National Safety Council

Case Study

MSD Solutions Lab
an nsc program

Implementation of Wearable Sensors for Risk Assessments and Real Time Feedback

What's the Risk?

Frontline workers at Pacific Gas & Electric Company (PG&E) are commonly exposed to musculoskeletal disorder (MSD) risk factors including awkward postures, forceful exertions, vibration, contact stress, repetitive motions and hot/cold temperature extremes. Additionally, work at PG&E occurs in variable environments and conditions, limiting the types of engineering controls that can be utilized to reduce risk. PG&E was interested in obtaining an easy-to-use, ergonomic risk screening tool that would allow them to conduct timely assessments in different environments and would immediately involve frontline workers in discussions on short- and long-term solutions to reduce the risk of MSD injuries.

History of Risk Assessment Efforts

Over the years, PG&E has used several ergonomic risk assessment methods including surface electromyography (EMG), traditional assessments using pen and paper (e.g., NIOSH lifting equation, Revised Strain Index), and computer vision software. Surface EMG was invasive (electrode pads had to be applied directly on clean and shaven skin) and cumbersome to use (requiring more than one assessor to set up and conduct the assessment) and required specific knowledge and skills to use it correctly, limiting who could use the technology effectively and the capacity to conduct a large volume of risk assessments. Similarly, while traditional ergonomic assessment methods are still used in some cases at PG&E, they require training and education for reliability and accurate interpretation.

While computer vision technology required less training, it introduced its own challenges. For accurate analysis, videos had to be recorded from the dominant working side of the body, perpendicular to the task, and at the same working level, conditions that are often difficult to achieve in field environments where employees may work in confined spaces below ground or at elevated heights. Additionally, the team wanted to collect large amounts of task data and support real-time coaching on body mechanics. However, the computer vision system required short, narrowly focused videos that captured specific risks, rather than continuous footage of various tasks. While this output could be a helpful tool to educate workers, the need to upload and process each video made it difficult to deliver immediate assessment results and feedback to workers. In many cases, the worker who was assessed did not ever see the results, missing the opportunity to understand MSD risk factors and be involved in the solution development process.

To overcome these limitations, PG&E began exploring wearable technology to gather high volumes of task data for the industrial ergonomics team and the injury prevention specialists (termed industrial athlete specialists at PG&E) to use in real time to discuss solutions with workers. **This case study describes PG&E's**

experience working with Longitude6 to implement Etiscope wearable sensors for risk assessments, including how the technology was implemented, impacts and lessons learned.

Technology Selection Process

PG&E was looking for a safety technology that could be used by non-ergonomics professionals (e.g., injury prevention specialists) to assess ergonomics risk for frontline and other industrial workers. PG&E was specifically searching for a technology vendor that could:

- Provide instant feedback to share with workers, allowing for more of a “show me” vs. “tell me” approach, in which workers can see for themselves their own risk assessment data and how body mechanics influence their ergonomic risk, as opposed to just being told about their risk.
- Assess work in confined spaces and elevated work, without compromising assessment quality.
- Assess ergonomic risk from a safe distance.
- Assist in the development of an API connection to import key ergonomic risk data into a centralized ergonomic risk management database to develop meaningful metrics and reporting.

After reviewing several options, the PG&E team determined that the Etiscope product met the above requirements, was easy to use and learn, and did not require ergonomics expertise to utilize.

Implementation of Wearable Sensor Technology

Once Etiscope’s technology was selected, an on-site demonstration was conducted by Longitude6 with key organizational partners to gather input, address questions and build early buy-in. Engagement with the union to communicate the benefits of the technology and get sign-off was also a critical step of implementation. To secure union support, the ergonomics team reviewed the technology and its intended use with union representatives and addressed their concerns, which included assuring them that the technology complied with privacy and data security policies and worker protections.

