

Request for Proposal

Topic: Health and Safety Management Predictive Data Analytics Study

Background: Health and Safety Management practices have been in existence in one form or another for decades. Most of the early attention has been devoted to cultural changes embracing more proactive interaction between workers and management in identifying hazardous situations and taking corrective action to mitigate the risk.

Early research in this area has largely been qualitative in nature often relying on surveys to establish perceptions of factors that impact health and safety management effectiveness. This perception-based qualitative approach has proven to have several limitations that preclude addressing causal links, including the relationships between proximal, contributory and root causes of injury and disease development.

More recently, efforts such as MSHA's pattern of violations have been promoted to help avoid compliance-based safety and health exposures. While this provides a degree of quantitative assessment, it does not focus on leading indicators that would be needed to proactively address the root causes of injury and disease.

Recent advancements in predictive data analytics that are evolving from artificial intelligence research have yet to be applied to the mining health and safety management problem. These systems provide an ability to automatically learn and improve from experience and may provide improved predictive capabilities. If such a system can be applied to mine health and safety data, then it may be possible to develop a more in-depth quantitative assessment of risks. In addition, such a learning tool could help to remove some of the human bias from the analysis, reducing the blame for who is passing judgement on what is considered an impending trend compared to a possibly more objective description of events and trends.

Goal: The goal of this project is to more effectively identify emerging health and safety trends and determinants of pathways such that proactive intervention measures can be implemented to reduce the incidence of injuries and illness to the working miners.

Specific Aim: The specific aim is to define a set of actionable leading indicators that could reliably predict the likelihood of workplace injuries and illnesses and then develop a quantitative method for identifying trends in these leading indicators. Specifically, it is expected that advanced predictive data analytics will be utilized to identify and better understand the relationships between leading and lagging indicators of health and safety management.

Proposal Guidelines: The proposal should describe the method to a) develop the definitions of leading indicators, b) the data aggregation approach, and c) the computational intelligence methodology that will be used to assess the association between potential leading indicators (i.e. operational data, health and safety intervention measures or lack thereof, production data,

maintenance data, etc.) and the outputs that form lagging indicators (i.e. incident rate, injury rate, compliance violations and pattern of violations, near misses, etc.). In addition to the description of the method, full disclosure and associated confirming evidence should be provided for the following:

- Has this approach been utilized in other industrial sectors beyond mining and what degree of success including what level of predictive accuracy was realized?
- Do you have first-hand experience in utilizing the proposed approach or is this the initial attempt to develop this concept?

Finally, the proposal should articulate a testable hypothesis regarding the accuracy and efficacy of the computational methodology to forecast or predict safety data patterns.

Submission Prerequisite: Establish a partnership with a mining company that has a robust health and safety management program that is committed to sharing the leading indicators defined (i.e., health and safety monitoring data, production data, maintenance data, and MSHA violations from multiple (at least 3) mine sites. Note, the types of leading indicators are offered only as examples and are not meant to suggest the only indicators to be considered.

Scope of Work: The submitter has flexibility to tailor the proposed scope of work to meet the project goals, but the following requirements must be met. NOTE: Each phase requires submission of a Milestone Report which must be approved by the Foundation before funding and approval to proceed to the next phase of work. A sub-budget must be provided for each phase.

Phase 1 - Mining Partnership's Health and Safety Program Assessment

Describe the current maturity level of analytics associated with the health and safety management at the Partnership's mines and work to describe the nature and examples of leading and lagging indicators that have significant potential for prediction and prevention. Provide evidence, if available that the proposed approach(es) to predictive analytics has been utilized in other industrial sectors beyond mining and the degree of success including what level of predictive accuracy was realized. If the proposed approach has not been used in other industrial sectors justify why this approach should be successful in the mining setting.

Phase 2 - Develop and Apply Methods to Analyze Predictive Capability

Document and describe the quantifiable relationships that enable forecasting of health and safety data patterns. Analyze the performance of the computational model relative to the appropriate input variables (leading indicators) and predicted outcome variables (lagging indicators) associated with the study design and the research hypothesis.

Phase 3 - Concept Feedback and Development of an Operational Health and Safety Management Tool

Explain how leading indicators and predictive capability provided by this research might be integrated with operational function and decision making at the mine level, including attention to the hierarchy of controls.

Discuss the potential of the predictive computation tool with the mining Partnership and seek feedback on their perspective of the system's value, their inclination for using it, and recommendations for improvement.

If the predicative capability of the system is proven successful and subject to approval by the Foundation, package the computation methodology into a practical working tool that can be utilized by a mine operator.

Phase 4 - Extended Trials at the Partnership's Mine

If consent is granted by the Partnership's mine, the project team shall support a yearlong trial of the health and safety management tool by the mining company to further explore its functionality. During this trial, the health and safety data analytics system shall be validated by reexamining the model with additional data from the Partnership's mines to further benchmark the leading indicators that support the predictive output capacity of the system.

Evaluation Criteria:

- (40%) Extent, strength and commitment of mining partnerships and accessibility to necessary mine data.
- (30%) Clarity of the proposed approach and convincing evidence, including previous applications, to support that the proposed approach will achieve the project goals
- (20%) Demonstrated background in predictive data analytics
- (10%) Cost and timeline validation