

Exploring the differences in safety climate among mining sectors

Emily J. Haas*, Patrick L. Yorio and Cassandra L. Hoebbel

National Institute for Occupational Safety and Health, Pittsburgh, PA, USA

*Corresponding author email: EJHaas@cdc.gov

Full-text paper:

Mining, Metallurgy & Exploration (2021) 38:655–668, <https://doi.org/10.1007/s42461-020-00364-w>

Keywords: Health and safety management system (HSMS), Linear regression, Mining, Safety climate

To read the full text of this paper (free for SME members), see the beginning of this section for step-by-step instructions.

Special Extended Abstract

This study revealed significantly less favorable perceptions of the existing organizational safety climate among workers in the underground coal-mining sector compared with those in the industrial-minerals and sand, stone and gravel (SSG) sectors. Consequently, it is important to consider pragmatic ways in which health and safety management systems (HSMS) in coal mines can alter processes to improve these perceptions. Given the interdependencies of safety climate factors and HSMS elements, researchers explored mineworker perceptions of the supportiveness of organizational safety climate factors among mineworkers and identified significant differences in perceptions across sectors. In this paper, we suggest that health and safety professionals in underground coal mining and organizations with fewer resources or less mature HSMSs focus on these factors to bolster support for proactive safety performance. Potential barriers to implementing or improving relevant HSMS elements and ideas to help foster more favorable perceptions of organizational safety climate are also discussed.

Background

Routine safety climate assessments are often used as a part of an organization's HSMS to identify safety policies, procedures and practices that may need improvement. However, it has been argued that risk-based management strategies inherent within a health and safety management framework have been diffused more slowly in U.S. coal mining [1]. Results of safety climate surveys of the workforce can be used for continuous improvement of HSMSs and in the diffusion of effective health and safety management practices [2]. The present study assessed safety climate perceptions among three U.S. mining sectors with a specific focus on how the perceptions of a sample of coal mineworkers differ from those of workers in the industrial-minerals and SSG sectors.

Methods

The U.S. National Institute for Occupational Safety and Health (NIOSH) created a safety climate survey that was

used to assess mineworkers' perceptions of several personal and organizational factors. The survey was originally developed to support a research objective to determine the most important organizational and personal characteristics needed to support worker safety performance in the mining industry [3]. Data collection occurred from February 2016 through February 2019. Participants consisted of 2,945 mineworkers at 40 mine sites in 18 states. The breakdown of participation in the survey by sector is shown in Table 1.

Five regression equations were used, one for each of the safety climate factors: (1) organizational support for safety, (2) coworker communication, (3) supervisor support for safety, (4) worker engagement and (5) training adequacy, measured on a scale of 1 to 6, with 6 indicating the most favorable perception. The mining sector served as a categorical independent variable with three levels — coal, industrial minerals and SSG — with coal as the reference variable.

Results

The means for each of the scales and the results of each of the regressions are listed in Table 2. The results suggest that the group of miners working in coal mines had significantly less favorable perceptions of their organization's safety climate than those working in other sectors.

Discussion

Because it has been argued that the development and diffusion of HSMS practices, specifically risk-based processes, have been slow to take hold in the coal-mining industry [1], the current results could have important implications. The core components of commitment, participation and communication between workers and supervisors have been shown to be critical aspects of HSMS implementation within a regulatory system [4], within both proactivity and compliance intervention research [3]. These elements should be further developed and integrated in the U.S. mining HSMSs across sectors and measured by assessments of the related safety climate factors included in Table 2, especially among

Table 1 — Breakdown of participation in the survey by mining sector.

Mining subsector	Survey count	% of sample	Range of participants per site	Average participants at each site	Mine count
Coal	620	21	78–280	207	3
Industrial minerals	907	31	22–244	101	9
SSG	1,418	48	7–127	51	28

Table 2 — Regression results with mean responses among sectors by safety climate factor.

