Near Misses

Lessons Learned From Near-Miss Reports to Reduce Risk Tolerance in the Aggregates Industry.

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Near misses can enhance awareness of the potential causes of injury and prompt safety management initiatives. Most companies require near-miss reporting; however, it is unclear what the value of these reports is and how they influence subsequent actions or controls to reduce on-the-job risks. During the summer of 2018, researchers at the National Institute for Occupational Safety and Health (NIOSH) conducted a case study with an aggregates company in which near-miss reports were analyzed. Workers recorded 249 near misses that provided insight into ways that risk communication and management programs can be improved to reengage workers and to raise their health and safety (H&S) situational awareness on the job.

Overlaps in Near-Miss Management and Risk Management

The National Safety Council [1] defines a "near miss" as an "unplanned event that did not result in injury, illness, or damage – but had the potential to do so." Near-miss incidents have been used as a critical metric of risk management as well as "free lessons for safety management" and a "knowledge framework" for those who study near-miss management [2, p. 1].

Some practitioners have argued that near-miss incidents should be further analyzed by assigning a risk rank based on the consequences and probability of occurrence. These efforts, practitioners claim, would help to gather knowledge and assess information around specific H&S hazards [3, 4]. Based on the probability of a negative event occurring, risk assessments can help determine whether the level of risk is acceptable to the organization [5, 6]. Figure 1 is an example of a risk matrix.

Figure 1. Example Risk Matrix and Evaluation Key used by ANSI/ASSE [7–9].

To date, the collective analysis of near-miss reports and how they have informed corrective actions and perhaps prevented incidents has not been studied in-depth. Therefore, in collaboration with the aggregates industry, NIOSH researchers felt that it was important to take these two prevalent activities (near-miss reporting and risk assessments), which are more often completed as separate entities, and assess what additional knowledge they could offer when viewed together. Specifically, when analyzing the near-miss reports, it was important to determine possible relationships among the risk type (i.e., low, moderate, high, and critical) and the corrective action implemented by the organization and/or its employees.

Collecting and Classifying Near-Miss Reports

First, to understand what near-miss information can provide in the context of risk management, two NIOSH researchers traveled to visit three aggregate mine locations in the Midwest during the summer of 2018. The purpose of visiting these site locations was to gather reports of incidents on near-misses observed or experienced by workers, as well as to understand the process that workers go through to report a near miss, how they are recorded, and how leadership assesses and documents their corrective actions as a part of the company's overall safety programming.

NIOSH researchers viewed and recopied all near misses that were reported and recorded during the previous three months. After understanding the company's processes for near-miss reporting, NIOSH was provided with near-miss reports for the entire region of the company during the same three-month quarter. The near-miss reports contained the following information: product group, classification, date occurred, date entered, description of event, corrective action, and company-specific information (which was deleted to maintain site anonymity). Collectively, 249 near-miss incidents were recorded. After cleaning and recategorizing the data as needed, 167 near misses remained in 12 hazard classifications (see Table 1).

The most common reason for eliminating a near-miss report from the sample was if the incident happened off the job. Although such reports can enhance situational awareness and help workers and organizations to recognize certain hazards on the job, specific hazards were often not identified, and therefore, corrective action could not be taken by the worker or organization.

As a result, these reports contributed little to learning and were deleted from the dataset. Specifically, 58 near misses were classified as third party/public driving, and they occurred off the job or at home. There were also 15 near misses that, upon examination, were not reported in enough detail to provide guidance on finding or mitigating a hazard. In most cases, these were positive-behavior-based or bystander-intervention reports that made mention of a safe decision or process. Although a positive occurrence, these were deleted from the database as well because no hazard or corrective action was identified.

