

Industry White Paper: The Safety Potential of Workplace Technology

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Abstract

From the factory floor to construction sites and offices, workers rely on their employers to help them avoid injuries and remain productive. Combined risk factors from age, physiology, task technique, workstation design, and other sources present serious hazards for workers in all settings, and musculoskeletal disorders continue to prevail as the leading cause of workplace injuries. In recent years, safety innovators have developed a range of technologies designed to alleviate risk and provide holistic solutions for the dangers that can keep employees out of work, costing their employers hundreds of thousands of dollars in workers compensation claims, absenteeism, and various other indirect costs that can seriously endanger an enterprise's bottom line. From desktop ergonomics to enhanced software training, wearable devices, and even exoskeletons, technology will shape the future of workplace safety. DORN Companies offers an array of safety tools that utilize the latest technology to capture workforce data, provide manual assistance for workers, and eliminate hazards in the work environment. In this white paper, we explore some of the most common and costly injury types affecting workers across industries and delve into some of the powerful technologies currently available to promote workplace safety.



Introduction

It's difficult to keep track of all the different ways that technology affects our lives, from waking us up in the morning to tracking health data, keeping us entertained, and helping us focus on our most important responsibilities. With our reliance on smartphones, laptops, and tablets, technological progress has become a given in our normal day-to-day. People are becoming comfortable with technology as a major part of life, and employers are beginning to realize the extraordinary benefits that staying on the cutting edge brings to their productivity and bottom line.

From wearable devices like health monitors and hazard alert systems to artificial intelligence-fueled predictive safety, technology can serve as a cornerstone of workplace safety programs across industries. Managers in today's economy are better equipped than ever to understand the specific needs of their workers and how the work environment can contribute to soft-tissue musculoskeletal injuries, chronic pain, and fatigue, all of which introduce significant costs in both human capital and financial resources. So while AI and advanced wearable equipment that improves human performance may feel like a radical step into science fiction, the truth is these technologies hold amazing potential to keep workers safe and boost productivity while alleviating the costs that come from injuries, chronic pain, and fatigue.

This white paper will explore vulnerable areas of increased risk within common work environments such as manufacturing, shipping, and the office, illustrating how a range of new technologies are transforming today's workplace. In delving into these tactics, we will size up the American pain and injury problem and identify the costs associated with musculoskeletal disorders, overexertion injuries, chronic pain, and the resulting absenteeism and lost productivity that burden employers financially. Finally, we will highlight successful safety programs in several key industries that have engaged new technology to boost productivity and most importantly, protect the vital people that power enterprises everywhere.

Pain Points

The Costs of MSDs and Pain

It's a well-established fact that musculoskeletal disorders (MSDs) have plagued employers for decades, and remain the most common type of injury suffered by workers today. These afflictions vary in severity and origin—many are caused by poor workstation ergonomics or unsafe elements in the work environment, while others result from overexertion and poor technique on the part of the worker. In the short term, MSDs cause employees to miss days while recovering from an incident, usually triggering workers' compensation costs for the employer. The long-term effects can be even more costly, as a large portion of MSD sufferers experience chronic pain following their injury.

Consider these facts about workplace injuries in the United States:

- MSDs account for at least 33% of all workplace injury cases
- Related injuries alone cost employers \$60 billion annually
- Employers spend \$635 billion each year on costs from chronic pain
- 100 million workers nationwide are affected by chronic pain
- 63% of chronic pain sufferers will see a doctor
- Chronic pain is linked to depression in 77% of sufferers
- Pain causes a total of 36 million lost work days per year

Too often, workers who suffer common injuries such as musculoskeletal disorders enter the workers' compensation pipeline after the incident, resulting in claims costs and treatment expenses for the employer and lost productivity that further disrupts the bottom line. The costs to employers can be staggering and continue to rise nationwide, increasing by nearly 3% between 2017 and 2018 alone, while costs from MSDs as a percentage of GDP nearly doubled between 2011-2015. The financial costs are only getting worse, and the human consequences have captured the attention of the national media. Virtually doubling in cost over the course of five years, MSDs continue to impact the workforce and place a heavy burden on the US GDP.



