

A DIFFERENT PERSPECTIVE

NIOSH researchers learn from CM operator responses to proximity detection systems

BY EMILY HAAS AND JOSEPH DUCARME



Researchers collect some of their information in the field.

Given the consistent increase in the number of proximity detection systems (PDSs) being used in underground coal mines, it is critical to understand ways that PDS technology influences mineworkers' assessment of their environment and subsequent behaviors. Regardless of the particular PDS model, it is important to document these general responses to the technology and any changes in workers' ability to perceive, understand and make safe decisions on the job.

More specifically, being able to anticipate certain behavioral responses may help minimize preventable incidents and guide future safety training and communication related to the PDS. To this end, the National Institute for Occupational Safety and Health (NIOSH) recently completed a preliminary assessment to understand continuous mining machine (CMM) operators' perceptions and behaviors in response to the PDS.

In its preliminary assessment, NIOSH researchers interviewed nine CMM operators during January and February 2014. The nine CMM operators represented five mine sites in the Appalachian region. Six of the operators had been using PDS between seven months and two years. The other three had knowledge of, but no experience using PDS.

The mining experience for the nine operators ranged from three to 33 years (mean = 20.8 years) and their experience as CMM operators ranged from 1.5 to 33 years (mean = 11.8 years). In the interviews, the operators discussed participation in high-risk behaviors, hazard identification, mitigation strategies and the impact of PDS in relation to these topics.

The following offers these mineworkers' perspectives, and highlights how their job tasks and environment could be and are affected when learning how to use PDS technology. A more

detailed discussion of the results summarized in this article can be found by referring to Haas and Rost (2015).

Perceived Influence of PDS on Operators' Hazard Recognition, Comprehension, Response

Prior to having a PDS equipped on their CMM, operators communicated that they had the confidence, training, and experience to mitigate hazards in their mine and make decisions quickly, if necessary. Due to their perceived ability to make these safe and quick decisions, CMM operators discussed times they had previously chosen to stand in the red zone (e.g., increased visibility or production).

Broadly, one operator said, "It's really all about balance — what makes my job easier between not. When I'm standing in the red zone I always think about that [it being risky]. You're always weighing the pros and cons when you're doing it or thinking about doing it."

In contrast, since the installation of the PDS, operators noted standing in the red zone much less or not at all. As one operator said, "Honestly, I was surprised when we started using this. I eventually learned to do things different. I learned what I shouldn't be doing, but was. I was surprised how many times it shut off on me at first."

In the interviews, the operators often discussed the process of retraining themselves to regularly stand outside of the red zone again once using the PDS. As one CMM operator said, "It is frustrating and you're learning all over again." Also, because operators started to place themselves in different, more unfamiliar positions, they discussed needing to be more aware of additional hazards including visibility of other equipment and mineworkers. One operator explained, "I'm not in the red zone, which is safer. But at times I have to stand too far away to tram and I don't want to be that far away because I can't see as well." In response to being in different placement positions around their CMM, operators discussed the importance of re-acclimating themselves with certain place-change scenarios and maintaining heightened awareness on the job.

Although changes in CMM operator comprehension and behavior occurred mainly in response to operating from a different place in relation to their CMM, they also discussed other risky decisions they made while learning how to operate their CMM with the PDS such as "cheating" the technology and working faster to meet production goals. Despite these initial frustrations with the PDS, most CMM operators recognized the positive outcomes of using the technology and eventually felt they were able or would be able to safely identify and mitigate project workplace hazards while using the technology.

Assisting With Safe Technology Integration

These discussions with CMM operators indicate that mine operators and mine health and safety personnel play a key role

in helping the workforce anticipate and safely respond to changes in their environment upon operating a mining machine that is equipped with proximity detection. Based on these discussions, the following considerations are offered for mine operators and safety personnel to support workers' ability to continue making safe decisions on the job:

- Introduce and discuss PDS technology as a learning tool. CMM operators commonly said that mine technologies, including the PDS, helped them to recognize and avoid emerging hazards and learn or relearn about safety rather than change their behaviors. This learning-oriented communication approach to framing the technology, rather than characterizing it as a tool that "does not let an operator stand in the red zone," may encourage a more positive response toward the technology.
- Be mindful of potential complacency. Regardless of the technology being used, it is possible for anyone to become complacent and momentarily lose focus while completing a job task. To help maintain worker awareness, communication and safety meetings related to PDSs should not end once the technology is fully integrated. Rather, dialogue should continue beyond initial on-the-job awareness and training to ensure that operators stay alert for potential hazards on the job.
- Acknowledge changes in the mine environment after introducing the PDS. Realistic dialogue with CMM operators about how the PDS technology is affecting their work environment and ability to make safe, quick decisions may be needed. One barrier referenced by CMM operators after using the PDS was a loss in production time. Perhaps at first use, discussion of a balance between production and safety during the introduction of this safety device should be considered.

Despite potential barriers when first introducing a PDS into a mine, operator feedback revealed that if the technology is working properly and individuals receive realistic training and communication about how the technology should function, it can be a useful device to help call attention back to hazards in the mine environment. As one operator said, "In my opinion, I think it can be easy to get distracted, there is so much to watch for, you can always watch for the wrong thing one time."

Although no technology is foolproof, providing operators the opportunity to notice and adapt to additional hazards of which they may not be aware of may continue to enhance their awareness on the job.

Progress in Intelligent Proximity Detection Systems

Based on the results of several field performance tests, feedback from stakeholders and comments from the CMM operators throughout our interviews, NIOSH researchers have been working on the development of a more advanced version of PDS technology. They have recently created an intelligent proximity detection system (iPDS) using Mine Safety and Health Administration-approved electromagnetic proximity detection hardware (for more information, see DuCarme et al., 2015). This technology contains efficient software that determines the real-time position of any worker relative to the CMM.

The system then intelligently responds with visual signals and disables only machine motion that could cause striking or pinning — thus greatly reducing the frequency of false alarms. By blocking only dangerous machine functions while allowing other motions to continue, the iPDS would be less interruptive to the CMM operator's work. As a result, the incorporation of this technology into commercially available PDSs may lead to greater acceptance by the mining workforce while continuing to maintain the safety of mineworkers.

References

DuCarme, J.P.; Carr, J.I.; and Jobes, C.C. (2015). *Proximity Detection With Selective Machine Shutdown*. Print proceedings of 144th Annual Society for Mining, Metallurgy, & Exploration Conference held in Boulder, Colorado, February 15-18, 2015. (Preprint 15-083).

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Emily Haas and Joseph DuCarme are part of the National Institute for Occupational Safety and Health's (NIOSH) Office of Mine Safety and Health Research in Pittsburgh.

SEEING MACHINES, CATERPILLAR GO GLOBAL

Australian-based Seeing Machines announced in mid-September it had inked a new global agreement with equipment manufacturer Caterpillar for product development, licensing and distribution.

The deal is the final phase of an alliance the two initially made in May 2013.

In the new agreement, Cat will take over responsibility for the manufacturing, marketing and sales of Seeing Machines' DSS rugged off-road product.

Both Seeing Machines and Caterpillar will work together to develop new products, and Caterpillar will market DSS and Seeing Machines Fleet products for in-cab operator fatigue and distraction monitoring solutions in the agreed Caterpillar industries.

Caterpillar will also have distribution rights for Seeing Machines Fleet product, according to the deal's terms, exclusive within agreed Caterpillar industries, as well as non-exclusive outside those industries.

The price tag for the deal is \$17.5 million; Caterpillar will pay that total over four years as well as royalty fees for DSS hardware, software licensing, monitoring and analytics services. The OEM will also purchase existing inventory of DSS units from Seeing Machines.

Current DSS customer agreements will be transitioned to Caterpillar and supported by the company's dealers. Caterpillar Safety Services will offer additional consulting services, system monitoring and data analysis.

"This is a pivotal moment in the history of Seeing Machines; the realization of several years of hard work for both companies," Seeing Machines CEO Ken Kroeger said. "Caterpillar is capable of maximizing the return on the DSS technology; their reputation, reach, capability, and commitment will deliver great outcomes for both companies and for the world's mining and construction related companies."