Table 1. Frequency of Near-miss Classifications

Company Classification	Frequency	Percentage
Electrical hazard	8	4.8
Employee in/under/near equipment	7	4.2
Equipment failure	15	9.0
Lack of proper risk assessment	17	10.2
Housekeeping	10	6.0
Plant hazard	17	10.2
Slip/trip hazard	14	8.4
Use of PPE	17	10.2
Process/procedure-related	13	7.8
Traffic control	14	8.4
Work zone intrusion	6	3.6
Vehicle rules (e.g., pedestrian segregation, alarm/reversing, load securement)	29	17.4
TOTAL	167	100

Determining Risk Ratings

The remaining 167 near misses were analyzed using a 5x5 matrix to guide a qualitative risk assessment (RA) analysis of each near miss (see Figure 2). Researchers met on several occasions during a six-week period to discuss and code the near misses. Coding near-miss narratives is not as simple as coding an actual injury narrative. Specifically, to code a near miss, one must "look for the most likely outcome that could have occurred, recognizing that one decision must be made when multiple outcomes are possible" [10, p. 126]. Therefore, meeting and discussing the near misses as an interdisciplinary group was imperative to ensure that all outcomes were considered when assigning scores.

After the near misses were coded, researchers consulted an H&S subject matter expert (SME) in the aggregates mining industry to validate the coding decisions. Ten percent of the near misses were shared with the SME along with researchers' thoughts on the probability of occurrence, consequence of occurrence, and corrective action. In all but one instance, feedback from the SME did not change the risk type of the near miss.

Identifying Relationships Between Risk Ratings and Corrective Actions

The frequencies of near-miss occurrences showed a fairly even distribution of the RAs across the four risk categories (see Figure 2).
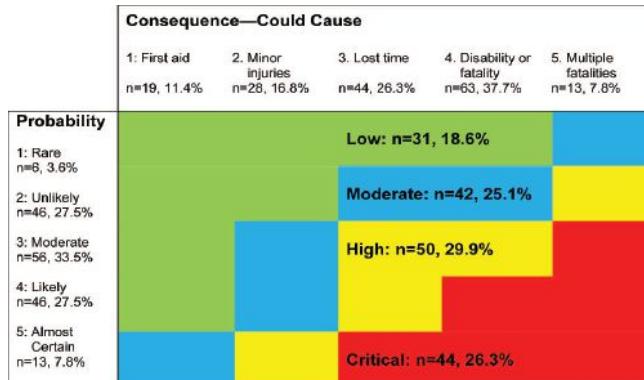

Figure 2. Cumulative RA Results for 167 Near-miss Incidents

Corrective actions were coded to each near miss based on whatever activity had been completed and documented in the report. Table 2 shows the total frequency of each corrective action that was coded as well as an example of the related action.

Table 2. Frequency of Corrective Actions

Corrective Actions	Frequency	Percentage	Example
Elimination or substitution of energy source	47	28.1	"Tagged out tool and replaced."
Engineering control redesign, enclosure, isolate	20	12.0	"Built up berms around area."
Implement safe work procedures	68	40.7	"Good use of mirrors but we need to stay aware of our surroundings because they easily could have been in a blind spot. We tightened up our cones there and talked about keeping your head on a swivel."
Issue PPE	15	9.0	"Plant manager told employee he needed to get safety glasses on which he did immediately."
Not yet fixed	17	10.2	No action listed or a futuristic statement such as "make sure people are aware."

Researchers were also interested in the relationship between risk type and corrective action to address gaps in risk management efforts on site. Figure 3 shows the frequency of corrective actions associated with the four risk types within the matrix.
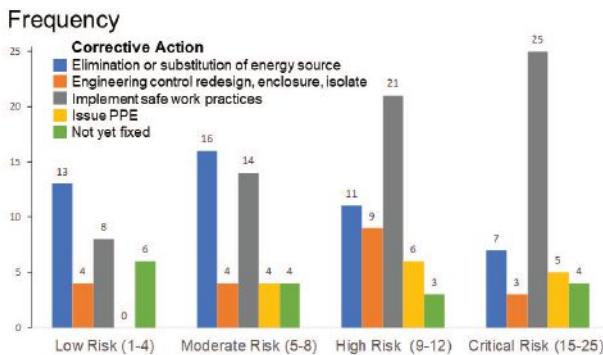

Figure 3. Corrective Actions Implemented by Risk Type

Finally, to determine if there was a relationship between the risk type and the corrective action implemented by the organization or its employees, a nonparametric median test was performed. The median test compared the proportion of scores within each category of corrective action that fell above the median risk type across all categories; risk types were ranked from 1 (low risk) to 4 (critical risk). The results of the test were significant (chi-square=13.64, df = 4, p < .005), indicating that the relative frequency of levels of risk varied across types of corrective actions. For example, the action "Implements safe work procedures" was associated with a higher level of risk than the action "Not yet fixed."

