organizational processes may contribute to the continuation of unwanted behaviors. When new processes are informally implemented, it becomes difficult to hold employees accountable to the expectations and standards of management. This type of implementation causes confusion and may result in differential treatment for some employees. A more formal implementation process would be helpful for effecting behavior change and would help mine management to treat all employees consistently. This process should clearly define the standards and criteria around the change, identify the communication process to be used to roll out a new standard or expectation, and specify the consequences of not meeting the expectation for implementing the process.

- **Ensure consistent policy enforcement and penalization for infractions.**

  This research has revealed that there tends to be inconsistency in enforcement of policies and procedures as well as penalization for infractions. Enforcing policies and procedures and doling out consequences for violations differently to different employees makes it difficult to hold all employees accountable to the expectations and standards of management. Consistent enforcement of all mine policies and procedures and a documented and consistently applied penalization structure would foster employee adherence to mine policies. It is also important to create a system for reprimand that recognizes not only the immediate and short-term consequences of behavior, but also the long-term consequences of repeated undesirable actions.

- **Be proactive.**

Organizations that have to conduct business in a highly regulated industry tend to become reactive to those regulations in many of their behaviors. The mining industry has witnessed several new regulations that have required substantial changes and resources over the last few years. Mine companies need to find ways to share experiences so that they can implement initiatives that will keep them ahead of the next safety event, and not just address problems after they occur. Benchmarking and industry-wide initiatives can be helpful to integrate new ideas and different ways of thinking into the organization's own processes and activities. A focus on finding ways to enhance the basic behaviors that will facilitate safety performance, and not just actions that are in response to new requirements, would be very valuable.

■ **Reconsider the structure of bonus systems.**

Using injury-based incentive programs does not necessarily prevent injuries. Instead, these programs often have the opposite result and reward employees who take chances, but are lucky enough not to get injured, or reward employees who do not report incidents. Production-based incentives reward employees for getting the job done no matter what, even if that means working in an unsafe manner. A high-performance safety culture is one that fosters safe work habits and the reporting of hazardous conditions, accidents, injuries, incidents, and near-misses. Injury-based and production-based incentive programs often work against this. Instead of rewarding people for avoiding injuries or meeting production goals, mines should consider rewarding safe behaviors that are directly linked to the desired result of improving safety.

■ **Conduct (regularly scheduled) safety culture assessments.**

Mines should conduct periodic safety culture assessments. Mine management cannot fully understand a mine's assets and areas in need of improvement without first conducting a baseline safety culture assessment. Periodic followup assessments are also recommended to allow mine management to track over time the improvement or deterioration of the mine's safety culture.

CONCLUSIONS

The existing safety culture at five underground coal mines was assessed against the characteristics identified to be important for the promotion of a healthy safety culture. Overall, the assessment team believes that the participating mines and their respective companies have a strong commitment to and belief in the importance of safety to their operations. Initiatives and behaviors that are designed to facilitate and promote a positive safety culture and safety-conscious work environment at the mines were identified over the course of the five assessments, including:

■ Documentation that describes the importance and role of safety in the operation of the mine exists, and multiple mechanisms exist for communicating the value of safety to all employees.
■ Management's and the Safety Department's commitment and involvement in safety-related activities is perceived positively across the organization.
■ Safety standards and norms exist for several different aspects of mine operations, including maintenance and operation of equipment as well as the conduct of personnel.
■ The majority of employees believe that they are responsible for identifying safety problems.

