SHARING CRITICAL CONTROLS

Brad Ross, Geotechnical Center of Excellence, UofA, Tucson, AZ
Chad Williams, Geotechnical Center of Excellence, UofA, Tucson, AZ
Jefferey Burgess, Mel and Enid Zuckerman College of Public Health, UofA, Tucson, AZ
Brenda Granillo, Mel and Enid Zuckerman College of Public Health, UofA, Tucson, AZ

Abstract

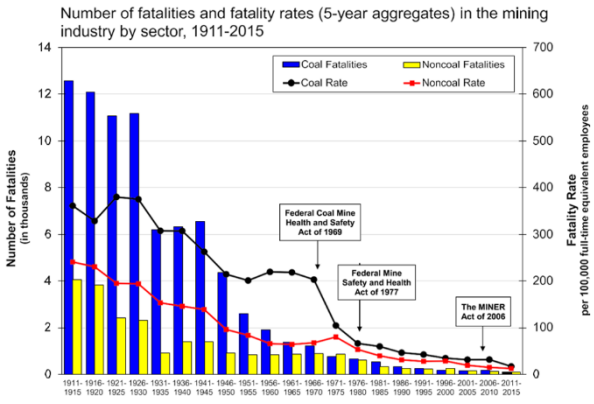
The mining industry understands the value of sharing safety learnings as shown by the use of safety shares at meetings, collection of data on incidents and close calls as well the distribution of MSHA's Fatalgrams. These are excellent methods of keeping safety to the forefront – but there is one piece that is missing: the sharing of the critical controls that companies have established to prevent or mitigate accidents and injuries.

The University of Arizona, through a grant with the National Institute for Occupational Safety and Health (NIOSH), has initiated a series of workshops to solicit and document these established critical controls, so they can be shared across the industry. The first workshop included 12 geotechnical experts and resulted in 81 documented critical controls. This paper will discuss the workshop methods, results of the first workshop as well as learnings for managing future workshops.

Background

Over the past 100 years the number of fatalities in the mining industry has been significantly reduced (see Figure 1 – Number of fatalities and fatality rates). A key part of this reduction is the reporting and sharing of information about serious and fatal accidents that is mandated by MSHA and has since become part of the culture for almost all mining companies. The learnings of these events are shared through various methods such as Fatalgrams from MSHA which are then distributed to miners throughout the industry. In effect, it can be said that the safety performance improvement is, in part, a result of the blood of those who were maimed or died in the mining industry.

Figure 1 - Number of fatalities and fatality rates[1]



NOTE: Excludes office employees. Noncoal includes metal, nonmetal, stone, and sand & gravel operations. Sand & gravel miners included starting in 1958. Hours for 1911-1923 computed on assumption that weighted average length of workday was 9.36 hours. Full-time equivalent employees (2,000 hours = 1 FTE employee). Data source: USBM and MSHA

As the number of fatalities have reached historic lows, the industry is now striving to reach zero – zero fatalities and zero injuries. To reach these lofty goals will take more than just sharing those learnings from the incidents that result in death or serious injuries. The industry must move to sharing the best practices (or critical controls) that each company has developed to prevent or mitigate the incidents (or material unwanted events) that result in death or injuries. By sharing these critical controls so that others can

implement them, the mining industry can be even more pro-active in preventing fatalities and injuries.

The University of Arizona, through a NIOSH grant, has undertaken an effort to collect and share critical controls that companies have put in place to protect people from material unwanted events. The first step in this process commenced on September 21, 2018 with a workshop that was held at the University of Arizona. Workshop participants included geotechnical experts from mining, consulting and manufacturing companies as well as faculty and students from the University of Arizona. During the workshop and ensuing communications, 81 critical controls were identified that covered three different material unwanted events (slope failures, rock falls, and tailings failures).

This paper will discuss the methodology used to gather the critical controls, results, and feedback from the workshop. The outcomes of this workshop will be used to improve critical controls and future workshops.

Workshop Process

The University of Arizona Lowell Institute for Mineral Resources hosted a half day workshop to gather input from mining geotechnical experts on critical controls that companies have implemented to keep people safe from material unwanted events (MUE) as described in the International Council on Mining & Metals book -- Critical Control Management Implementation Guide. This workshop was part of a larger meeting that was held to discuss the creation the Geotechnical Center of Excellence at the University of Arizona.

