MINING ENGINEERING:
Management: Safety in Mining II

2:00 PM • Wednesday, February 26

Chair: **R. Hill,** *University of Arizona, Tucson, AZ*

2:00 PM
Introductions

2:05 PM
Assessing the Safety Culture of Underground Coal Mining: Results and Recommendations

C. Kosmoski; NIOSH Office of Mine Safety and Health Research, Pittsburgh, PA

The mining disasters since 2006 have placed renewed focus on several different aspects of safety in the underground coal mining industry. One area which has received increased attention is the concept of Safety Culture. Safety culture is defined as the characteristics of the work environment that influence employees' perceptions of the importance that the organization places on safety. Safety culture assessments were conducted at five underground coal mines between the years of 2010 and 2012. The methodology involved obtaining a variety of quantitative and qualitative information, using multiple methods including functional analysis of mining documents, in-depth interviews, behavioral anchored rating scales, paper surveys, and behavioral observations. This manuscript describes the results of the five safety culture assessments. Observations regarding the characteristics of the mines' safety culture that should be sustained as well as areas in need of attention and management focus to improve the mines' safety culture are presented. The manuscript concludes with general recommendations for areas any underground coal mine could focus on in an effort to improve safety culture.

2:25 PM
Age, Injuries, and Costs in the Mining Industry: A Case Study for U.S. Gold and Coal Mines

E. Lutz[1], T. Regan[2], X. Liu[2] and J. Burgess[1]; [1]College of Public Health, The University of Arizona, Tucson, AZ and [2]Dept. of Economics, University of Arizona, Tucson, AZ

In terms of fatalities, the Bureau of Labor and Statistics reports that the mining industry, as a whole, is the most dangerous industry sector in the U.S. As part of their regulatory scheme and reporting requirements, the Mine Safety and Health Administration makes available data on accidents and injuries in the mining industry. This study describes the gold and coal mining industries for the last two decades using this data. We used data from 1990 to 2010 to focus on the relationship between these types of incidents and age. We calculated an average annual injury rate of 5.65 percent for gold and 13.46 for coal. We found that young coal miners are more prone to injury. Using the Center for Disease Control's Web-based Injury Statistics Query and Reporting System (WISQRS), we calculate an average total economic cost of $7,000 (2010 US$) per injury and determine that nearly 85 percent of this amount stems from lost work thus highlighting the enormity and importance of accounting for indirect, in addition to direct, costs.

2:45 PM
Fatalities and Disasters in Coal Mining

E. Lutz[1], C. He[2], G. Gowrisankaran[2] and J. Burgess[1]; [1]College of Public Health, The University of Arizona, Tucson, AZ and [2]Dept. of Economics, University of Arizona, Tucson, AZ

Coal mining is a dangerous occupation. Economic theory suggests that coal firms and workers balance productivity and the risk of accidents, yet recent literature suggests that exogenous shocks may gratuitously stimulate both mine productivity and safety. We use fatalities and disasters as a source of exogenous variation to understand how coal mine productivity changes in response to such shocks. After a coal mining disaster, we find decreases in less severe accidents and declines in coal production for mines within the affected state, with the total losses in the state exceeding a billion dollars. We do not find that a disaster has significant effects on mine activity nationwide. After to a fatality within a mine, we find evidence for increases in productivity but no evidence of changes in accident rates. Our quantitative analysis using firm level production data is a rare contribution to a tiny economic literature on firm productivity and safety.

3:05 PM
Tracking in Returns and Remote Areas of the Underground Mines

T. Michaud; Technology Office, Strata Worldwide, Sandy Springs, GA

Traditional tracking and communication systems rely on having mine power nearby to operate. For inby areas and remote areas of a mine, the nearest mine power can be miles away leaving these areas of the mine uncovered by traditional technologies. The arrival of the new battery powered wireless tracking systems has changed this. CONSOL has deployed the latest in wireless mesh battery powered communication systems in remote areas of both Enlow and Bailey mines to provide tracking and communication. This presentation will discuss the issues associated with these remote areas; the current monitoring requirements; CONSOL's battery powered wireless mesh solution; architecture and installation of the system; and the resulting improvements in mine safety.

3:25 PM
Sustainable Fatigue Management

E. McKenzie; EdanSafe, Pinjarra Hills, QLD, Australia

Fatigue has been recognized as an issue within the mining industry for some time. ICMM and other bodies are actively promoting various approaches to fatigue management. The SmartCap operator fatigue monitoring solution represents the next generation of fatigue monitoring technologies. Independently validated, preemptive in nature and education, the SmartCap solution has been assessed as being head and shoulders above other fatigue technologies. This presentation will introduce participants to the solution and we will present findings from real world adoption of the solution.

MINING & EXPLORATION:
Operations: It Happened Again: When Optimization, Planning, and Reality Collide

2:00 PM • Wednesday, February 26

Chairs: **C. Roos,** *Newmont Mining Corporation, Greenwood Village, CO*
T. Elenbass, *Newmont Mining Corporation, Greenwood Village, CO*

2:00 PM
Introductions

2:05 PM
Next Generation Mine Planning: Advanced Scientific Approach to Optimize your Extraction Sequence

D. Spitty; Solveit, Schneider Electric, Mississauga, ON, Canada

The generation of ore body models for in-situ resources is subject to rigorous compliance guidelines. The strategic analysis and planning of an extraction sequence based on these modeled resources and reserves is then usually subject to a disparate suite of analysis tools and software applications. The suggested approach for Advanced Planning & Scheduling (APS) for Mine Planning provides a single environment for planning and scheduling and takes into consideration the differences in drivers for decisions - from Strategic Mine Planning driven by broad financial assumptions to shorter term schedules constructed with grade, tonnage and fleet capacity and productivity assumptions The APS can be applied to open pit and underground mines, multiple time horizons, optimization objectives, and ore types and grades. To achieve optimal results, it employs the latest advances in Artificial Intelligence (AI) and Operations Research to develop the optimization and prediction platforms, This enables the ability to compare multiple scenarios of extraction sequences against often competing objectives including tonnage, quality, cost, energy, emissions and NPV to determine the best strategy.

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