

WAKE UP AND SAVE: REDUCING FATIGUE RISKS WITH TECHNOLOGY & CULTURE



+ TRUE STORY:

A heavy equipment owner with a large Cat® fleet, concerned about a growing problem with fatigue-related accidents, made a big investment in in-cab fatigue-detection technology. Shortly after the system was installed, fatigue events dropped by 44 percent.

That's the good news.

The bad news is another equipment owner deployed the same technology on a similarly sized fleet and cut fatigue events by 82 percent—nearly double the level of the first owner.

And to make matters worse, the first owner's system was tampered with 375 times during the initial phase, reducing its effectiveness and driving up costs. The second owner experienced just 13 tampering events. The difference? The first owner deployed the technology—period. The second reinforced deployment with cultural support and change management. This paper discusses the impact of fatigue on construction safety and efficiency and explains how technology and culture can be leveraged to reduce fatigue risks.





+ WHY FATIGUE MATTERS

There's no shortage of facts about the role fatigue plays in workplace safety and productivity.



ACCIDENTS

Fatigue is a contributing factor in one-third of all occupational accidents¹

93 percent of haul truck accidents are caused by human error—and 60 to 70 percent of human-error accidents can be attributed to fatigue²



INJURIES

Injury risks for night-shift workers are 31 percent higher than those of day-shift workers³

Risk of injury doubles by the 12th hour of a shift³

The injury incidence rate for US workers is more than 3 times higher for people who usually sleep less than 5 hours per day versus those who usually sleep 7 to 8 hours³



PRODUCTIVITY

Fatigue-related productivity losses cost US employers about \$2,000 per employee per year³

Fatigued employees are susceptible to costly health problems including depression, diabetes and cardiovascular disease⁴

Given the impact fatigue can have on any business, it pays to know more about why it's so prevalent and how it can be managed.

+ UNDERSTANDING FATIGUE

There are many misconceptions about fatigue, starting with the word itself. It is not a synonym for sleepiness. Sleepiness is the physiological desire to sleep. Fatigue is a physical, mental or social impairment that typically includes the desire to sleep—but is also characterized by reduced energy levels and increased effort to perform a task.⁴

Worker fatigue is often believed to occur as a result of poor personal choices: unhealthy food, too much alcohol, not enough exercise, too much screen time, erratic sleeping schedules. But in reality, many factors that cause worker fatigue have little to do with personal choice.

- **SHIFT WORK**, common in the construction industry, can interfere with the body's circadian rhythms, disrupting natural sleep-wake cycles. This is most likely to affect night-shift workers, as well as those who start early, put in long hours (12 or more at a time) or rotate between day and night shifts.
- **ECONOMIC STRESS** can create the need to hold multiple jobs. According to research, workers who have more than one job sleep 40 fewer minutes per day than those who have just one job.³
- **REPETITIVE TASKS**, whether manual and back-breaking or mental and mind-numbing, can lead to excessive fatigue.
- **ENVIRONMENTAL CONDITIONS**—excess heat, cold, moisture, dryness, noise, dust and vibration—all found in construction, all contribute to fatigue.
- **UNDIAGNOSED MEDICAL CONDITIONS** such as sleep apnea or thyroid dysfunction increase the risk of fatigue, as do certain medications used to treat high blood pressure, high cholesterol, allergies, depression or anxiety.
- **CULTURAL EXPECTATIONS** play a significant role. Living and working in a Type-A, 24/7, "Sleep-When-You-Die" society can create a stigma around sleep.

Obviously, personal behaviors make a difference as well, but many other factors contribute to the problem and must be taken into consideration in order to manage and mitigate fatigue risks.

DID YOU KNOW?

More than 70 million Americans suffer from a sleep disorder⁶

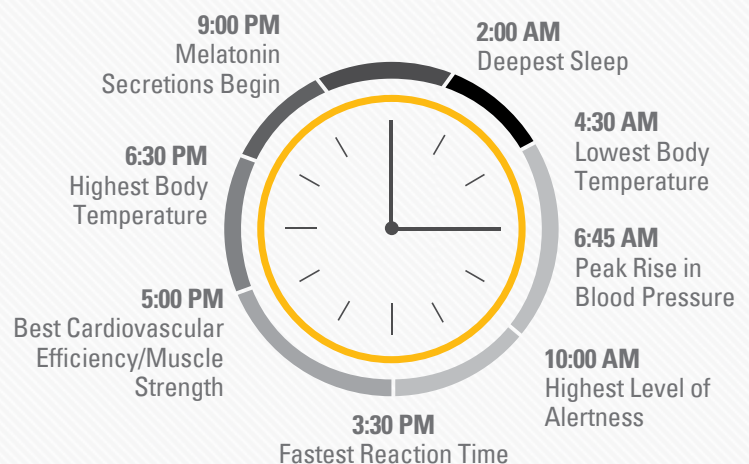
38 percent of US workers sleep less than 7 hours per night⁹