Practical Implications of Near-Miss Reports as Risk Tolerance Tools

Notably, the results showed that the dominant corrective action in response to the near misses reported was an increased adherence to safe work practices on the job. Thus, these results provoke thoughts on organizational and communication gaps that might exist about safe work procedures as well as underlying reasons why certain work procedures are not always implemented as intended.

Two areas to further consider include individual differences in workers' risk tolerance that may contribute to these results as well as potential gaps in how workers are involved in not only near-miss reporting but also the execution of mitigation strategies on behalf of their worksite. Both are discussed below.

First, it is possible that workers' risk tolerance helps to explain these results in that if workers are more tolerant of risks, they may be more likely to make judgments that

they find acceptable and unconsciously work around certain procedures to complete a job task [11]. This does not mean that workers necessarily want to take risks; rather, they may accept risks to get the job done.

Additionally, working around these conditions consistently without implementing safe work procedures can result in workers believing that they are overestimating their initial risks on the job [12]. As an example, several near-miss reports in the current sample reported workers' driving around site or leaving site with their truck bed raised. Although this can result in significant damage and injury if the truck bed meets another energy source, it is likely that some workers underestimate that this contact can happen and result in electrical shock. So, they continue this at-risk practice because it is more convenient to do so, and they are willing to accept the associated risk.

- Judgments about risk tolerance are also made, in part, based on the processes through which safety is managed and communicated, as well as whether those messages are considered reliable and trustworthy [13]. As a result, feedback about high-risk near misses that are consistently reported should be given, including the corrective actions taken. Such feedback being delivered to workers either face-to-face, posted on bulletin boards, or via other on-site messaging are all viable options.

The results also show the importance of not just developing but also promoting formal near-miss reporting systems that establish guidelines for a quality near-miss report. For example, in the current study, researchers started with 249 near misses and ended with 167. In other words, 30% of the near misses turned in by employees who are part of a company that does have a formal reporting mechanism were deemed ineffective.

What implications might this have for companies that do not have formal near-miss programs? This finding suggests that near-miss reporting cannot only be encouraged and completed, but organizations also need to routinely check these near-miss reports, act on an organizational level to fix hazards, and intervene with those who identify or encounter hazards.

To help support this process, the concept of near misses can be explained to employees, including why they are important to report and that no disciplinary action will be taken as a result of those reports [14]. Subsequently, rather than leaving the risk ranking efforts up to management, workers can be provided the opportunity to assign probability and consequences to hazards identified on site as well as the option to make suggestions to improve any deficiencies in company plans and processes [15]. It is possible that such

efforts can force workers to truly assess the reasonable probability and consequences of hazards and motivate them to think critically about their daily surroundings.

Moving Forward in an Era of Big Data

This study shows that near miss reports can serve as useful learning tools. Moving forward, it is important that organizations better assess their own risk management and communication processes around near misses and residual feelings of perceived risk. To do this, new ways of collecting and assessing near-miss data may be necessary for companies to make quick and effective decisions. It is known that the time, effort, and resources to collect near-miss information are already extensive prior to even trying to understand the data. In the case of this study, researchers spent the time qualitatively analyzing the near-miss data for quantitative trends.

In future scenarios, it is possible that more predictive analytics can be used to ensure that the most value is extracted from the data and that safety practitioners are able to identify areas needing attention [16]. However, this study also showed the importance of an interdisciplinary team being engaged in analyzing risk-based information. Therefore, even as the use of big data and predictive analytics continues to replace traditional matrix assessments, interpretations of findings by social scientists, engineers, and H&S practitioners will continue to be imperative to best apply the outcomes. ▲

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Disclaimer: The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. Mention of any company or product does not constitute endorsement by NIOSH.

