

# FATIGUE

## IN SAFETY-CRITICAL INDUSTRIES: IMPACT, RISKS & RECOMMENDATIONS



### Final report of a three-part series

Based on results from the 2017 National Employer and Employee Surveys on Workplace Fatigue

# EXECUTIVE SUMMARY

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Annual productivity gains are part of many organizational goals. Employees may seek to increase their income by working more hours, and they have family and social obligations after work. Time for recovery rest breaks and restorative sleep seems like a luxury that fewer and fewer people and organizations provide. With all these factors, fatigue is becoming a major concern for U.S. employees and employers.



**FATIGUE**



The impact of fatigue risk factors must be understood and addressed. Risk factors come from both employees and employers. In addition to the typical feeling of weariness at the end of a workday, fatigue can be caused by sleep disorders, sleep loss, working at night, putting in long hours and more. Fatigue affects employees' ability to think clearly, slows reaction time, decreases attention and vigilance, and impacts short-term memory, judgment and other functions.

The National Safety Council surveyed employers and employees in 2017, gaining insight into the state of fatigue among both populations. In this report, we compare answers for the safety-critical industries of Construction, Manufacturing, Transportation and Utilities to the overall population. In general, we found that safety-critical industries experience equal or higher risk factors and impacts from fatigue. Throughout this report, NSC provides recommendations on actions that employers and employees can take to reduce the effects of fatigue.

There is a serious gap between how employers and employees view fatigue and its impact on their safety. Notably, 93% of all employers feel fatigue is a safety issue, but just 72% of employees agree. This indicates that employees are not good judges of their own fatigue, signaling a need for employers to invest in fatigue risk management systems (FRMS) and empower employees to participate in sleep health programs.

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### **Other notable differences in survey responses from employers and employees in safety-critical industries include:**

- 97% of the employers in the Transportation industry feel the impact of fatigue – the highest among all safety-critical industries surveyed. 66% reported decreases in productivity and 45% said they had experienced safety incidents.
- Nearly all—98%—of employers in Manufacturing said it is unsafe to drive while tired, but just 77% of employees in that industry agreed.
- Every Construction industry employee surveyed reported at least one risk factor for fatigue (see page 13). Of those workers, 46% said they work during high-risk hours, and 77% said they have demanding jobs.
- Transportation industry employees who reported at least one risk factor cited long shifts (42%) and sleep loss (48%) as the most common causes of fatigue.

# METHODOLOGY

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*Fatigue in Safety-Critical Industries: Impact, Risks & Recommendations* is the last of a three-part series of reports produced by the National Safety Council on the prevalence of fatigue in the American workforce. This report releases new data from the 2017 National Employer and Employee Surveys, and compares selected safety-critical industries to the overall workforce.

**Four safety-critical industry subsets were identified in our survey data, and have been compared to all industries in this report:**

Industry	Employee participants	Employer participants
Construction	74	51
Manufacturing	209	55
Transportation	94	29
Utilities	29	22
All industries	2,010	504

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These four segments were well-sampled in the survey. Safety-critical industries may be at higher risk for fatigue-related incidents and injuries than industries overall. The industries profiled in this report do not necessarily have the most severe fatigue issues, and are not necessarily the industries with the highest number of near misses, injuries or deaths with fatigue as a contributing factor. Data does not exist on which industries have the most fatigue-related incidents. The industries profiled in this report tend to use shiftwork, which carries significant fatigue-related issues.

The National Employer Survey on Workplace Fatigue was conducted in June 2017 with 504 human resources decision makers who were responsible for health, safety and/or shift scheduling. Data from this report was initially released in *Fatigue in the Workplace: Risky Employer Practices*.

This report also references data released in the first report of this series, *Fatigue in the Workplace: Causes & Consequences of Employee Fatigue*, and data subsets that include safety-critical industries. The National Employee Survey data are the results of a probability-based study of 2,010 working adults. The survey sample was balanced according to U.S. Census figures by age, gender, ethnicity and geographic region. Interviews were completed February–March 2017.