The results of these assessments also indicate that some of the behaviors associated with the safety culture characteristics need more attention. These behavior recommendations, presented for consideration in the continued enhancement of safety performance, are listed below:

■ Although there are multiple mechanisms to communicate the value of safety to all employees at each of the participating mines, performance on behaviors indicative of the value of safety needs to be improved and more consistently demonstrated.
■ There is a need for more proactive thinking about the integration of safety into all activities and processes and more knowledge on how behaviors important to safety can enhance the quality of all work to be done.
■ Communication issues exist at each of the participating mines. These issues may include poor shift-to-shift communication, questions about the accuracy of communications, a lack of trust in communications, and a lack of accountability for what is communicated.
■ Informality and inconsistency in the change management process being used by mine management may be inhibiting the effect of the desired behavioral change.
■ Efforts to learn from past performance have been addressed for some major industry events, but the process of learning from all aspects of basic day-to-day performance is not consistently or systematically implemented in the organization.
■ The behaviors important to creating an environment where concerns can be openly raised without fear of some type of retribution are not perceived to be present by a large percentage of the organization.

A NIOSH-numbered publication offering a Safety Culture Assessment Toolkit is planned for release in the near future. This toolkit will contain all of the data collection instruments used for the assessments conducted through the current research. This includes interview questions, behavioral anchored rating scales (BARS), the safety culture questionnaire, and behavioral observation checklists. The toolkit will also include detailed instructions for administering each of these data collection methodologies. Finally, the toolkit will offer guidance for analyzing and interpreting the data collected in order to draw conclusions about the safety culture at the mine where the assessment is conducted. This Safety Culture Assessment Toolkit will allow mines to conduct safety culture assessments on their own without relying on NIOSH or a consultant.

LIMITATIONS

The limitations of this research primarily revolve around the issue of sampling. Specifically, there are three sampling-related limitations. First, this methodology stems from the sample of underground coal mines where the safety culture assessments were conducted. This research did not employ a systematic sampling method, but rather relied on a convenience sample of mines that volunteered to participate in this research. To obtain these volunteers, NIOSH researchers first published an article in a trade magazine detailing the project and explaining that mine sites were being sought as participants in the project. This resulted in one mine site volunteering. NIOSH researchers then contacted company representatives from mines that had participated in previous NIOSH research. This tactic resulted in securing two mines as volunteers. Finally, NIOSH representatives presented information about the project at mining-related conferences and stressed that mine sites were being sought to participate in the research. These presentations and recruitment efforts resulted in securing the final two participating mines.

Although at the commencement of this project the goal was to obtain participating mines that represented the varying sizes, geographic locations, and union affiliations of the total population of underground coal mining, this was not accomplished due to the convenience sampling method employed. As a result, this research does not include, for instance, a participating mine from the coal-producing region located in the central United States. Also, small mines are underrepresented in the research sample. Finally, only one of the mines participating in this research was a unionized mine. Although the sample of participating mines for this research may not be truly representative of the population of all underground coal mines, the researchers are confident that the sample that was obtained is large and diverse enough to provide an important and very informative look into the safety culture of the U.S. underground coal mining industry. Future research into the safety culture of underground coal

mining should seek to include mines from the geographic regions, size categories, and labor affiliation categories that were underrepresented in the present research.

A second limitation of this research is the sampling procedures that were undertaken for the in-depth interviews. By providing a list of selected job classifications on specific shifts to the mine and allowing the mine to select the actual interview participants, the possibility exists that the mine management may strategically choose certain employees to participate. One could postulate that the mine may supply interview participants who are likely to reveal only positive insights about the safety culture at the mine. Nevertheless, this research must assume and accommodate for this limitation because the mine must be given some level of control over which employees are taken away from their production jobs to participate in research activities. For example, if a roof bolter is requested as an interview participant, the mine needs to have the control to provide a roof bolter who works on a section with a backup roof bolter who can step in and fill the position while the other is participating in an interview. Also, by giving mine management control over selecting interview participants, they are able to provide participants who would be more willing to participate in an activity such as an interview. If interview participants were randomly selected, there might be a higher rate of individuals who refuse to participate in the interviews. The impact of the above limitation has been tempered by some aspects of the design of this methodology, including (1) each of the interviews lasted about an hour, (2) neither mine management nor the interviewees were given the interview questions in advance, (3) many more employees responded to the quantitative survey and BARS than participated in interviews, and (4) a strongly skewed sample for the interviews would be indicated by substantial disagreement between the interview results and the results from the quantitative measures, which was not the case with the current research.