The experts represented a variety of mining companies, geotechnical equipment manufacturing companies, consulting companies, university faculty, and students. The agenda for the session began with a brief overview of the NIOSH U60 Grant Health and Safety Research Program and the purpose of this workshop was to achieve one of its aims; to formalize Collaborative Partnerships for Critical Control Management.

A total of 12 participants attended the session either in person or remotely via Zoom. Due to the high level of participation and interaction, a total of 81 critical controls were shared and documented during and after the workshop.

To ensure all participants had the same working knowledge, the facilitator defined MUEs and used the Bingham Canyon Landslide case study to facilitate dialogue. A stepwise interactive approach was used to identify and prioritize MUEs and share critical controls.

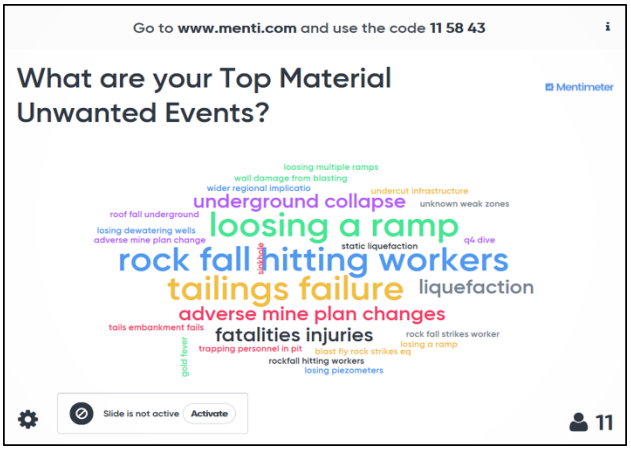
Once all participants had a common understanding of MUEs and critical controls, a five-step process was used to gather information from the participants. The steps included:

- Identify the top three MUEs with Mentimeter's polling application.
- Share critical controls for the top three MUEs.
- Discuss critical controls and document their description.
- Build an Excel table of critical controls and share with participants for input.
- Update Excel table with feedback from participants.

Identify top MUEs with Mentimeter

The participants were asked "What are your Top Material Unwanted Events?" and they responded through the Mentimeter polling application. The application then placed the answers in a word cloud where the rate of responses is proportionally represented by the font size (see Figure 2 – Material Unwanted Events word cloud).

Figure 2- Material Unwanted Events word cloud



The Mentimeter application is simple to set up and use. Following are some of the benefits of the Mentimeter application:

- Set-up simply requires input of the polling question and the format of how the answers will be displayed to the audience.
- There are eleven different display formats that range from a word cloud (see Figure 2 – MUEs word cloud) to open ended answers (see Figure 3 - Rock fall critical controls).
- The user can also create multiple choice questions. Mentimeter can then display the numeric results of votes of each choice in a variety of formats such as bar or pie charts.
- The Mentimeter questions can be embedded in a PowerPoint presentation or stand on their own within the on-line application.
- The benefit of using an application such as Mentimeter is that no additional equipment is needed (such as clickers), and there is no limit to the number of people who can join the poll.
- Participants use their smart phone, tablet, or a computer to access the website.
- As participants answer the poll questions the results are displayed in real time for all participants to see. This allows everyone to have input and they know their "voice" has been heard.
- Remote or off-site participants can share their input.

The use of the polling application proved to be very effective. As a result, prioritizing MUEs was completed quickly from a large amount of input from participants.

