Advancing the state of H&S big data in the mining industry

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Outline of topics

• Current NIOSH research in HSMS

• State of the problem in mining health, safety, and risk management

• Upcoming research and data collection approach

• Input
  • Critical topics
NIOSH has been studying relationships among individual and organizational perceptions and performance to improve HSMS implementation.

How can these broad elements and practices work together to reduce incidents?
In an effort to improve **culture and performance**, mines across the country participated NIOSH’s safety climate survey, with several questions focusing on leadership, risk, and communication.

- Stone, sand, and gravel (53%)
- Industrial minerals (34%)
- Coal (13%)

2,683 workers
### Indicators measured within NIOSH safety climate survey

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<thead>
<tr>
<th>Individual and Organizational Factors</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td><strong>Individual</strong></td>
<td><strong>H&amp;S Performance</strong></td>
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<tr>
<td>• Adaptability on the job</td>
<td>• Proactivity</td>
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<tr>
<td>• Risk tolerance/avoidance</td>
<td>• Compliance</td>
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<tr>
<td>• Thoroughness on the job</td>
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<td>• Sense of control on the job</td>
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<tr>
<td>• H&amp;S Motivation</td>
<td><strong>H&amp;S Event</strong></td>
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<td>• H&amp;S Knowledge</td>
<td>• Near Misses</td>
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<td>• Age</td>
<td>• Incidents</td>
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<tr>
<td>• Education</td>
<td></td>
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<tr>
<td>• Experience (Site, Job, Industry)</td>
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<td>• Workgroup</td>
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<td>• Work schedule</td>
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<td><strong>Organizational</strong></td>
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<td>• Organizational H&amp;S Support</td>
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<td>• Supervisor H&amp;S Support</td>
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<td>• Supervisor H&amp;S Communication</td>
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<tr>
<td>• Coworker H&amp;S Communication</td>
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<tr>
<td>• Worker Engagement/Involvement</td>
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<tr>
<td>• H&amp;S Training Adequacy</td>
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These indicators are similar to those within programmatic HSMS...
Also completed interviews and focus groups with managers and workers with a focus on perceived leadership and communication practices.
Some things we learned...

• The perceptions of workers can be influenced based on leadership and organizational support via interventions

• Leading indicators that were measured did predict worker performance and outcomes... to a degree
Secondary Strength, Maintain

Performance is high, but constructs are deemed less important. This is a good indicator of wasted resources.

Core Strength, Leverage

Performance is high and constructs are important to workers. These constructs are competitive advantages.

Secondary Weakness, Low Gain

Although performance is poor, these constructs are relatively unimportant.

Critical Weakness, Fix

Performance is poor, but constructs are important to workers.

Analysis showed the relative importance of each construct to help organizations understand key drivers to worker performance.
Organizations could identify critical areas to improve within their HSMS

- **Secondary Strength, Maintain**
  - H&S training
  - Supervisor support

- **Secondary Weakness, Low Gain**
  - Organizational support
  - Adaptability

- **Core Strength, Leverage**
  - Thoroughness
  - Coworker communication

- **Critical Weakness, Fix**
  - Risk tolerance
  - Worker engagement
  - Supervisor communication
  - Sense of control
Research found contrasting information about supervisors’ communication processes and practices that support workers’ health and safety.

- Visible support
- Consistent communication
- Opportunities for engagement
Results showed that supervisor practices and actions are correlated with workers’ risk-based decisions

- 22% feel their supervisor does not monitor H&S practices
- 37% feel they have impossible production pressures
- 47% feel that most of the problems they experience at work are out of their control
- 33% of hourly workers felt they could not question safety rules or procedures
- 25% feel supervisor does not listen to concerns
- 29% feel that they are not involved in H&S initiatives on site
The perceptions of workers are fluid and can change based on leadership and organizational support via interventions.
Leading indicators measured, including risk tolerance, did predict worker performance and outcomes, to a degree.
Changes in leadership communication and engagement can impact safety records.

Interventions started in 2017 to improve worker engagement and overall sense of belonging and participation in site safety.

12 Month Rolling Reportable Injury Rate

NIOSH Surveys - Supervisor Obsv's & Mgmt Safety Tours
Questions still remain because occupational H&S, and accompanying systems or programs, are not static and changes as the industry changes.

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<td>Do we know what we are tracking in terms of risk?</td>
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<td>How do we continuously monitor trends?</td>
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<td>How do we measure improvement?</td>
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<td>How do we know and sustain engagement in all of these areas?</td>
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There is lack of lagging indicators available to learn from for risk management and incident prevention (ICMM, 2012).
We can use leading indicators that are frequently measured to identify and control risks

• Many companies don’t know how to use these data together, and often isolate the data points

• Identify and aggregate H&S leading indicators that are critical to preventing incidents or disease for advanced statistical analysis...

• Use the leading indicators within an overall H&S management system
Leading Indicators

Help organizations anticipate negative outcomes
What day-to-day H&S data are predictors of H&S outcomes?

### Day-to-day H&S Data—i.e., Potential Leading Indicators

- Rate of employee participation in daily activities and training
- Management engagement metrics
- Health assessments, including but not limited to medical surveillance or substance abuse
- Closing actions against OHS audits
- Near-miss incidents including type and corrective actions
- Risk assessments
- Employee perception surveys
- Reduction in risk factors, or corrective actions
- Safety audits
- Behavioral observations (both peer-to-peer and manager-worker)
- H&S knowledge assessments
- Workplace exams
- Training scores
- Pre-shift safety meetings
- Workplace exams
- Leadership communication

### H&S Outcomes from MSHA Database and company-specific data if applicable

- Incident – classification of, accident type, and activity during time of
- Injury – occupational injury type, source of injury, nature of injury, degree of injury, lost days
- Worker – experience in industry, at mine, in job, job title
- Mine/Company – type of mine, number of reported accidents/illnesses, number of employees, production, commodity

Statistical models developed for
Aggregated data
Company-specific data
Sub-sector data
How can information be collected and analyzed with a higher level of accuracy and purpose?

**NEW MEASUREMENT AND BALANCE APPROACH**

Technology can facilitate engagement and organize data.

Focus on efforts and leading indicators compared to lagging results.
The industry could benefit from a system that encourages full and accurate reporting in real time without fear of consequence.
Technology can help capture both tangible and intangible events in real time even if there is no injury or damage.

i.e. the identification and documentation of leading indicators!
In other words, we can also use it for big data analysis and the identification of risk “hot spots”
But, we can also use this data more holistically for greater engagement, communication, and leadership.

Companies are already using this platform for communication and education at all levels of the workforce.
Key Points

• It is critical to aggregate and analyze leading indicator measures that are commonly used to prevent the occurrence of incidents or onset of disease (e.g., near miss incidents, risk assessments, safety audits, behavioral observations, knowledge assessments, workplace exams, etc.).
• Upon identifying potential risks via these leading indicators, draft tools are needed to help operationalize the ways in which mines can measure the strength of their HSMS.

Current stage of the work:
• Development of big data workgroup
• Partners to participate in Acknowlogy process for information sharing to prevent incidents
• Partners to validate leading indicators identified
• Partners to help disseminate interventions developed
What do you want to know that your data can tell you?

Leading indicators

Safety

Emergency

Health

Risk