*Source: Medical Expenditures Panel Survey (MEPS), Agency for Healthcare Research and Quality U.S. Department of Health and Human Services, 1996-2014.

Evaluating the Opioid Problem

Research has demonstrated that musculoskeletal disorders and the associated chronic pain are commonly linked to the use of opioid painkillers. Painkillers of all types are commonly prescribed by doctors to workers who have filed a workers' compensation claim. However, the rate of opioid prescriptions is disproportionately high compared to other treatments—of claims that included a prescription in 2016, 44% included an opioid painkiller. Up to 80% of people who misuse heroin (an illegal recreational opioid) first misused prescription opioid painkillers.

When you compare these figures with the fact that the Centers for Disease Control estimated a total of around 70,000 opioid overdose deaths in 2017 alone, it's easy to see why a glut of injury claims originating in the workplace contributes to the ongoing opioid crisis in the United States. Once prescription painkillers are involved, workers face an uphill battle returning to their jobs at maximum effectiveness, and the increased risk of opioid misuse implies a host of other risks for the employee and their employer.



Protecting a Multigenerational Workforce

Complicating the matter further is the changing nature of the workforce. The American working population is steadily growing older, as shifts in cultural norms have pushed more and more longtenured workers to remain at their jobs later in life or pursue employment elsewhere after retiring. The cost of living has risen across the country, and more and more older individuals are finding it necessary to remain at work later into life, not to mention the national retirement savings deficit, which experts indicate will reach up to \$400 trillion by 2050 if trends continue. All signs point toward a more significant share of the workforce being aged above 55 in the coming years, a trend that implies increased pressure on employers to maintain effective safety programs that respond to the needs of workers from every generation.

Indeed, workers aged 55 to 65 now represent a larger portion of the workforce than ever before, their presence growing by more than 50 percent in the last five years. Some 40% of individuals aged 55 or older are currently participating in the workforce, a significant change from about 30% in 1996. Lower birthrates have helped push this change as well, with fewer young workers entering the workplace than ever.

A workforce composed of a greater number of older individuals poses risks to employers across industries. Long-tenured employees face MSD-related injuries at a higher rate and severity than their younger counterparts, but this new trend isn't going away any



Labor force participation rates by age group in 1992, 2002, 2012, and projected 2022

time soon—10,000 members of the Baby Boomer generation turn 65 every day, and many continue to contribute to workplaces that have not made effective enough changes to ensure their safety. Research indicates that only about a third (35%) of companies nationwide have analyzed how having a larger share of older workers will affect their operations. Since some 36% of Social Security disability claims now originate with a musculoskeletal injury, it's quickly becoming essential for organizations to look to new avenues to identify the needs of their workers, including older employees whose unique combination of experience and knowledge make them an invaluable part of the workforce, even with the increased risks implied by greater age.

Just as concerning as the aging of the workforce, however, is the increasing share of millennials who bring a handful of risk factors for MSDs to the workplace. Millennials, raised on different principles than older generations, often exhibit poor work habits, specifically when it comes to posture. Technology and mobile devices have virtually always been a part of life for millennials, and as a result many suffer from poor posture related to bending over to look at a smartphone or slouching when seated in front of a computer. In fact, many workers from that generation enter the workforce with pre-MSD conditions that most employees don't face until they have worked for 10, sometimes 20 years. Likewise, research has demonstrated that phone-related MSD conditions are prevalent among workers in the millennial age group—smartphone users are more likely to develop numbness and pain in the hands and fingers, and strain from bending the neck to look at a phone has been shown to cause neck injuries. With these considerations in mind, it's becoming increasingly essential to tailor workplace safety programs to the needs of these age groups, and technology will represent a critical tool as both millennials and baby boomers experience more work-related injuries.

and over

Source: U.S. Bureau of Labor Statistics.

The Potential of Safety Technology

A Force for Growth

This burgeoning discussion of technology in the workplace comes on the heels of great turmoil within the American marketplace. Despite strong performance in the stock markets, companies continue to lose money on preventable costs from injuries and health care. With the rise in safety technology, however, the national economy stands to experience rapid growth as more and more organizations adopt technological solutions to their worker safety problems.