A third limitation of this research is the convenience sampling of events for behavioral observation. Because the research team was only able to observe events that took place during the time they were onsite at the mine for data collection, the sample of behavioral observations for each mine varied widely. Some mines have regularly scheduled events, including preshift safety meetings, daily foremen's meetings, and weekly management meetings, that provide multiple opportunities for behavioral observations. However, some mines do not have regularly scheduled events. Some of the safety culture assessments happened to take place during time periods when mines were having events that happen on an infrequent basis, such as annual refresher training or a monthly safety kickoff meal. Finally, some mines experienced safety incidents during the time of the safety culture assessment, and the research team was allowed to observe incident investigation procedures.

Although the events that were observed at each mine varied, the research team was consistent in observing the above-ground conditions of each mine, the training that each mine provided to research team members prior to going underground, and the underground working conditions at each mine. Obviously, the more events the research team was able to observe, the more data was collected to contribute to the overall safety culture assessment. Despite this limitation, a sufficient number of behavioral observations were conducted at each mine to draw objective conclusions about the actual goings-on at the mine.

A final potential limitation (non-sampling-related) of this research is that we may have experienced a Hawthorne Effect (Mayo 1945). Employees at the mines may have altered their behavior because they were aware that NIOSH personnel were onsite and evaluating the safety culture at their mines. However, the use of multiple methods (as was done in the current study) instead of the reliance on only one assessment method should have minimized, if not eliminated, the impact any change in participant behavior may have had on the end results of the research.

DISCLAIMER

The findings and conclusions in this report are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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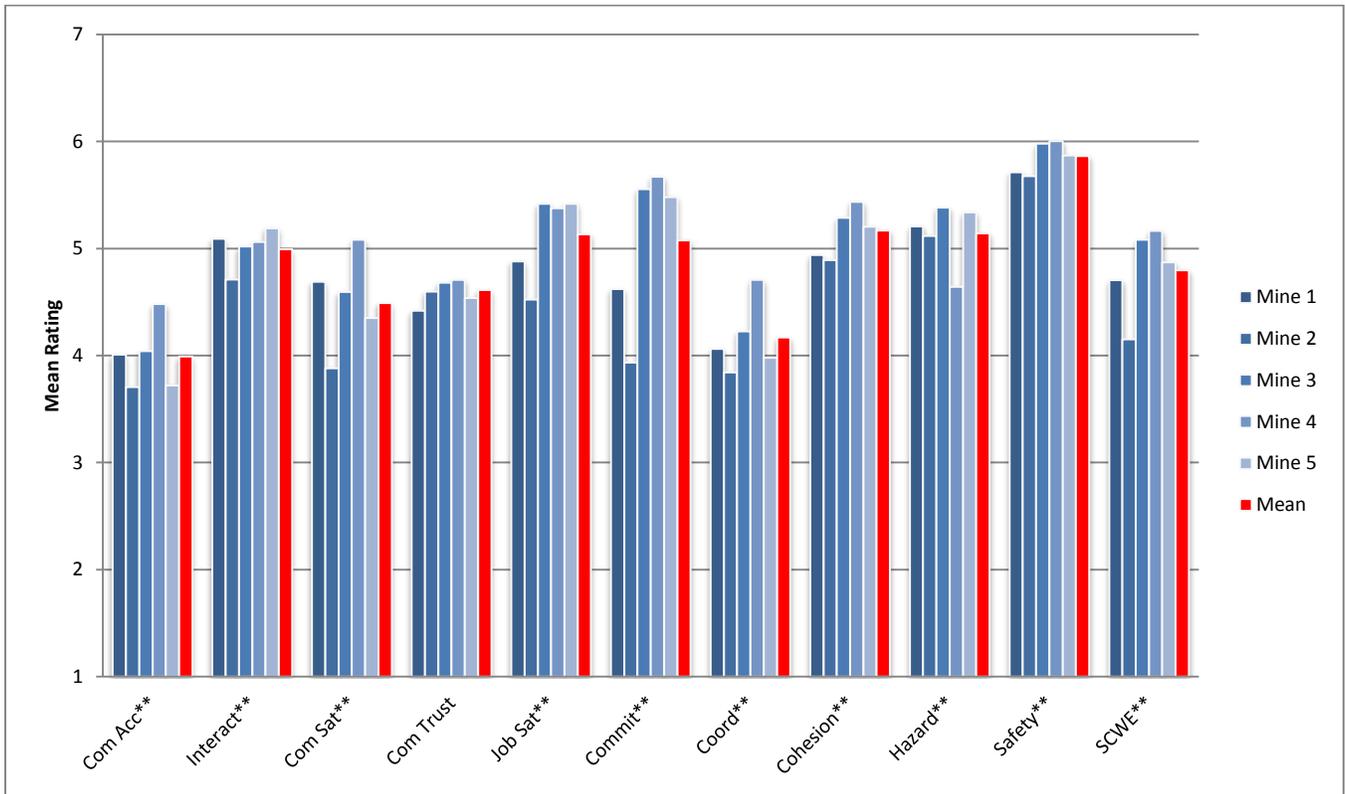
Figure 1. Organizational and safety culture survey results.