40 percent of night time workers admit to nodding off during their shift²

Safety experts say losing 2 hours of sleep produces the same effect on motor skills and reaction time as having 3 beers.⁷

BEYOND FATIGUE: THE POWER OF CIRCADIAN RHYTHMS

According to the National Institutes of Health, circadian rhythms are "physical, mental and behavioral changes that follow a roughly 24-hour cycle, responding primarily to light and darkness in an organism's environment. They are found in most living things, including animals, plants and microbes." Eight disruptions to circadian rhythms not only contribute to fatigue, but also impact many functions such as reaction time and muscle strength.



+ UNCOVERING HIDDEN RISK

One of the most challenging things about fatigue risk is its potential to hide. Many fatigued individuals don't remember what "well-rested" feels like, and as a result, don't realize they are impaired. Even those who have had adequate sleep—but work early in the morning or late at night—are often fighting fatigue because their body's natural sleep-wake patterns have been disrupted.

Many tools are available to uncover and quantify fatigue risks.

- **WEARABLE** wrist-worn devices monitor quality and quantity of sleep. The information is used to calculate an effectiveness score that can be viewed by the wearer at any time. Data from the devices can be aggregated and analyzed by fatigue experts who make recommendations about scheduling, education and other variables affecting risk.
- **IN-CAB DETECTION SYSTEMS** provide a non-intrusive way to assess fatigue and distraction. Some use historical data based on percent of eye closure to predict risk. Others, like the Cat Driver Safety System, track eye closure and head pose in real time, using an advanced algorithm that builds a custom 3D model of the operator's face. Both types of systems alert the operator when thresholds exceed pre-set levels. Data collected from a real-time system like the DSS can be transmitted to a monitoring center where it is analyzed by fatigue experts and converted into actionable recommendations.
- **VALIDATED SURVEYS** identify an organization's risk profile and clarify the cultural factors that can either drive or impede improvement. Survey data can be used to develop improvement plans and benchmark performance against world-class companies.
- **FATIGUE MODELING SOFTWARE** uses individual and group sleep data to pinpoint vulnerabilities, predict performance and optimize scheduling and staffing decisions.

These tools, used individually or together, deliver critical information that guide decision-making and foster behavioral change. But unless they are wrapped in and supported by a strong, positive safety culture, their effectiveness is limited.



70%

In fact, when wearable technology is used to measure fatigue in shift-workers and night-shift employees, it's common to see scores of 70 percent, which equates to a Blood Alcohol Content level of 0.08—the concentration at which drivers are considered drunk in the United States.⁵

IT ONLY TAKES A SECOND (OR LESS)



The Driver Safety System detects "microsleeps"—brief lapses of consciousness that last from less than 1 to about 30 seconds. We've all had them. But if you're operating equipment during a microsleep, the consequences could include:

- Fatalities
- Serious injuries
- Damage to property or equipment



+ CULTURE IS CRITICAL

It has been our experience that safety technologies deliver the biggest return on investment when they are deployed within a culture that shares these characteristics.

- **COMMITTED LEADERS.** Managers at every level understand the value of fatigue reduction and demonstrate visible support for the changes required to enhance safety and efficiency.
- **OPEN COMMUNICATION.** Employees are well-informed about any new technology that will be deployed—what it does, how it works, where it will be installed, how the data will be used and who will have access to the information.
- **CLEAR GOALS.** Improvement targets are broadly communicated and based on sound data. They are specific, measurable and achievable.
- **CONSISTENT PROCESSES.** Employees know what will happen when a fatigue event takes place, when an intervention will be required and what will occur after an intervention. Supervisors can be counted on to handle events and interventions consistently.
- **POSITIVE COACHING.** Data is used to guide and encourage improvement, not punish offenders.
- **FATIGUE EDUCATION.** Employees are taught about fatigue risks, including those over which they have little or no control. They are encouraged to report fatigue without fear of retribution and instructed to seek medical help for excessive fatigue or sleep disorders. They are also taught about personal choices that optimize alertness including diet, exercise, sleep habits and responsible use of alcohol and prescription drugs.

LESSONS LEARNED FROM THE REAL WORLD

Caterpillar has deployed fatigue-reduction technology with heavy equipment owners all over the world. In addition to learning about the importance of culture and change management, here are a few other tips from our customers.