Recent developments promise great potential in several technological areas to both improve worker safety and alleviate the economic burdens keeping companies from achieving their goals. Spurred by a huge boost in data collection and advances in com-



puting power that bring cutting-edge analytics and services to enterprises at a relatively low cost, technology is progressing, providing organizations with more tools than ever to keep workers safe and enhance profitability.

Perhaps the most significant of these technologies is the broad field of artificial intelligence, which has seen record growth in the last several years as its capabilities and business applications have become better understood by investors. Accenture suggests that investment in artificial intelligence (AI) has the potential to double economic growth rates, spurred by record investment from venture capital of over \$9.3 billion in 2018, almost 10% of the total amount invested through venture capital that year. Likewise, Accenture predicts a boost to overall global economic value of up to \$4.7 trillion by 2035 due to investment and implementation of AI technologies, a factor that should inspire confidence in managers looking for creative ways to alleviate costs. Even more significant to the equation is productivity, which also benefits from AI integration—Accenture's data predicts a 35% increase in worker productivity resulting from AI technologies being applied in the workplace.

Other technologies have seen major growth in both capability and integration as well. Exoskeleton technology, which augments human abilities and supplies workers with extra strength to accomplish difficult tasks, is being explored by companies across the nation, especially in construction and manufacturing environments. Wearable technology, sometimes itself powered by artificial intelligence, has also become popular among managers for its ability to collect real-time data on the health and behavior of workers. Predictive tools that measure and predict factors such as fatigue and high-risk times for injuries have made a significant impact for many employers, while desktop ergonomics platforms put the solution in the employee's hands. All told, these technologies hold tremendous promise for employers, and their successful implementation around the nation is already inspiring change at workplaces of all types.



Exploring New Technology Solutions for Safety

Artificial Intelligence and Predictive Safety Technology

Artificial intelligence is transforming how companies do business in the 21st century. A scalable, adaptable solution that can be applied across an array of tools to improve worker safety, artificial intelligence could double economic growth in the United States by 2035, paired with an expected \$4.7 trillion boost across the American marketplace.

While the full potential of AI is still being explored, employers have already found several applications aimed at reducing injuries and optimizing the workers' compensation system. Large tech companies have developed services that identify hazards in the workplace using cameras and software augmented by AI capabilities. In this case, the service might alert managers to dangerously placed equipment, spills, electrical hazards, and faulty tools, all of which are leading drivers of soft-tissue injury at work. Another fruitful area for AI integration has been data collection and analysis. Companies have developed predictive tools that synthesize a wealth of unstructured data (that is, data that can't be easily sorted into neat spreadsheet columns), utilizing the results to understand fatigue risks and adjust the work environment to keep employees safe.

Predictive Risk Management Tools

While artificial intelligence continues to develop, several other tools are available that use data analysis to predict safety conditions and risks in the workplace or for specific workers. These solutions, referred to in this paper as predictive tools, have been utilized in some of the world's largest labor settings, from heavy manufacturing to mining, most commonly in order to curb the risks associated with fatigue. Where many data-based safety strategies rely on point-of-failure alerts to notify management of a worker whose abilities are impaired, advanced data tracking systems in use around the world now collect real-time information as workers go about their jobs, allowing administrators to observe the workforce with the benefit of trend analysis. These systems largely rely on the Two-Process model of sleep regulation, initially developed by Swiss fatigue scientist Alexander Borbély in the 1980s, which splits sleep cycles into two categories:



- Process S: Also known as Sleep-Wake Homeostasis, this refers to the process by which sleep chemicals are introduced to the human brain. It's the chemical side of the human sleep cycle, and is the force behind the feeling of tiredness that first characterizes fatigue.
- Process C: Commonly known as the circadian process or circadian rhythm, this is the human body's natural way of interpreting light-dark cycles and setting the brain's patterns for sleep. It is responsible for the timing of sleep cycles on a daily basis, and is the primary reason why humans can never fully adjust to a non-traditional work schedule—specifically, shift work in which employees sleep during the day and work at night. It is possible for some workers to adjust to a non-traditional circadian pattern, but that adjustment is temporary, and fatigue risks will inevitably occur.

