Request for Proposal

Topic: Health and Safety Management Data Analytics and Machine Learning System

Background: Health and Safety Management practices have been in existence in one form or another for decades. Much of the recent 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. Efforts such as MSHA's pattern of violations have been promoted to help avoid compliance-based safety and health exposures. One of the issues that the MSHA pattern of violations has recognized is the management, interpretation, and communication of this compliance information to the mine operator. They have worked to address this shortcoming through development of an on-line Significant and Substantial (S&S) and Pattern of Violations Monitoring Tool and Calculator.

Recent advancements in data analytics and machine learning systems 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 without being explicitly programmed. If such a system can be applied to mine health and safety data, then a more in-depth assessment of risks and perhaps underlying conditions can be developed. Such a capability would preemptively work to mitigate MSHA pattern of violation citations and improve mine management risk practices.

In addition, such a learning tool would help to remove the human bias from the analysis, reducing the blame for who is passing judgement on what is considered an impending trend compared to an anomalous set of events.

Goal: The goal of this project is to develop a health and safety management data analytics and machine learning system for use by a mining company to proactively address and minimize the risk of emerging harmful health and safety trends. It is assumed that initially, the system will work with the MSHA pattern of violation data, since this information is freely/easily available to all mines and the public.

Scope or Work: Note that previous proposal resubmissions are discouraged without improvements that reflect review comments when provided. 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 much be approved by the Foundation before funding and approval to proceed to the next phase of work. As noted in the proposal template, a sub budget must be provided for each phase.

<u>Phase 1 – Assessment of MSHA Pattern of Violations</u>

- Analyze MSHA's Significant and Substantial (S&S) and Pattern of Violations Monitoring Tool and Calculator.

- Determine limitations and impact on hazard prevention by mining companies.

Phase 2 – Classification of Violations and Hazards

- Prepare examples of three mine data sets for enhanced analysis that are appropriately detailed to meet the project objectives aimed at enhanced risk assessment and management.
- Develop a classification system to capture mine risk data related to health and safety.
- Correlate/combine this data with the MSHA violations and near miss assessments.
- Provide convincing evidence that the data set meets the necessary requirements to support implementation of machine learning algorithms.

Phase 3 – Learning Algorithms

- Implement machine learning algorithms on these mine data sets.
- Examine determinant factor correlations to risks and conditions leading to violations.
- Using real or supplemental ad hoc data, demonstrate that a pattern of recognition can be developed and learned through experience by the system.

Phase 4 – Proof-of-Concept

- Building off the accomplishments of the project research, provide a Proof-of-Concept health and safety management machine learning system as a project deliverable.

Funding Plan: The project will be funding in phases according to the Scope of Work with funding for subsequent phase dependent on a successful outcome in the previous phase.

Submission Requirements: The submitter is required to submit a proposal not to exceed 20 pages in length to provide documentation of how the scope will be accomplished, the project team and its experiences, a detailed budget to support the project costs and a project timeline. Proposals with advanced planning or more detail with how the scope of work will be accomplished will be rated higher than those lacking detail.

Since machine learning is relatively new to the mining industry, the submitter is expected to provide references of previous and current activity/research in this area and/or references to support that the machine learning approach is likely to be viable in the mining industry. The submitter is also encouraged to seek and provide input from experts within the artificial intelligence community to bolster the type of data that is best suited to application of artificial intelligence and machine learning efforts.

Finally, as noted in the evaluation criteria, the proposed project team is expected to include key personnel that have machine learning expertise along with staffing that have the necessary mining backgrounds to complement the project goals.

Evaluation Criteria:

- (35%) Background in (large) data analytics and machine learning systems

- (30%) Background in mining health and safety management and MSHA Pattern-of-Violations system
- (25%) Experience and access to working with mining companies
- (10%) Cost and timeline validation