$* p < .05, ** p < .01$

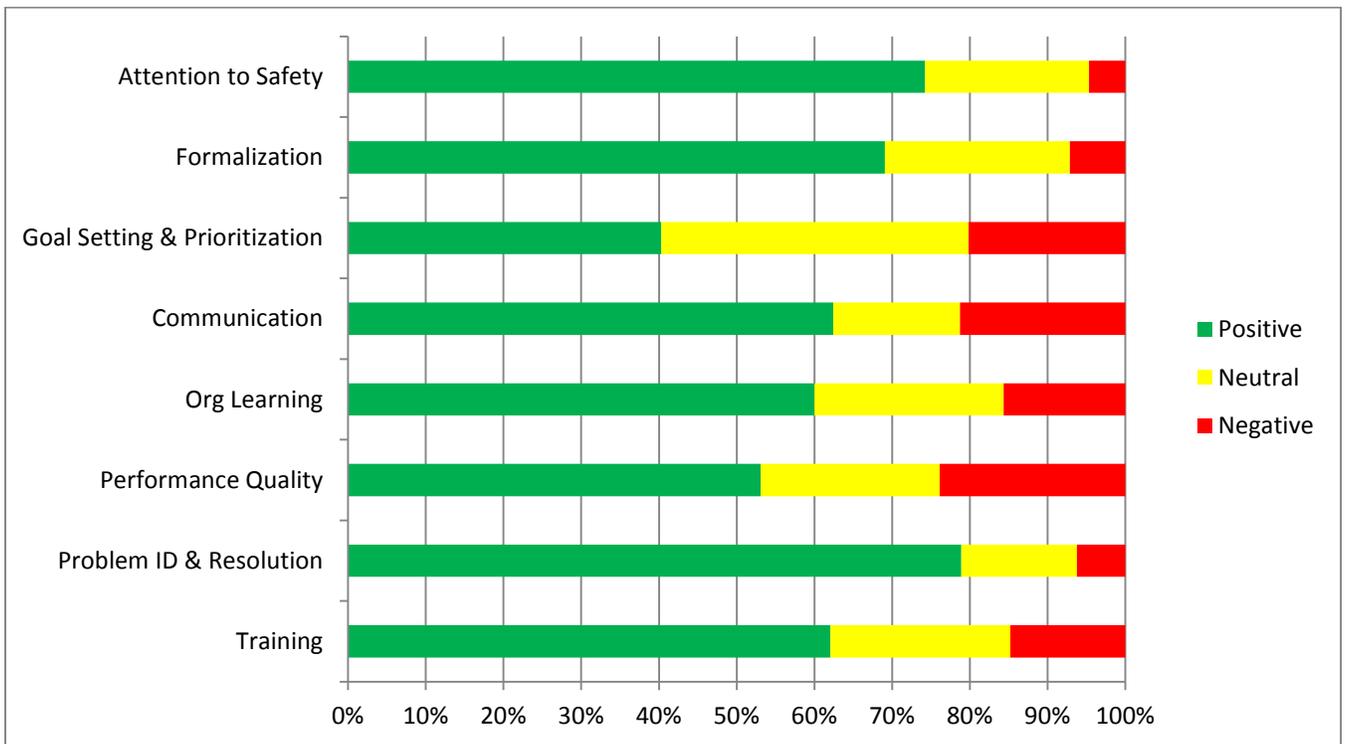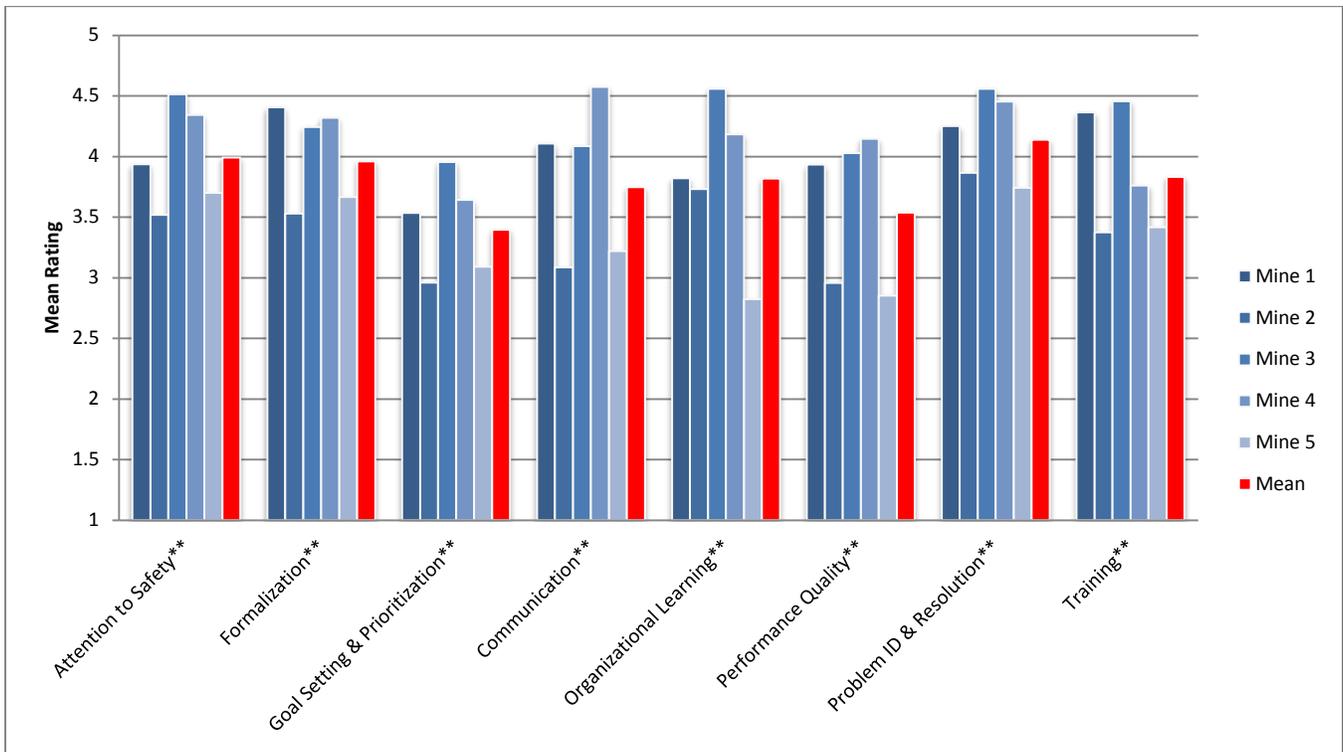**Figure 2.** Percentage of positive, neutral, and negative responses to behavioral anchored rating scales (BARS).