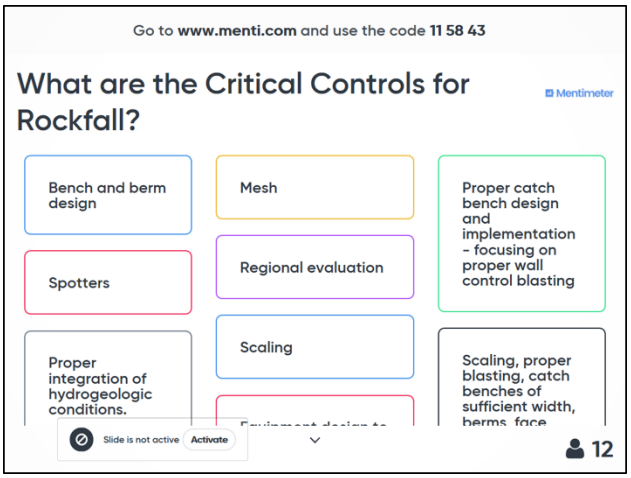
The top three MUEs included rock fall, slope failure and tailings failure. Additional geotechnical MUEs can be considered in future workshops.

Share critical controls

The polling program was also used to collect critical controls for each of the top three MUEs (see Figure 3 – Rockfall critical controls for an example).

The polling program was extremely useful in ensuring that all participants contributed to the list of critical controls.

Figure 3 - Rock fall critical controls



Critical control discussion

After completing the polling for each MUE there was a facilitated discussion of the critical controls to develop a better understanding and agreement of each critical control. The discussion led to the identification of additional critical controls.

Not only did the discussion serve the purpose of identifying the critical controls, it was effective in providing a detailed sharing of those critical controls between participants. In the feedback questionnaire, the discussion portions of the workshop were found to be the most effective part of the workshop with a score of 4.75 out of a possible 5.

Build Excel Database

As the discussion took place, one of the two facilitators recorded key information in an Excel table. Additional descriptive data was collected to add in filtering and searching of future databases. The Excel table included the following data:

- MUE
- Potential Consequence
- Critical Control
- Preventive or Mitigating
- Description
- Type of Mine (underground or surface)
- Commodity of mine
- Company
- Contributor

Since most of the controls that were recorded were based on a group discussion, the company and contributor can be deleted from the data fields.

Update of Excel data

Participants had two opportunities to review and provide feedback of the data that was collected during the workshop. The first review was during the workshop where the information that was recorded was shared with the participants to ensure that the discussions were accurately captured.

After the workshop, the Excel table was emailed to all participants as well as professionals who were unable to attend. An additional 16 critical controls were recorded based on the feedback for a total of 81 critical controls (see Table 1 – Critical Controls per MUE).

Table 1 - Critical Controls per MUE

MUE	Critical Control
Rock Fall	30
Slope Failure	35
Tailings failure	16
Total	**81**

Feedback

A participant evaluation form was emailed to the workshop attendees after the session. A total of six participants completed the evaluation form. Some of the key takeaways from both the forms and verbal feedback included:

- Overall, there was an increase in knowledge of Critical Control Processes and MUEs after the workshop. See Figure 4 – Change in knowledge chart.
- Overall, the workshop was effective by the participants. The group discussions were considered the most effective part of the workshop. See Figure 5 – Workshop format effectiveness.
- The participants were experienced industry professionals that have been employed from 7 – 38 years. See Figure 6 – Mining Experience.
- A majority of attendees felt the workshop was relevant to their job role and would apply critical controls on a regular basis. See Figure 7 – Application of Controls.

