Pilot: Systematic Evaluation of Exoskeletons in Reducing Musculoskeletal Disorders in Manual Timber Felling

FINAL REPORT
Year 3 of 3 (2019-2021)
PI: Jay Kim, PhD, MS
Assistant Professor, Oregon State University

Challenge

Logging represents one of the most dangerous occupations, with high fatal and non-fatal injuries, particularly with timber falling. The physically demanding nature of the work is challenged by steep ground and adverse weather conditions with unstable footing. This pilot project seeks solutions to reduce physical risk factors and injuries for hand timber fallers by introducing exoskeletons as an ergonomic control.
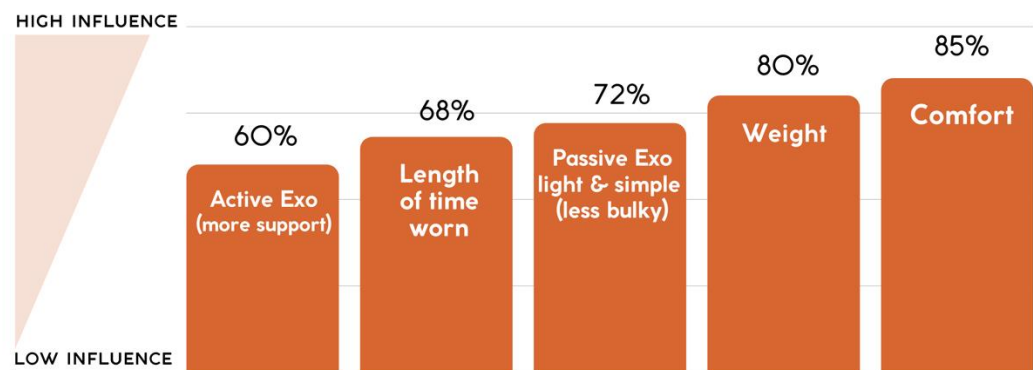
Project Overview

We surveyed loggers to identify potential barriers and unintended safety hazards associated with exoskeleton use. Due to COVID safety considerations, this survey was conducted online with professional logging workers, including timber fellers, safety managers, logging company owners, forestry educators, and logging workers. Survey results will provide understanding of the feasibility of an exoskeleton intervention in improving hand fallers' health and safety and offer guidance for safe and effective use in forestry settings.

Findings to Date

- Survey results showed that while the forestry workers were not familiar with exoskeletons, they expressed considerable interest and acceptance for their use in the forestry industry.
- The results identified timber falling, cutting/sawing, and mechanic work as potential forestry tasks that may benefit most from exoskeleton use.
- The important factors of the exoskeletons included weight, comfort, and simplicity/portability. When asked about health risks that may be posed by use of exoskeletons, workers expressed concern about getting snagged in brush, reduced mobility causing hazardous situations, loss of feeling from the ground, stab injuries, being trapped, malfunction, and weight stressing on the body.
- Potential barriers to exoskeleton adoption can be grouped into four categories: Financial, productivity, psychosocial, and physical aspects. The most important barrier to respondents was the productivity barrier.

To what extent do you think the following exoskeleton characteristics would _influence the acceptance_ of this technology by yourself or other forestry workers?

HIGH INFLUENCE

- Active Exo (more support): 60%
- Length of time worn: 68%
- Passive Exo light & simple (less bulky): 72%
- Weight: 80%
- Comfort: 85%

LOW INFLUENCE

Next Steps   Data from the survey results have been analyzed and will be disseminated through a peer-reviewed journal article. These survey results suggest that given the high prevalence of musculoskeletal pain in the low back and upper extremities, evaluating exoskeleton support of these areas would be a reasonable first step in a future study. Overall, the survey results suggest that passive exoskeletons, which are lighter, simpler in structure, and more portable than active exoskeletons, may be a good candidate for forestry settings and inform a future study, including field-testing with loggers in real forest conditions.

Resources   **https://bit.ly/OSU-Logging-Ergonomics**

Kim, S., Moore, A., Srinivasan, D., Akanmu, A., Barr, A., Harris-Adamson, C., Nussbaum, M. A. (2019). Potential of exoskeleton technologies to enhance safety, health, and performance in construction: Industry perspectives and future research directions. IISE Transactions on Occupational Ergonomics and Human Factors, 7(3-4), 185-191.