Since this approach to understanding sleep patterns does not evaluate fatigue during waking hours, a third process was later developed and introduced to models that predict fatigue in workers:

 Process W: Referred to as waking, or sleep inertia, this process defines the temporary fatigue that occurs immediately after an individual wakes from sleep, which leads to a short-term reduction in performance ability.

The proactive approach employed in these advanced data-tracking systems begins from the moment a worker is hired, when static data on the individual such as age, weight, and prior work history is synthesized with the following information about the job itself:

- Job task stress levels
- Strength requirements
- Duration of tasks or strenuous motions
- Frequency of strenuous motion

These two data sets are then run through a bio-mathematical algorithm that considers the entirety of the worker's experience, from their sleep patterns at home to their exertion levels on the job. Static data collection can be taken directly from the work site's databases, using clock-in and clock-out timing and pre-hire testing to complement the necessary data for the bio-mathematical model.

The modeling that powers these predictive software systems evaluates a set of leading performance indicators, which are variable based on the nature of the work being done at each site. Sleep data can be collected either by surveying employees (which introduces subjectivity and may reduce overall accuracy) or through the use of a wearable actigraphy device that actively measures the worker's rest status and deep sleep patterns.

Using software, these systems pass an individual worker's data through the bio-mathematical model, which produces a fatigue risk assessment that updates in real-time.

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It's important to stress that fatigue, or alertness, is so much more than what the traditional understanding of fatigue suggests, which is that fatigue is exclusively sleep-related. You could be distracted, you could be emotionally distressed about something outside of work, you might have financial hardships or a sick parent to care for. Maybe you're experiencing side effects from a new medication. It's essential that fatigue management systems are source-agnostic in how they detect and report impairment.

Lori Guasta, Ph.D. (Vice President, Consulting Services & Research at Predictive Safety SRP, Inc.)

Connection to Bowles-Langley Technology

The final component of an effective predictive strategy for fatigue, one that will reduce incidents such as musculoskeletal injuries caused by impairment during work hours, typically takes the form of a testing process that identifies each worker's fitness for duty at the start of and throughout a shift. Bowles-Langley Technology, a system of testing that has users identify patterns or anomalies in a simple graphical interface, completes the fatigue assessment loop by providing an immediate picture of the worker's impairment levels. These tests usually require less than one minute to take and can be re-taken throughout a shift if concerns about fatigue levels exist.

In the case of one major manufacturer in the West, predictive fatigue monitoring was more than a tool for keeping workers safe—it also reduced costs and spurred productivity across the board.



Data-Based Fatigue Management Technology Supports Metal Plant Success

V-Forge, a metal processing plant and parts manufacturer located in Lakewood, Colorado, adopted a comprehensive fatigue management system in 2016 in order to tackle impairment and the resulting costs from injuries, absenteeism, and lost productivity. After experiencing incidents on a nearly weekly basis for years, V-Forge was saddled with significant costs not just from workers' compensation claims, which were staggering, but also from drug testing requirements, another strategy for detecting impairment among workers. In addition, the company was experiencing another major problem: high turnover of workers whose trust in management to keep them safe had eroded.

To address these issues, V-Forge implemented a data-based impairment detection system that utilized graphical interface testing and key indicator tracking to create a nuanced profile of fatigue impairment among its workers. After just two years using the technology-based solution, V-Forge reported a handful of tangible benefits, including:

- Reduced workers' compensation costs by 70%
- Increased worker retention by 35%
- Cut drug testing costs by 90%
- Overall productivity increased by 11%

And the benefits for V-Forge go beyond the numbers. According to survey and testimonial information, workers reported feeling a greater level of trust in the organization's management after introducing the system—instead of using drug testing to "catch" workers doing something wrong, dangerous, or illegal, V-Forge used technology to support worker wellness and ensure that each individual was fit for duty before the start of a shift. The benefits of technological integration for worker safety are not limited to cost benefits, though these are substantial—these solutions also have the power to promote a culture of trust and wellness at an enterprise, supporting healthy habits and attracting talent to remain with the organization over the long term.