Figure 4- Change in knowledge

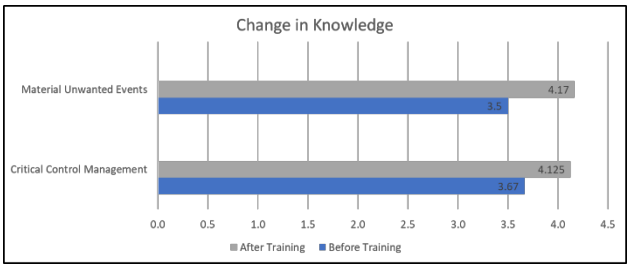


Figure 5 - Workshop format effectiveness

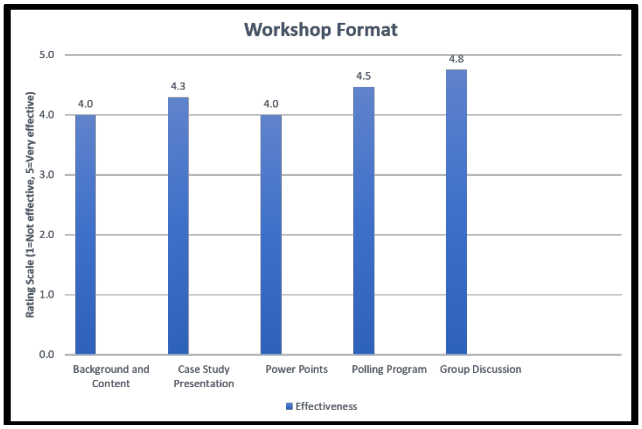


Figure 6 - Mining experience

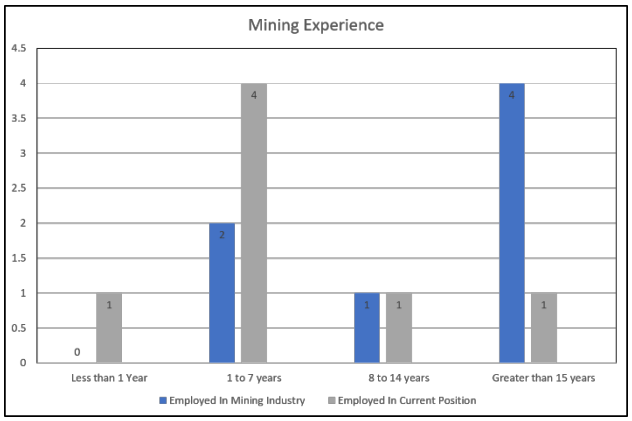
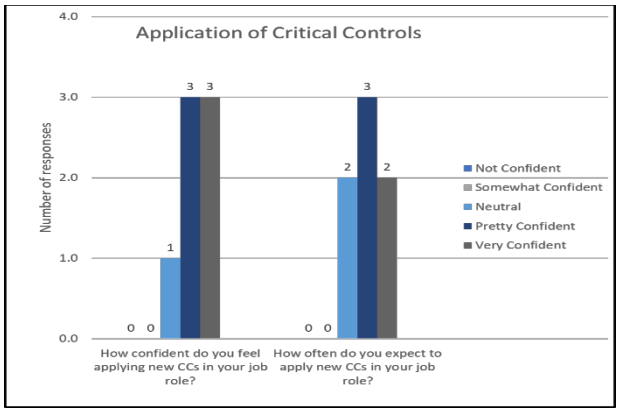


Figure 7- Application of critical controls



Thematic analysis (TA) was used as the qualitative data analysis method. Although the dataset is small, the researchers were able to examine patterns (or "themes") with respect to the open-ended questions in the survey. An example of the themes is illustrated in Figure 8 – Best practices for sharing lessons learned.

Figure 8 - Best practices for sharing lessons learned word cloud

Going Forward

Now that the process of using a polling application to engage both on site and remote participants, has been tested and shown to be successful in gathering critical controls, there are still improvements that can be made. Some of the improvements and next steps going forward will include:

- Test the process with different group make-ups including participants from multiple disciplines and a single company as well as participants from multiple disciplines and companies.
- Develop a process to prioritize the critical controls for any one MUE by using the input from experts or workshop participants.
- Develop a database that will filter and sort critical control data that can be used to optimize downloading data.
- Develop a dedicated website to share the critical controls across the industry.

The geotechnical critical controls can be downloaded from the Lowell Institute for Mineral Resources website at https://minerals.arizona.edu/.

Conclusion

As part of a NIOSH U60 Grant, the University of Arizona held the first in a series of workshops designed to document and share critical controls that companies use to prevent and mitigate material unwanted events. The workshop included 12 participants and resulted in the documentation of 81 critical controls that covered 3 geotechnical material events.

The workshop was not only successful in documenting the critical controls, it also allowed professionals to discuss their learnings and share experiences. This initial workshop demonstrated that the methods used to solicit and document critical controls were effective. Changes will be made and tested in future workshops to improve the process.

Acknowledgement

This research was supported by National Institute for Occupational Health and Safety under grant number 2U60OH010014-08.

Reference

1. CDC (2018, 6 14). (NIOSH) - Statistics: All Mining. Retrieved 11 3, 2018, from Center for Disease Control and Prevention: https://www.cdc.gov/niosh/mining/statistics/allmining.html