After union sign-off was obtained, a train-the-trainer model was utilized to prepare for deployment of the wearable sensors. User training sessions were first held by Longitude6 for the core industrial ergonomics team. Then, the core team trained injury prevention specialists over three training sessions, in small groups to ensure everyone had a chance to practice and ask questions. The training included hands-on practice with the sensors and app interface, and covered how to set up an assessment, how to set up the wearables, use cases in which the wearables are appropriate, and how to interpret data. Following training, users were given time to apply the technology in demo scenarios, allowing for additional practice and feedback. Weekly check-in meetings were held to answer questions, address concerns and support continuous learning. The training period lasted about six months, during which PG&E worked in close partnership with Longitude6 to address questions and troubleshoot issues.

After the injury prevention specialists and industrial ergonomics team members were comfortable using the technology to conduct risk assessments, company-wide rollout involved live demonstrations at safety huddles, safety summits, all-hands meetings and similar events to show the frontline workforce how the wearable sensors are able to assess body mechanics and ergonomic risk. PG&E also worked closely with safety partners and safety grassroots teams to promote the technology and encourage participation.

Getting buy-in from frontline workers and establishing trust were a challenge due to some concerns over what data would be collected and used. To ensure transparency and trust throughout the process, a participant consent form was created, clearly outlining that individual data would not be shared with anyone other than the

worker who is the subject of the risk assessment and the industrial ergonomics team. Any data sharing is done so anonymously, and the data are aggregated unless workers consent for their data to be shared. Additionally, videos associated with the data allow for face blurring to help protect privacy for those who are concerned.

The wearable sensors were officially rolled out in October 2024, and to date, they have been used to conduct assessments for electric line workers, gas meter techs, fleet garage mechanics, material handlers, and gas and electric construction crew members. Participation in risk assessments is voluntary, but interest has been high, and feedback has been generally positive. Injury prevention specialists are able to demo the technology for the worker and share what to expect before performing an assessment. After the assessment, the Etiscope wearables app produces a report on the spot that can be airdropped to the worker's phone, allowing them to see and refer back to their data.

Currently, PG&E uses a combination of wearable sensor data and traditional assessment methods when necessary (e.g., to assess body parts that cannot be assessed with wearables, like distal upper extremities) for ergonomics risk analysis and assessments. The industrial ergonomics team remotely reviews new assessments weekly on the Etiscope dashboard, identifying issues in need of further analysis, work tasks that may require further evaluation or intervention, or data discrepancies. When such cases are identified, assessors trained to use traditional assessment methods may follow up.

Impacts

The introduction of Etiscope wearable sensors has significantly expanded PG&E's ergonomic assessment capabilities across its service territory. Previously, ergonomic evaluations were primarily conducted by just two assessors who traveled throughout the territory. With the wearable technology in place, 26 trained assessors are actively conducting evaluations in the field, covering the entire service territory and improving both the reach and consistency of assessments.

Several more specific impacts of the use of wearable sensors were also realized:

- Utilization of the sensors has increased PG&E's capacity to assess the full range of tasks performed within a job role, as opposed to only evaluating individual work tasks. This provides a more comprehensive understanding of ergonomic risk based on the job and has led to the discovery and development of targeted, viable engineering and administrative controls to reduce risk. For example:
    - Wearables have been used to conduct several industrial ergonomics task assessments. The assessment data have been used to support tool or equipment changes and procedural changes and administrative controls, such as worker rotation, that reduce ergonomic risk.
- The wearable sensors allow PG&E to collect risk assessment data and provide feedback to the worker in real time, fostering timely and meaningful conversations and collaborative problem solving between injury prevention specialists and workers in various situations:
    - Injury prevention specialists can provide guidance for workers to adjust their body mechanics or tool use to reduce ergonomic risk, then compare risk levels before and after the adjustment on the spot.
    - Injury prevention specialists can use the sensors for body mechanics coaching when a worker returns to work after an injury.

- Since implementing the sensors, there has been greater engagement among frontline workers in understanding and addressing ergonomic risks, including:

    - Increased awareness of the impact that proper body mechanics and the use of recommended tools have on injury prevention and overall wellness.
    - Positive experiences being shared by word of mouth among the workforce and an increase in requests to use the wearables for assessments and body mechanics coaching.
    - Expressed appreciation for the ability to view their risk levels and receive feedback immediately after an assessment.