Wearable Tech Evaluates Worker Exertion

Today, wearable devices are among the most accessible Al-equipped technologies aimed at promoting worker safety. Wearables have proven especially useful for companies with warehouses or large manufacturing facilities, where managers may not be able to observe the entire job site unaided. Devices such as wrist monitors provide real time data collection and instant reports for managers, alerting the responsible parties to hazards or incidents that require intervention. Many companies have gone even further than wrist devices, working with service providers to develop work suits equipped with sensors that measure the employee's exertion levels, fatigue signs, and overall behavior patterns while working on a specific task.



With the data provided by wearable devices, companies can implement changes in the work environment, from individual tools and workstations to task design.

Surface Electromyography

In an economic era in which managers are typically responsible for monitoring a large staff of workers at a worksite, it has become essential that organizations have tools that offer observation and data collection without the need for close in-person inspection. To that end, employers have begun using surface electromyography (sEMG), a medical diagnostic tool that became prevalent in hospital and therapeutic settings during the early 1980s.

A non-invasive procedure that utilizes electrode pads placed on the skin over important muscle groups, sEMG measures the electrical potential of muscles and transforms that information into exertion data. Surface electromyography is a versatile technology that measures electrical output of muscles both at rest (static) and in motion (dynamic), recording electrical action potential, which informs the level of exertion being performed by the individual. In clinical settings, sEMG is used to identify muscular disorders and injuries, as well as to gauge the effectiveness of rehabilitation techniques following an injury.

In the workplace, surface electromyography can easily be adapted to serve as an evaluative tool for managers who need to maintain an accurate picture of the strengths and weaknesses of a workforce. Ergonomists have devised several variants of the technology to make it usable while workers go about their tasks. The simple electrode pattern design can easily be integrated into work uniforms, with contact points embedded in clothing that continuously monitor the worker's exertion levels throughout a shift.

On the management end, sEMG devices deliver comprehensive performance data that can be tailored to the specific needs of any job function. The profiles generated from sEMG data can be used in both the short- and long-term. Managers are notified of immediate drops in performance that may indicate overexertion that could cause an injury; alternately, sEMG also detects signs of muscle fatigue that may warrant an intervention, such as manual therapy, biomechanics training, and trained self-care techniques, before impairment leads to a more serious incident. Over the course of months and years, sEMG data can be used to generate holistic profiles of worker performance across an organization, defining trends that can predict fatigue. Surface electromyography is a simplified way to test for ergonomic hazards, because you don't need to measure all the inputs you used to—push/pull forces, body angles, things of that nature. Those are all proxies for what's actually happening physiologically. Electromyography measures the physiological response directly, making it much more objective than anything that's been available in the past.

Dr. Antony Harris (Co-Founder & CEO at Harris Fitness, LLC, Associate Medical Director, WorkCare)

At the granular level, wearable technology like sEMG can also be used to identify hazardous tasks or equipment at a work site. Organizations looking to implement new tooling or workstation elements may use sEMG monitoring to help in the design of new equipment, clarifying the effectiveness of equipment and identifying whether the intervention has successfully improved performance and decreased the exertion levels required of the worker. One company found that its workers were at increased risk of upper extremity injuries, and decided to utilize surface electromyography in order to identify potential safety improvements.

Case Study: Surface Electromyography in Garage Installation

Among the most physically draining and hazardous motions required of workers is reaching overhead to lift or hold an object in place or perform a task on an elevated surface. Recently, a garage door installation company noticed a prevalence of shoulder injuries in its front-line employees, who were required to work with their arms over the head for hours each day.

To address the problem, the company wished to integrate a new set of operational best practices that would redefine how workers performed the most strenuous tasks in their jobs. In this case, workers were asked to wear sEMG-equipped clothing for short periods of work in an effort to identify the risk factors associated with the job. Specific tasks were analyzed for injury hazards, using a set of key indicators focused on exertion, duration, and frequency of certain motions. The company ultimately used the data to inform a new set of educational initiatives and interventions for workers that aimed to reduce unnecessary exertion.

