Photo submitted by Carey Tarr

A new study proposes using motion capture to map the muscular forces at work when doing physical job demands like lifting and bending.

New tech sheds light on job-site physical demands

By Gail Johnson

One way of understanding the nature of a job — and the possible exposure to health and safety hazards that goes with it — is through a physical job demand analysis (PJDA). Used to break down the requirements of a specific job or task, these assessments help prevent work-related injuries and illnesses, and facilitate the return-to-work process.

New technology could change the way PJDAs are carried out, making them far more accurate and reproducible — resulting in better outcomes for workers and employers alike.

Research supported by WorkSafeBC looked at the use of this technology in workers at their actual jobs to gain insight into the nature of their work and test the technology's effectiveness.

The traditional observation-based method

PJDAs get down to the nuts and bolts of a task: they capture information on factors like the frequency of activities such as lifting, lowering, pushing, pulling, bending, and twisting, as well as the muscular forces required to carry out that task. Details like these help with prevention efforts through job design and with sustainable return-to-work plans — it's much easier to find an appropriate post-injury job for a worker with physical limitations if the true job demands, options, and functional abilities are known.

Traditional observation-based PJDAs are compiled through a range of methods, from checklists and questionnaires to video and laboratory assessments of tasks. While helpful, these approaches have limitations: they can be time-consuming and costly, and when limited to performance in a lab setting, may not provide an accurate portrayal of a day-in-the-life.

Motion-capture measures biomechanical variables in a new way

A B.C. company called Biosyn Systems has developed a motion-capture system for measuring occupational biomechanical variables. Portable and wireless, this state-of-the-art technology is already used in sports analysis, collecting information on body position and forces in real time while high-performance athletes are in action. In the workplace, the system can measure job-site physical demands and work capacity objectively using biomechanical principles.

The data-collection system is known as Functional Assessment of Biomechanics, or FAB. It uses inertial and force-sensitive sensors that can be worn by workers performing their regular job duties without any impact on their movement or productivity.

"The motion-capture technology improves the evaluator's accuracy while removing subjectivity and observer error, and improving speed of data gathering and productivity," says Russell McNeil, CEO of Biosyn Systems. "With motion capture, we can gather real-world data in seconds with instant analysis."

Preliminary research shows real-world applications

With funding from Research Services, researcher Dr. Tyler Amell undertook a proof-of-concept study to better understand the real-world applications of this wearable technology, with the participation of Vancouver's Fairmont Waterfront Hotel. Ten room attendants wore the motion-capture sensors during the regular performance of their duties. The system captured movement and force requirements associated with the job and transferred the information wirelessly to a notebook computer for data collection and analysis. Meanwhile, experienced occupational therapists also delivered traditional PJDAs via direct observation, and the two approaches were compared, both for their clinical relevance and cost.

Dr. Amell's study found that the technology provided a vast amount of valuable physical demand data not usually gathered in conventional PJDAs. The information from the sensors was more detailed and included applied biomechanical forces, accurate percentages of time spent in various body positions, and precise ranges of motion.

"With observations, there's not a high degree of reproducibility," Amell says. "There will be variability among different people observing the same work at the same time, and there's even variability within individual observers. The technology increases the validity of the measures. We found that we could get good, reliable measures at a fraction of the cost, helping with both risk reduction and the return-to-work component."

The sensors captured over 44 hours of data from all ten workers as they performed work in 128 hotel rooms. The occupational therapists conducting traditional PJDAs analyzed data from four workers over four hours in four hotel rooms. Having occupational therapists on site to do an equivalent amount of data collection would be considered cost-prohibitive in most cases.

This kind of data, Amell says, has the ability to be applied on a large scale. It can capture information on a large number of problematic job tasks impacting the affected workers across sectors, from health care to construction.

"This is on the forefront of innovation in terms of injury prevention and reducing the risk of a worker getting hurt or sick on the job and reintegrating injured workers back into the workplace," Amell says. "The technology will allow for improved, objective injury prevention and more successful return-to-work efforts through improved job matching and identification of alternative duties, improving return to work timelines."

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>
> —**Dr. Tyler Amell**, lead researcher for the Proof of Concept for an Innovative Approach to Physical Job Demands Analysis

Putting the technology into practice

As regional manager of Return-to-Work Services for Interior North at WorkSafeBC, Margaret Smithson has done numerous PJDAs over the years. She says she can see the potential for the use of motion-capture sensors in diverse workplaces with the data being used by insurers, employers, disability managers, and occupational health and safety professionals, especially when combined with traditional approaches.

"If we've got someone who comes to us with a strained back, then we want to know what the physical demands on their back are in their regular job and what the opportunities are for modifying their job so we can

get someone back to work successfully," Smithson says. "The sensors allow the analysis to be conducted over a longer period of a time compared to conventional PJDAs.

"The technology is very intriguing," she adds. "I don't see it being used as a standalone, but used in combination with other techniques, it could help guide stay at work, recovery, and return-to-work activities."

The role of research in workplace safety

Lori Guiton, WorkSafeBC director of Research Services, says the project is a great example of the way research can help support healthy and safe workplaces.

"Research helps us to develop new approaches to preventing occupational injuries, which protects workers in the longer term," Guiton says. "Using new technology, this sort of collaboration between a researcher and a workplace can go a long way to making meaningful changes in occupational health and safety."

In support of the development and use of the best scientific evidence on occupational health and safety issues, WorkSafeBC is calling on innovative thinkers to apply for grants through the 2016 Innovation at Work competition. It's open to applicants whose research can lead to the development of new knowledge or practical problem-solving in the workplace. For the first time, applicants have the opportunity to get feedback on their projects before submitting a complete proposal. Applicants can request feedback by indicating this on their letter of intent.

Proposals are also being accepted for WorkSafeBC's Specific Priorities Research Grants until September 16. The current competition aims to develop a better understanding of issues relating to static electricity in a combustible dust environment.

Full application details are available at worksafebc.com.