Request for Proposal

Topic: Application of Exoskeleton Technologies for the Prevention of Musculoskeletal Disorders in Mine Operations

Background: Mine workers in all sectors and numerous specific operations are known to be at high risk for developing musculoskeletal disorders related to biomechanical stresses including awkward postures, repetitive motion, forceful exertions, repeated impacts, contact pressure and vibration. Exoskeletons are devices worn on the human body that work in tandem with individual activity to modify these biomechanical stresses in ways that augment, reinforce, or otherwise assist human performance. Over the past 50 years many advances have been made in the design of exoskeletons, both powered and passive, that modify user biomechanics to improve performance and/or reduce harmful stresses. Practical applications in rehabilitation and military settings have demonstrated the potential widespread usefulness of these technologies in occupational settings, but very little work of this sort has been done in mining operations.[1]

Project Goals:

- Assess the feasibility and effectiveness of exoskeletons in selected mining operations.
- Based on the this assessment, develop guidelines for successful application of exoskeleton technologies in additional sectors and operations, including
    - consideration of which designs are best suited to different types of task demands,
    - determination of factors that facilitate and inhibit introduction of exoskeleton use,
    - methods to assess possible adverse and unanticipated consequences of exoskeleton use

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.

- <u>Phase 1</u>
    - Convene a multidisciplinary advisory group to assist in assessing industry interest and readiness for the introduction of exoskeleton technology into mining operations, including potential positive and negative factors affecting acceptance, feasibility, productivity and safety.
    - The advisory group should review the steps in Phases 2 &3 below and recommend whether a) there is sufficient interest and likely readiness among some industry partners to proceed as planned, b) whether modifications are needed in order to proceed or c) there are compelling reasons for not proceeding.
    - Taking into consideration the deliberations of the advisory group, prepare a report identifying any proposed changes to Phases 2 & 3. Continuation of the project will follow review and approval by the Alpha Foundation.

- <u>Phase 2</u>
    - Identify 3-5 mining operations that are potentially suitable for exoskeleton use. Include at least two different mining sectors in this group.

- Identify exoskeleton designs that are potentially suitable for these operations and secure or develop equipment for field testing.
- Conduct field testing of the equipment, including assessments of biomechanical impacts, user acceptance and training needs, productivity and job quality effects, and assessment of environmental considerations such as confined spaces or proximity to hazards that may impact the introduction of exoskeletons.

- Phase 3
  - Using the experience gained in Phases 1 & 2, prepare a guidance document to assist efforts to expand successful exoskeleton usage in mining operations. The guidance document should address at least the elements in the Project Goals.
  - Develop, test and disseminate the guidance document for use by mining stakeholders concerned with improving safety, health, and productivity of mining operations.

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

Submission Requirements: The submitter is required to submit a proposal not to exceed 20 pages 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.

Evaluation Criteria:

- 25% Knowledge and experience relevant to the proposed design
- 25% Quality of the study design
- 25% Likelihood of securing access to mining operations necessary to achieving the scope of work
- 25% Rationale for cost and timeline

[1] IISE Transactions on Occupational Ergonomics and Human Factors. Vol 7 (3-4), 2019.