Desktop Ergonomics

Workplace injuries aren't limited to factories and construction sites. A significant portion of musculoskeletal disorders have far more innocuous origins, often afflicting workers whose jobs require long periods in front of a computer screen. Sitting is a strain on the human body, diminishing blood flow and causing back pain, muscle aches, and other symptoms that often lead to workers' comp claims and lost productivity. Desktop ergonomics has emerged as a useful tactic against these kinds of injuries, with companies deploying robust software solutions that target the ergonomic risk factors for office employees. Posture, eye-to-monitor placement, and foot positioning all contribute to desktop health, so organizations have turned to software that allows workers to self-assess their comfort and wellness, learn about the safety hazards of being seated for prolonged periods, and self-correct damaging behaviors, reducing the demand on the organization's ergonomist. These programs also remind workers to stand, stretch, and move around at regular intervals while collecting data on worker health to inform stronger ergonomic standards.

Sitting: The New Cancer

Though ergonomic leaders have often focused heavily on manufacturing and industrial settings due to the number of high-profile injuries, and even fatalities, the rapid shift of the global workforce toward computer-oriented tasks even in the manufacturing setting



has driven a spike in injuries and claims from workers who are seated at a desk for the bulk of their day. As a result, research has increasingly demonstrated that one of the most prevalent health risks faced by workers is the one that seems the most innocuous: sitting.

The rise in computer-based work has increased the time workers generally remain seated throughout the day. Research published in 2016 by Lancet breaks down the global costs of a sedentary lifestyle, much of which can be attributed to being seated at work. Lack of physical activity cost the global economy nearly \$68 billion in 2013, and has been shown to increase the likelihood of a range of serious medical conditions, including Type 2 diabetes, coronary heart disease, stroke, and several types of cancer. Sitting inhibits blood flow and hampers digestion, causing long-term health defects that are damaging for both the individual and the employers responsible for workers' compensation claims. In fact, research has demonstrated severe consequences of the sedentary lifestyle that seems to be encouraged by long-term computer work, including:

- Nearly 70,000 premature deaths per year in the United Kingdom alone
- Lack of physical activity puts 1.4 billion people worldwide at risk for serious disease
- Back injuries, a common result of prolonged sitting, cost between \$40,000 and \$80,000 per claim, according to The Ohio State University Spine Research Institute

DORN found in one client organization that 47% of all lower back issues at the plant were driven from the scheduling department, with afflictions caused by poor body positioning and outdated office equipment.

Combine this data with the fact that workers are rarely encouraged to take breaks and move around only about 1 in 5 workers reports taking a lunch break away from their desk—and it's plain to see the risk being foisted upon workers and their employers due to the simple fact that most work is done on computers. Indeed, a standing desk installation usually costs the employer just \$500 per unit—contrasted with the cost of workers' compensation claims and the indirect costs associated with musculoskeletal injuries, which can surpass 250 times the direct costs, the return on investment is evident.

Common Office Environment Injuries

Sitting is a major driver of serious diseases, but it's also important to quantify the effects of other common afflictions associated with desk work. Musculoskeletal disorders generally account for some 33% of all workers' compensation costs, totaling to about 600,000 injuries per year. Moreover, MSDs require almost 40% more time away from work for recovery and treatment.

More specifically, repetitive motion or repetitive strain injuries (RSIs) are a major driver of productivity losses, absenteeism, and claims among desktop focused organizations. These afflictions result from awkward, strenuous, or overly forceful use of the limbs and extremities, and lead to damage in muscles, tendons, and even nerves. Common among office workers, laboratory staff, and other non-industrial settings, RSIs are generally characterized by pain or numbness in the extremities, especially in the hands and fingers. They can lead to more serious symptoms like the inability to grab or hold objects, decreased strength in hand muscles, and pain in the back, neck, and upper extremities. Tendonitis and carpal tunnel syndrome are the most common afflictions among office workers.

The costs of RSIs can be staggering. In the United States, employers spend some \$20 billion on claims costs alone for RSIs, and another \$100 billion on indirect costs like absenteeism, presenteeism, and employee turnover. Indeed, the average cost of a single repetitive strain injury is about \$40,000, plus the losses from missed work days and decreased employee effectiveness.