PG&E has seen a downward trend in ergonomic-related injuries over the last several years. Given that it has been less than one year since the rollout of the Etiscope wearable sensors, the return on investment has yet to be determined, but early engagement and feedback from workers have been positive and task assessments have shown that even small changes can lead to a reduction in MSD risk. Additionally, PG&E is working with its ergonomics risk management software vendor to integrate data from the wearable sensors into its main database, with the goal of developing a predictive industrial ergonomics model by 2027.

Lessons Learned

PG&E learned many valuable lessons from introducing Etiscope wearable sensors in its work environments, which can be readily applied to other organizations planning similar technology deployments.

1. Users should be allowed time to practice with the technology in a low-pressure, test-mode environment.
    - This approach gave assessors the space to build confidence, refine their technique and receive feedback, ultimately leading to more consistent and accurate use of the wearables.

2. Wearable sensors should be used in conjunction with (not as a replacement for) traditional ergonomic assessment methods.
    - PG&E uses the wearable sensors as a screening tool, to be used in conjunction with traditional assessment methods when risky movements or behaviors are detected.
    - Assessment methods, whether they are wearable sensors or traditional, should only be used by those trained to use them.

3. Implementation of the wearable sensors required careful planning and user awareness.
    - Reliable data collection depends on proper sensor placement, secure attachment and sufficient recording duration.
    - Environmental factors such as extreme temperatures and the need for Wi-Fi to upload data to the database were also necessary considerations.
    - Some knowledge of ergonomics and body mechanics and movement is necessary to properly interpret the data produced by the technology in a meaningful way.

4. Gaining union support and building trust among workers are critical, particularly around data privacy and usage.
    - PG&E ensured that individual data would only be shared with the ergonomics team and the worker, unless written consent was provided. The team also worked to define what de-identified, aggregate data could be shared with leadership and safety teams to support broader safety initiatives.

5. Clear and consistent communication across the organization is essential.

- Introducing a new tool required resetting expectations around how ergonomic assessments were conducted and ensuring that all stakeholders understood the purpose, benefits and limitations of the technology.

6. Be aware of the technology's capabilities prior to deployment to ensure expected outcomes of the technology are realistic.
    - While not a dealbreaker for PG&E, the devices could not be used in energized or intrinsic environments and did not capture data for hand, wrist and lower body movements.

Pacific Gas and Electric Company, incorporated in California in 1905, is one of the largest utility companies in the United States. Based in Oakland, the company is part of PG&E Corporation.

There are approximately 28,000 employees who carry out Pacific Gas and Electric Company's primary business: the transmission and delivery of energy. The company provides natural gas and electric service to approximately 16 million people throughout a 70,000-square-mile service area in northern and central California.

Pacific Gas and Electric Company and other energy companies in the state are regulated by the California Public Utilities Commission. The CPUC was created by the state legislature in 1911.

ETISCOPE

Find the Safest Way

Etiscope's mission is to identify the root cause of hazardous manual handling injuries using wearable sensors and machine learning algorithms on a simple-to-use app. It applies ergonomic principals to deliver immediate reports so that safety professionals can expedite cost-effective risk controls before injuries arise. Users can analyze tasks and compare them across different sites, worker experiences and more. Winner of the Technology Platform of the Year 2023 amongst other industry awards, Etiscope is helping thousands of workers from some of the world's biggest brands to look after their workers.

Longitude

Longitude6 provides access to the world's best technologies that analyze workplace activities and people to reduce workplace musculoskeletal injuries and costs.

By providing unique and innovative ways for companies to acquire access to technologies and supporting them in the use of the technology to achieve company objectives, Longitude6 assists clients in optimizing their use of technologies.

The Longitude6 team are experts in aggregating technology outputs to ensure a comprehensive approach to workplace solutions is achieved.

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