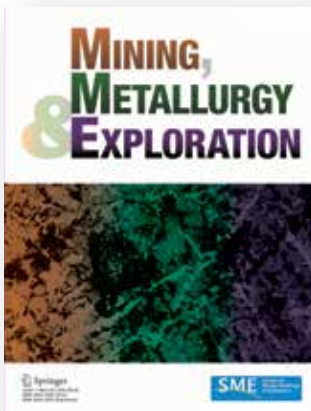


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Exploring worker experience as a predictor of self-reported routine and nonroutine safety performance in the mining industry

Cassandra L. Hoebbel^{1,*}, Emily J. Haas² and Margaret E. Ryan²

¹Mining Research Division, National Institute for Occupational Safety and Health, Pittsburgh, PA, USA

²National Personal Protective Technology Laboratory, National Institute for Occupational Safety and Health, Pittsburgh, PA, USA

³New York, USA

*Corresponding author email: Choebbel@cdc.gov

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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

Researchers examined datasets from two separate studies that measured common demographic variables but different safety performance outcome variables. Of specific interest was how types of experience might relate to workers’ preparedness to effectively mitigate or respond to both routine and nonroutine risk in the mining industry. The results suggest that individual factors such as length of job, industry, and mine experience are predictive of routine safety performance — as measured by self-reported proactive and compliant safety behaviors — and/or nonroutine safety performance — as measured by perceived competence in self-escape knowledge, skills and abilities (KSAs) — in significant and sometimes unexpected ways. The results provide insight into the usefulness

of examining individual mineworker characteristics to design and target interventions for both low-frequency/high-severity events — such as mine emergencies and disasters — and higher-frequency/lower-severity events — such as near misses and nonrecordable incidents — with an emphasis on continuous engagement of mineworkers across various levels of job, and mine site and industry experience.

Background

In recent years, there has been increasing interest in the role that individual factors, such as job role or tenure, play in health and safety (H&S) outcomes in the mining industry. In particular, the association of mineworker experience and in-

dividual safety incidents has garnered attention and is being explored by the U.S. Mine Safety and Health Administration (MSHA) and National Institute for Occupational Safety and Health (NIOSH). Additionally, and in response to the NIOSH-sponsored investigation by the National Academy of Sciences on “Improving Self-Escape from Underground Coal Mines,” individual factors are being examined in terms of their relationship to personal emergency response preparedness in the underground coal mining industry. Although there has been a great deal of speculation about the relationships between experience and safety performance, there is little empirical evidence to support the existence or direction of these relationships.

Methods

Two surveys, one measuring self-reported routine safety performance and one measuring individual perceived competence in the nonroutine KSAs critical to emergency response, were administered to two samples of mineworkers in two separate research studies over a two-year period. To explore ways in which individual characteristics measured by both surveys — time in current job, time in current mine, time in mining industry, age, formal education, workgroup, work schedule and family mining history — might predict routine safety performance and self-escape competence, an exploratory analysis of the cross-sectional results was conducted.

To measure routine safety performance, survey scales were adapted from previously validated metrics and included items to measure mineworker agreement with statements related to compliance with safety policies and procedures (for example, “When I am at work, I use the correct H&S

procedures for carrying out my job”) and proactivity (for example, “When I am at work, I try to solve problems in ways that reduce H&S risks”). Participants in this survey included 2,020 workers from 39 mine sites. Sixteen percent of the participants worked in underground coal; 52 percent in stone, sand, and gravel; and 32 percent in industrial minerals.

To measure nonroutine safety performance, mineworkers were asked to rate their level of confidence in their ability to correctly demonstrate or explain critical self-escape KSAs (for example, their mine’s emergency response plan, how to don a self-contained self-rescuer, and the locations of their mine’s emergency response features and apparatus). Participants in this survey included 696 hourly underground coal miners from eight different mine sites. Outcome variables were measured using six-point and 11-point Likert scales, respectively, with higher numbers indicating higher levels of performance.

Using logistic regression, each outcome variable was first split into quartiles and then dichotomized, allowing the highest (most desirable) 25 percent to be distinguished from the remaining 75 percent scores (“high” and “lower,” respectively). Univariate analysis was used to identify which of the demographic variables common to both datasets were significantly ($p \leq 0.05$) related to the outcome variables, followed by backward stepwise selection procedures to determine each final model.

Results

While controlling for all other variables, three demographic variables were found to be significantly associated with routine safety performance — time in current job ($p =$

Table 1 — Logistic regression results for demographics by routine self-reported safety performance ($n = 1,895$).

Demographics	Odds ratio	95% confidence int.	p-value
Time in current job			0.016
<1 year	REF ^a		
1–5 years	1.42	(0.92–2.19)	
6–10 years	1.57	(0.96–2.58)	
11–15 years	2.75 ^b	(1.58–4.80)	
16–20 years	1.96 ^b	(1.05–3.65)	
20+ years	2.07 ^b	(1.18–3.62)	
Time in mining industry			0.030
<1 year	REF		
1–5 years	0.60 ^b	(0.37–0.98)	
6–10 years	0.55 ^b	(0.33–0.93)	
11–15 years	0.38 ^b	(0.21–0.67)	
16–20 years	0.41 ^b	(0.22–0.76)	
20+ years	0.49 ^b	(0.28–0.85)	
Workgroup			0.000
Production	REF		
Maintenance	0.56 ^b	(0.42–0.75)	
Other	0.91	(0.69–1.20)	

^aReference variable

^b $p < 0.05$

Table 2 — Logistic regression results for demographics by perceived self-escape competence.