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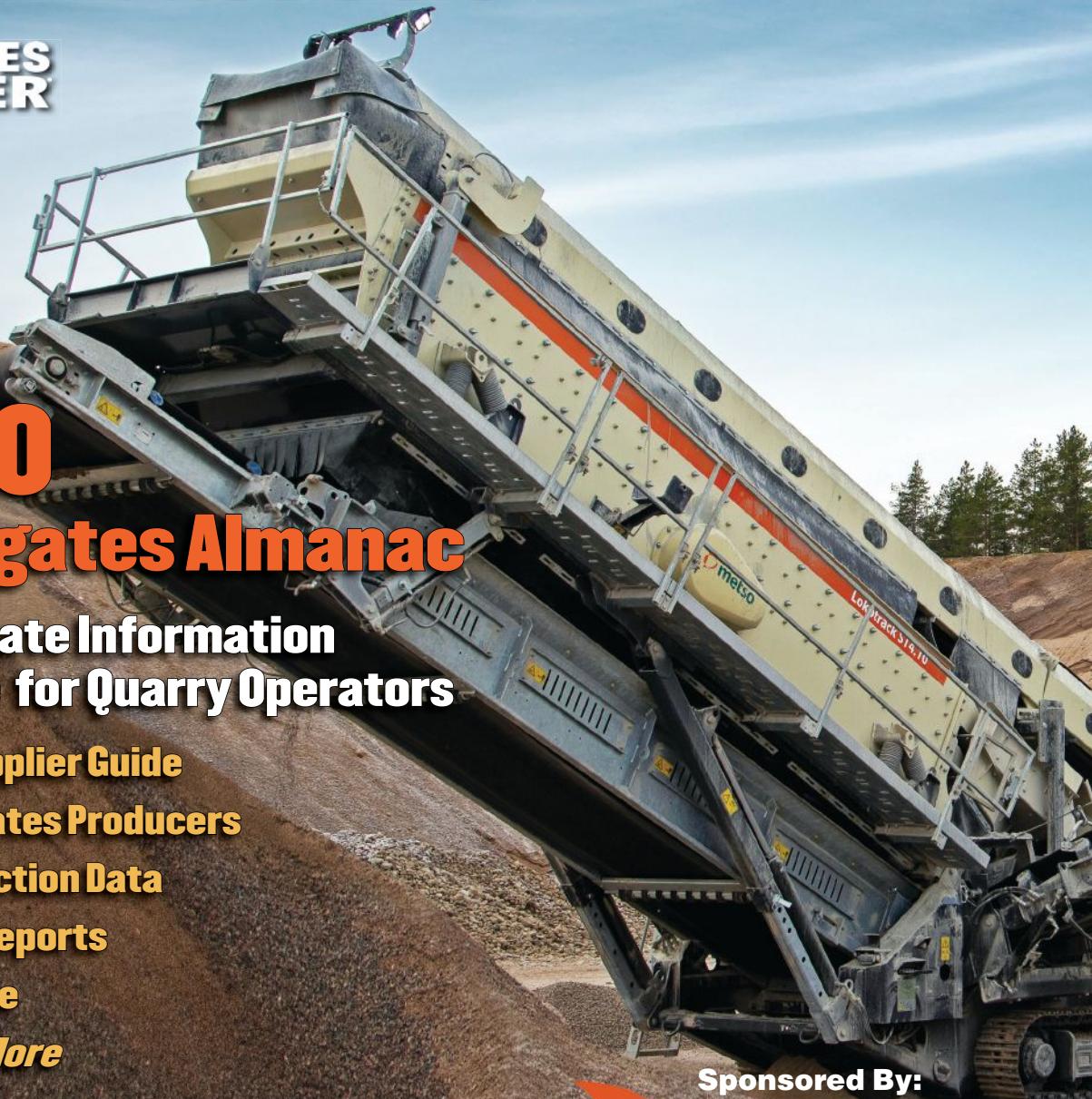
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