Figure 3. Mean scores for behavioral anchored rating scales (BARS) for each mine and the average of all five mines.
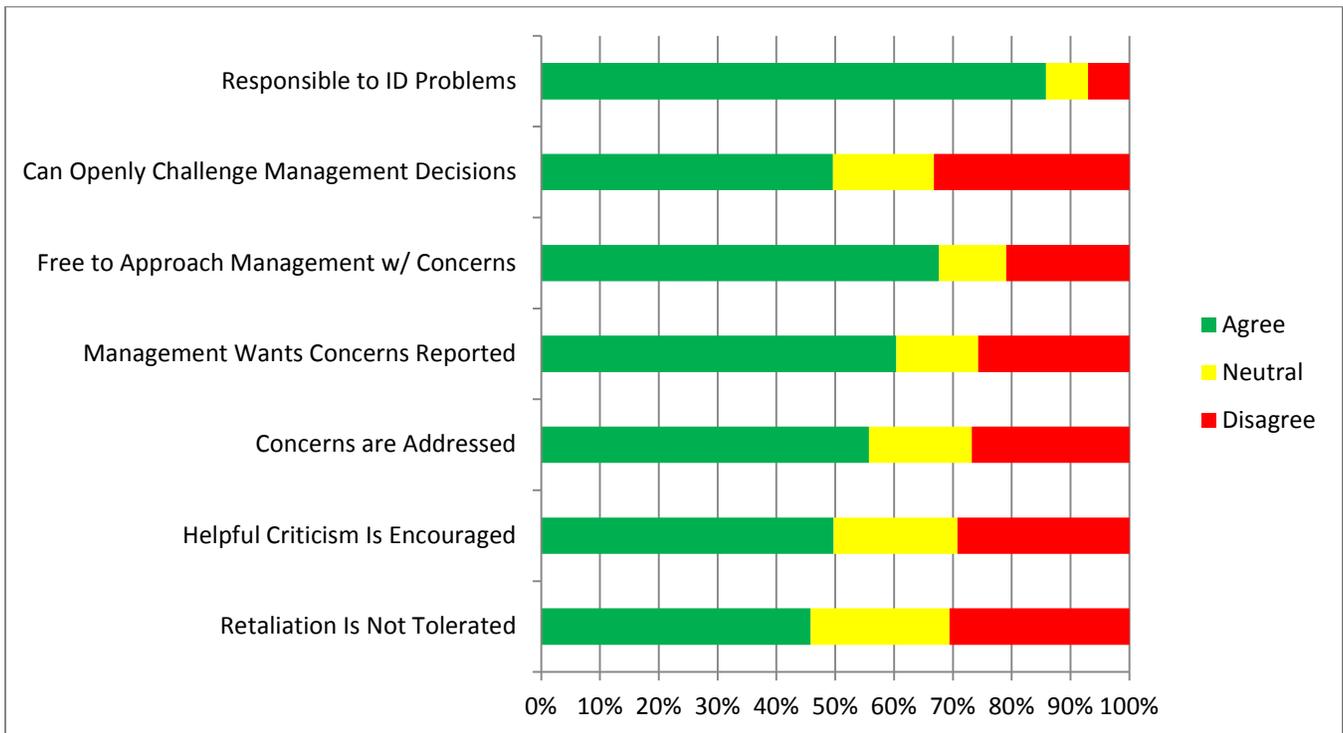
$* p < .05, ** p < .01$

Figure 4. Safety conscious work environment (SCWE) survey item results.

Appendix A

Sample In-Depth Interview Questions

<u>Introduction Questions</u>

1. Please start by telling me a little about your history in mining, such as how long you have worked in mining, how long you have worked at this mine, how you got your current job at the mine, etc.
2. Tell me about the roles and responsibilities in your current job.