To alleviate the human and financial burden of MSDs, RSIs, and other office-related injuries, employers are increasingly turning to software and training solutions that offer workers the knowledge and opportunity to correct harmful behaviors and work conditions.

Software and Training for Better Desktop Health

Thanks to advances in the digital realm, many providers have created software that aims to address the behavioral, physiological, and environmental causes of common injuries experienced by office workers. Desktop ergonomic training has been refined to the point that training can take mere minutes out of an employee's day, making it a perfect solution for organizations that demand high productivity from workers throughout the day.

One finance organization found that software train-

ing was effective in helping workers confront the leading risk factors for chronic pain and musculoskeletal injuries. As an investment and brokerage firm, the organization's workers were highly motivated to remain at their desktop workstations for the entire shift—using upwards of six computer monitors and working in a field in which every second holds enormous revenue potential, these employees needed a health intervention from their employer but couldn't spare the time away from the trading floor for training.

To address the problem, the enterprise began integrating software training programs that could be accomplished in a matter of minutes at each workstation. The program isolated several areas of concern specifically tailored to the needs of the global finance world-namely, desks oriented too low, screens not optimally placed at the proper eye level, employees slouching and remaining seated for long periods of time. The organization found that 90% of the traders in the pilot program voluntarily finished the training regimen, leading the company to roll the program out to the larger workforce. Not only the did enterprise see the benefits in its bottom line through reductions in workplace injuries and claims, but employees reported their gratitude for the software training, stating that the intervention customized to their daily needs helped them take better care of themselves. Creating



solutions is vitally important for all organizations, but even the most carefully built strategies will fail without employee engagement. In this way, software training programs for desktop ergonomics are uniquely well-suited to help workers in the office environment self-assess and self-correct harmful behaviors before they become injuries and comp claims.

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Most wellness plans operate on the 80/20 principle: 20 percent of the employees will participate, 80 will not. But usually, group you want to engage most is that 80 percent. When we roll out our software interventions, we're experience an average of 65% participation off the bat. That level of participation provides a very accurate picture of what's going on in your employee population. The most at-risk individuals can't hide in that 80%—their problems can be exposed. We find that employees crave training, especially when you're customizing the program specifically to their needs.

Bill Pace (President, North America at Cardinus Risk Ltd)

Exoskeleton Technology

According to 2017 data from Liberty Mutual, overexertion accounted for almost a quarter of all workplace injuries, carrying a cost of nearly \$14 billion to employers in one year alone. Overexertion typically occurs when a worker attempts to push, pull, or lift something that is either too heavy or in a difficult position (i.e., above the head).

Recently, advances in exoskeleton technology have provided options for employees in jobs that require a high degree of physical exertion, typically in construction, manufacturing, and warehouse settings. New equipment augments the worker's own physical strength, making it easier to move, load, and carry heavy objects without the risk of a strain or sprain. And the benefits aren't limited to the short term—exoskeletons prevent gradual wear and tear on joints and tissue so that workers remain healthy throughout their careers.



Exoskeletons and Fatigue

Perhaps the greatest benefit of exoskeleton technology comes in its ability to prevent fatigue among workers performing strenuous manual labor for entire shifts. Especially important for workers whose jobs require long periods of reaching above the shoulder or overhead, exoskeletons can mitigate overexertion stress, supporting muscles and joints when the worker has to stretch past a certain angle. Fatigue is a widespread problem in workplaces worldwide; according to a 2017 study by the Journal of Environmental and Occupational Medicine, some 40% of the American workforce experiences occupational fatigue, stemming from a combined set of factors including poor or insufficient sleep, strenuous repeated motion, mental distraction, and environmental noise and temperature.

Exoskeletons carry a host of benefits for users whose work can cause acute fatigue and stress to the upper extremities. Using carefully calibrated springs and customizable configurations that allow for tailoring to each individual worker's needs, these exoskeletons support the natural movement of the employee without interfering with job tasks. Specifically, most manufacturing applications require the worker to extend their arms from a 50-degree angle all the way up above the head to 100 or even 110 degrees.