Safety climate factor	Mining subsector	Mean	B*	Std. error*	Wald chi-square*	p-value*
Organizational support	SSG	4.33	0.47	0.06	70.29	<0.001
	Industrial minerals	4.53	0.67	0.06	125.75	<0.001
	Coal	3.86	Reference group			
Coworker communication	SSG	5.09	0.30	0.05	38.42	<0.001
	Industrial minerals	5.05	0.26	0.05	24.66	<0.001
	Coal	4.79	Reference group			
Supervisor support	SSG	4.83	0.25	0.05	25.77	<0.001
	Industrial minerals	4.88	0.30	0.05	29.78	<0.001
	Coal	4.58	Reference group			
Worker engagement	SSG	4.55	0.41	0.06	48.81	<0.001
	Industrial minerals	4.64	0.50	0.06	66.43	<0.001
	Coal	4.14	Reference group			
Adequacy of training	SSG	5.09	0.31	0.05	36.78	<0.001
	Industrial minerals	5.32	0.54	0.05	104.59	<0.001
	Coal	4.78	Reference group			

*Note: B is the unstandardized regression coefficient. Std. error is the standard error for the regression coefficient. Wald chi-square is the test statistic for the regression coefficient derived from the maximum likelihood, robust regression. The p-value is the probability value for the regression coefficient (level of significance).

underground coal miners. Potential explanations for the significant differences between coal and the other two sectors are discussed in detail in the full paper.

Size of mining worksites. One factor to consider and further study is the size (number of employees) of the mining companies and the worksites that participated. As shown in Table 1, the coal mines in the study were larger (averaging 207 participants) than the industrial-minerals mines (101 participants) or SSG mines (51 participants). This raises questions as to whether size may affect the ability of companies to effectively disseminate HSMS practices, policies and processes. Even though they may have more resources, larger mines often must resort to routine regimes and limiting discretionary action taken by workers. Although limited in resources, smaller mines may be able to communicate more effectively through personal contact, thereby empowering mineworkers to proactively respond to safety concerns during day-to-day operations.

Prescriptive versus proactive risk management. Although the U.S. coal mining industry has progressed toward a risk-based systems approach, particularly using the National Mining Association's CORESafety framework [5], rules and regulations in the United States are still more prescriptive than other countries [6,7] and other mining sectors, which may lead to compliance-focused approaches to safety management [1]. In addition to these considerations, it is likely that approaches to health and safety management in mining also vary based on environmental factors, like the economics of supply and demand across sectors. Future research should also consider the maturity of an operation's HSMS when conducting safety climate research.

Conclusions

It is important to note when interpreting these results

that, in general, the averages for each scale across sectors were relatively high. That is, even though the coal sector experienced lower averages, the averages tended to still be in the 3–4 ("somewhat agree" to "agree" with positive organizational safety statement) range. Even so, with this trend in the results, it is important to consider that small differences on a perception scale can equate to meaningful differences in outcomes. The results provide an impetus for companies to think of ways to improve the execution of HSMS policies, procedures and practices to consequently improve safety climate perceptions among the workforce. Specifically, because factors such as workforce size and market demand for various commodities are largely beyond industry control, practices pertaining to organizational commitment to safety and worker engagement are vital to improve system and safety performance. The development of tailored interventions and their assessment is necessary for successful implementation and adoption across mining sectors, and particularly coal mining, as they relate to the safety climate factors examined in this study. ■

Selected references

1. Yang B (2012) Regulatory governance and risk management: Occupational health and safety in the coal mining industry. Routledge, New York.
2. Haas EJ, Yorl P (2016). Exploring the state of health and safety management system performance measurement in mining organizations. Saf Sci, 83:48–58
3. NIOSH (2020) Assessing the impact of safety climate constructs on worker performance in the mining industry. By E Haas, C Hoebbel, P Yorl. Pittsburgh PA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2020-120, RI 9704
4. Beus JM, McCord MA, Zohar D (2016). Workplace safety: A review and research synthesis. Organ Psychol Rev 6(4):352–381
5. National Mining Association [NMA] (2014) CORESafety, "CORESafety framework handbook"
6. Foster P, Hoult S (2013) The safety journey: Using a safety maturity model for safety planning and assurance in the UK coal mining industry. Minerals 3(1):59–72
7. Committee on Safety and Health at Work (1972) Safety and health at work: report of the committee 1970–72, Chairman Lord Robens. Her Majesty's Stationery Office, London

Reproduced with permission of copyright owner. Further reproduction
prohibited without permission.