<u>Attention to Safety Questions</u>

1. How does the mine handle the potential trade-offs and conflicts that exist between safety and productivity?
2. What would you do to improve the safety attitudes of workers at the mine?
3. What organizational barriers exist that keep people from reporting potential safety concerns?
4. What is done to encourage employees to strive for excellence when it comes to safety?

<u>Concluding Questions</u>

1. Is there anything else you would like to tell me about today before I ask just one last question?
2. If you were king or queen of this mine and had the power to change anything, what three things would you change to make this a better place to work?

Appendix B

Sample Behavioral Anchored Rating Scale

Attention to Safety

Attention to Safety refers to the characteristics of the work environment, such as the norms, rules, and common understandings that influence site personnel's perceptions of the importance that the organization places on safety. It includes the degree to which a critical, questioning attitude exists that is directed toward site improvement.

> Individuals at the site believe safety is the number one priority and that perspective is reinforced by senior (high-level) management and clearly spread to all individuals at the site.

> Personnel make an effort to correct problems in a timely and effective manner to ensure that safety levels are not compromised at the site. Individuals have a clear understanding that safety is a top priority.

> Site management reflects a delicate balance of emphasizing safety, while at the same time, making it clear that there is a need to keep the site operating.

> At times, the interests of the stakeholders seem to take priority over concerns regarding the safe operation of the site and the lack of organization wide support for safe site operations is clearly evident.

> Questions regarding safe operations are not welcome or addressed. Management's attitude is to keep running coal regardless of evident safety issues.

Appendix C

Organizational and Safety Culture Survey Scale Definitions

The Communication-Trust Scale assesses respondents' impressions regarding the freedom they feel to discuss the problems and difficulties in their jobs with an immediate supervisor without jeopardy. A higher value indicates greater trust in the communication process.

The Communication-Accuracy Scale assesses respondents' perceptions of the accuracy of information they receive from other organizational levels (superiors, subordinates, and peers). A higher value indicates greater perceived accuracy of communications.

The Communication-Interaction Scale assesses respondents' level of desire for frequent interactions and contact with others in the organization (superiors, subordinates, and peers). A higher value indicates greater desire for interaction.

The Communication-Satisfaction Scale assesses respondents' overall satisfaction with the communication process. A higher value indicates greater satisfaction.

The Coordination Scale assesses the respondents' perceptions of the degree to which the subunits of the organization operate according to the requirements of each other and of the total organization. A higher value indicates a perception of work being highly coordinated.

The Cohesion Scale assesses the relative strength of respondents' identification with and involvement in a particular work group. A higher value indicates high work group cohesiveness.

The Hazard Scale assesses respondents' perception of the emphasis the organization places on making employees aware of the hazards of their job and work environment. A higher value indicates higher perceived hazard emphasis or awareness.

The Attention to Safety Scale is used to assess perception of the importance of safety to success in an organization and is measured by the value placed on various safety promoting behaviors. A higher value indicates higher attention to the values and/or behaviors important to safety performance.

The Job Satisfaction Scale assesses respondents' overall satisfaction with their job. A higher value indicates greater satisfaction.

The Commitment Scale assesses the relative strength of respondents' identification with and involvement in a particular organization. Commitment extends to the goals of the organization and the desire to maintain membership in the organization to facilitate these goals. A higher value indicates greater commitment.

The Safety Conscious Work Environment (SCWE) Scale assesses the degree to which individuals agree or disagree with a number of characteristics that impact the establishment of a Safety Conscious Work Environment. Those characteristics include:

- Individual responsibility for problem identification;
- Ability to openly challenge management decisions;
- Freedom to approach management with concerns;
- Management's desire to have concerns reported and willingness to listen to problems;
- Management's constructive address of concerns raised;
- Encouragement of constructive criticism;
- Management's intolerance of retaliation for raising concerns.

A higher value indicates greater emphasis placed on behaviors important for an effective SCWE.