Reducing Muscle Load and Back Strain

In addition to being used to combat fatigue, exoskeleton technology promises major improvements in some of the most common injury types experienced by workers in heavy manufacturing and construction. Back injuries are especially prevalent among these workers, no surprise considering data from the US Bureau of Labor Statistics reporting that back-related afflictions account for some 20% of all injuries in the workplace. Worse, about 80% of adults experience lower back pain at some point, in large part driven by work techniques and overexertion on the job. Indeed, back injuries are the most common cause of work-related disability, and are a major driver of absenteeism and skyrocketing costs-studies have shown that back injuries and pain cost employers more than \$100 billion each year.

Considering the significant costs of treating back injuries, combined with the indirect costs of lost work days and diminished function after return-to-work, it makes sense that employers in high-exertion industries would look to adopt assistive technology to support their workers. At construction sites, employers are increasingly turning to back support exosuits that redistribute weight to reduce back strain—some larger, full-body exoskeleton models even feature a counterweight that extends directly to the ground, completely removing the strain on the worker. Other partial-body suits function more as technique guides that ensure best practices are followed when workers are lifting or bending over, providing some structural support to reduce strain and cut repetitive stress injuries.

The breadth of tasks that can made safer with exoskeleton technology highlights one of its most appealing features for employers: customizability and modular design. While full-body suits are useful in limited situations, smaller suits with modular components allow flexibility for employers who need a single suit model to serve a variety of purposes across the organization. In these cases, a worker focusing on overhead tasks may receive an exoskeleton with a spring-based design that may only include one component, making it inexpensive to implement and easy to train for workers. Meanwhile, an employer with high-strain lifting, pushing, and pulling tasks may assign a more complex suit that supports wide range of motion and augments the worker's physical strength.

One company found that exoskeleton technology was invaluable both in keeping workers healthy on the job and in improving overall quality of life, even away from the shop floor.



Case Study: Exoskeletons in Airplane Manufacturing

Aviation manufacturing is a complex business, requiring long periods of hands-on manual labor through various stages of the building process. In the case of a major builder of aircraft based in Wichita, Kansas with facilities worldwide, the buffing, sanding, and painting portions of the manufacturing process presented unique challenges for workers, as the nature of the aircraft required employees to stand underneath the wings and fuselage and reach up above the head in order to perform their tasks. These strenuous motions, difficult to eliminate because of the shape of the aircraft, caused soreness and fatigue among workers, especially at the conclusion of an eight-hour shift. The problem was compounded in workers who had been employed by the aviation company for upwards of 20 years.

To combat the fatigue issue in their facilities, the aircraft builder decided to invest in exoskeleton technology. The devices they selected featured minimal contact points and a modular design that supported customization based on the needs of each worker. With relatively simple features that provided assistance to the upper arm and a rest for the neck and head, the exoskeletons selected by the company successfully mitigated fatigue for workers, who reported lower levels of chronic pain and increased quality of life outside the job floor.

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Since we began using exoskeletons, my employees tell me, now I can go home and pick up my kid, play catch, or whatever they want to do. Before, they just couldn't do that after finishing a whole day sanding aircraft.

Leading Business Jet Manufacturer



Conclusion: Making Room for Tech

If the safety benefits for workers aren't incentive enough for employers to adopt new technologies, then the financial rewards should seal the deal. Technology can maximize the effects of other safety and wellness tactics, including on-site therapies, departmental stretching routines, ergonomic assessments, and biomechanics training, combining to form a holistic system of health services that can cut workplace injuries by well over 50%. Change starts at the top, and investment in proactive safety programs inspires change among workers, fostering a culture of wellness that empowers workers to take charge of their health and safety, even while on the job. DORN Companies provides a range of technology solutions, many of which have been explored in this paper. Should you wish to learn more about how technology can improve safety for your workforce, please contact us for a free consultation.



If you would like to schedule a free consultation or demo about safety technology solutions, please feel free to contact us **info@dorncompanies.com** or call **(888) 870-8828.**



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DORN is a disruptive innovator and the country's leading wellness-based pain management and injury prevention company, committed to reducing costs of healthcare, workers' compensation and lost productivity. DORN focuses on treating and addressing employee's painful muscular conditions before they become costly claims through implementing a customized program of manual therapy, ergonomics, training, coaching and technology solutions.

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