Demographics	Odds ratio	95% confidence int.	p-value
Time in mining industry			0.023
0–5 years ^a	REF ^b	REF	
6–10 years	2.59 ^c	(1.33–5.05)	
11–15 years	2.99 ^c	(1.35–6.62)	
16–20 years	3.73 ^c	(1.42–9.82)	
20+ years	3.45 ^c	(1.44–8.27)	
Time at current mine/company			0.044
<1 year	REF	REF	
1–5 years	0.86	(0.45–1.62)	
6–10 years	0.43 ^c	(0.23–0.82)	
11–15 years	0.58	(0.25–1.37)	
16+ years	0.26 ^c	(0.08–0.86)	
Work schedule			0.014
Set schedule	REF	REF	
Rotates/shiftwork	0.53 ^c	(0.32–0.88)	

^aBecause of the small number of participants with < 1 year of industry experience (1.7%), the 0–1 and 1–5 year groups were combined into one categorical variable (0–5 years).

^bReference variable

^c $p < 0.05$

0.016), time in the mining industry ($p = 0.030$) and workgroup ($p < 0.000$) (Table 1) — and three were found to be significantly associated with perceived self-escape competence — time in the mining industry ($p = 0.023$), time at current mine ($p = 0.044$) and work schedule ($p = 0.014$) (Table 2).

Three of the five significant predictors of the self-reported safety performance outcomes measured in this study were related to experience — time in industry, job, and mine site — with time in the mining industry the only variable significantly associated (in opposite directions) with both outcomes.

Specific to industry experience and the self-reported routine safety performance, all groups with more than one year of industry experience were less likely (40 to 62 percent less likely) to report high routine safety performance when compared to those with less than one year of industry experience. Conversely, those groups who reported being in the mining industry for more than five years were 2.6 to 3.5 times more likely to report high average self-reported self-escape competence than those with five or fewer years. When controlling for other factors, length of industry experience was negatively related to routine safety performance and positively related to nonroutine safety performance. For illustrative purposes, the odds ratios for the industry experience associations have been converted to probabilities (Fig. 1).

Discussion

This analysis explored how mineworkers' individual characteristics relate to self-reported routine and nonroutine health and safety performance outcomes. The results suggest that significant differences in relationships between individual characteristics and the outcome variables of interest exist and that both length and type of experience could be relevant to performance outcomes in the mining industry. The results also suggest that these relationships are more complex than researchers and practitioners might expect.

Conclusion

While taking into consideration the limitations of this

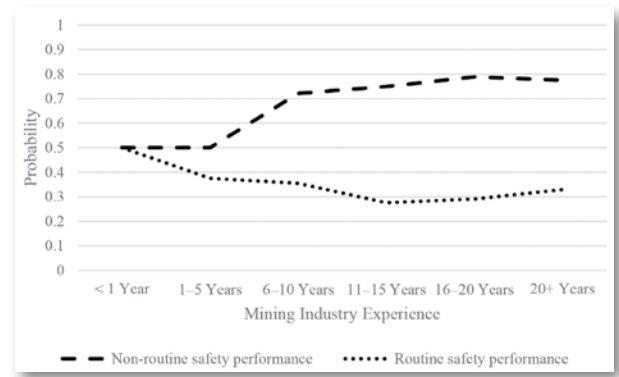


Fig. 1 Mining industry experience and probability of self-reported high routine and nonroutine safety performance.

study, these findings could provide a foundation for further study in the areas of individual differences, safety performance and emergency preparedness. The findings from the exploratory analysis described in this paper, though not definitive, lend credence to the idea that mine safety and health professionals should avoid taking a “one size fits all” approach to risk management or assuming that experience, in general, is necessarily or positively related to performance outcomes. Further research is warranted to better understand these relationships and their implications for targeting training, reinforcement and assessment efforts in the mining industry. ■

Disclaimer

The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of NIOSH, Centers for Disease Control and Prevention. Mention of company names or products does not constitute endorsement by NIOSH.

References

A list of all references is available in the full paper.

Out of the comfort zone: Quantifying country risk for foreign mining project investment feasibility

Matt Renaud and Mustafa Kumral*

Mining and Materials Engineering Department, McGill University, Montréal, Quebec, Canada

*Corresponding author email: mustafa.kumral@mcgill.ca

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Keywords: Country risk premium, Financial model, Mining investment, Feasibility study, Cost of debt

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

Mining corporations have spread their operations worldwide in the last few decades. The reason behind widening

operations geographically can be seen as it being part of a risk diversification strategy. Given that the technical, financial

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