- + **Bring a fatigue expert to the site** to explain how the technology works in a relaxed informal setting.
- + **Ask for volunteers** to test the technology. It helps build trust and deepen engagement.
- + **Review personal data** with volunteers in a confidential, one-on-one setting.
- + **Invite volunteers** to talk about their experiences with team members.
- + **Present team data** to the whole organization so all are aware of the risks.
- + **Use daily safety meetings** to educate teams about fatigue.
- + **Manage fatigue events** and interventions openly using positive reinforcement and consistent processes.
- + **Use data** from a combination of technologies to capture a more robust view of the situation.
- + **Compare fatigue event data** with telematics data to identify operator performance issues such as hard braking, aggressive shifting and driving with the truck body raised.
- + **Adjust schedules** to balance productivity and safety goals. While many factors affect scheduling, don't underestimate the negative impact of early start times, late nights, long shifts and rotating schedules.
- + **Check your medical benefits** for coverage of sleep disorders.
- + **Consider a competition to reward good sleep habits**, using data from wrist-worn devices.



+ MAKING THE RIGHT CHOICE

The process of selecting fatigue detection technology doesn't have to be overwhelming, but there are several key questions to consider upfront. As you review the options, look carefully at both the technology and the supplier providing it.

WHAT SPECIFIC FATIGUE ISSUES NEED TO BE ADDRESSED?

The type of technology you choose depends on the challenges you face. These challenges can be identified through a survey (which can be prone to bias), a more objective fatigue risk assessment or some combination of both. You may discover, for example, that scheduling and lifestyle issues are your chief risks, which would lead you to investigate scheduling software and/or wearable technologies.

WHAT MAKES SENSE FOR YOUR BUSINESS?

Application matters, as does the size of your operation. An aggregates producer with multiple haul trucks might be a candidate for in-cab detection technology, while a general contractor with two excavators and a loader could benefit more from an investment in wearables.

WILL THE TECHNOLOGY BE VIABLE OVER THE LONG TERM?

Begin with the future in mind, considering things like maintenance requirements and costs; expected frequency of upgrades; scalability and cost of expansion; and ability to integrate with other systems and platforms.

HOW WILL DATA BE SECURED?

Review the provider's data privacy policies and security processes. Know how the personal and operational data you collect will be captured, viewed, shared, distributed, managed and protected.

HOW SUCCESSFULLY HAS THE TECHNOLOGY BEEN DEPLOYED ELSEWHERE?

Talk to others in the industry who are already using the technology. Get real-world feedback on deployment challenges, operator acceptance, product reliability, supplier support and overall effectiveness at reducing fatigue risk.

HOW WILL THE TECHNOLOGY BE SERVICED?

Check the terms and conditions of the warranty. Find out whether technology upgrades are included, how they are distributed and how configuration modifications are handled. Determine whether you have the capacity to store parts and the resources to perform maintenance and service.

CAN THE PROVIDER HELP FOSTER A SUPPORTIVE CULTURE?

Ask for resources to assess your culture and identify vulnerabilities. Seek assistance with communication, training and change management.



+ WAKE UP AND SAVE

Fatigue is often an invisible threat. Few companies are fully aware of their own fatigue risks and few individuals recognize the extent of their impairment. Fatigue-detection technologies provide a simple, reliable way to uncover and quantify risks. When these technologies are deployed within a supportive culture the savings add up.



SAVE LIVES. Send all home safely at the end of every shift.



SAVE MONEY. Reduce the cost of absenteeism, productivity losses, healthcare, insurance, litigation and more.



SAVE TIME. Finish jobs efficiently with an alert, aware crew.



SAVE REPUTATION. Secure your legacy as a safe, responsible employer.

1 https://www.workzonesafety.org/files/documents/worker_distraction/fatigue_e-device-use.pdf

2 Caterpillar Safety Services White Paper. Driver Safety System: Specifications and Technical Overview

3 <http://www.safetyandhealthmagazine.com/articles/15271-fatigue-and-worker-safety>

4 <http://www.nsc.org/learn/NSC-Initiatives/Pages/Fatigue-Whos-at-Risk.aspx>

5 Caterpillar Safety Services White Paper. Reducing Fatigue Risk

6 <http://www.nsc.org/learn/NSC-Initiatives/Pages/Fatigue.aspx>

7 <http://www.nsc.org/Fatigue%20Documents/Drowsy-driving-poster.pdf>

8 https://www.nigms.nih.gov/education/pages/Factsheet_CircadianRhythms.aspx

Other sources:

Caterpillar Safety Services White Paper. Choosing a Fatigue Management Technology

<http://www.safetyandhealthmagazine.com/articles/10412-sleepy-and-unsafe-worker-fatigue>

<http://www.uab.edu/uabmagazine/images/uabmagazine/fall2010/magf10cellclockbg.jpg>