All reports in this series can be found at [nsc.org/FatigueSurvey](https://nsc.org/FatigueSurvey)



## Fatigue Can Have Devastating Consequences

Incidents in safety-critical industries can have serious consequences for employees, the public and employers, so it is essential to address factors that contribute to high injury and fatality rates. As noted in the NSC report *Fatigue in the Workplace: Causes & Consequences of Employee Fatigue*, nearly every American employee (97%) is at risk for fatigue, and fatigue likely affects every workforce.

Safety-critical industries have higher risks because the impact of fatigue is more than just lower productivity. Safety incidents endanger not only the employees involved but all those around them. In addition, increased health care costs, lawsuits, breach-of-contract issues and lost business are just a few of the significant financial costs of fatigue that organizations may experience.

## What Is Fatigue?

The symptoms of fatigue include tiredness, sleepiness, reduced energy and increased effort needed to perform basic tasks. Many factors cause fatigue, with the most obvious being sleep loss. However, factors in addition to sleep loss can play a role in employees' ability to get proper rest and how much fatigue they experience. Shift schedules, monotonous tasks, physically demanding work, stress and the work environment are also factors.

## Biological risk factors

Sleep loss and untreated sleep disorders are risks that employees bring with them to work. While fatigue is caused by factors that may or may not be within employees' control, obtaining restorative sleep is the best defense against fatigue. Sleep is a basic biological need that is just as necessary as food and water.

Fatigue and sleep are related in two primary ways: the amount of sleep in a 24-hour period, and continuous

time awake (or time since a person last slept). Adults need seven to nine hours of sleep a day to perform at an optimal level. As soon as people awaken, their bodies begin to accumulate the need for sleep. With each passing hour, their need for sleep rises. After 16 hours, a person can become too fatigued to perform at a desired level (Dawson, 1997).

## Circadian rhythm—the body clock

Most people's circadian rhythm—also known as the body clock—is on a predictable schedule. Melatonin begins secreting around 9 p.m., and deepest sleep happens around 2 a.m. Melatonin stops secreting around 7 a.m. and peak alertness occurs around 10 a.m. People who must work against their circadian rhythm, such as shift workers, find it difficult to perform during the late-night or early-morning hours and to sleep during daylight hours. Night shift workers frequently report getting less sleep than day shift workers; 59% of night shift employees reported sleeping less than seven hours a day, versus 45% of day shift workers.

The combination of misalignment with the body clock and sleep debt (the difference between needed and actual hours of sleep) has a greater effect on safety-critical industries than industries overall. This may be due to a lack of flexibility in scheduling around seasonal and weather circumstances, such as when Utilities workers are called out during storms.





**NEARLY HALF OF EMPLOYEES  
REPORT FEELING TIRED AT  
LEAST SOME OF THE TIME  
DURING THE WORKDAY.**

# IMPACT OF FATIGUE

Employers and employees agree that fatigue is a legitimate safety issue, but there is a large gap between the number of employers and employees who agree. This could point to differences in perception among employers and employees. Employers have objective ways to measure the effects of fatigue: productivity, absenteeism, safety incidents and injuries. Employees may not feel secure in reporting fatigue, and the company culture might consider fatigue to be a badge of honor. In addition, fatigue affects judgment, and therefore employees may not be capable of accurately judging when their performance is affected by fatigue (Dawson, 1997).

## Percentage of those surveyed who agree that fatigue is a safety issue

Industry	Employers	Employees
Construction	98%	75%
Manufacturing	95%	82%
Transportation	100%	73%
Utilities	95%	66%
All industries	93%	72%

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### Tiredness and Falling Asleep on the Job

High numbers of employees report feeling tired at work and employers report employees falling asleep on the job. Transportation employees have the highest level of feeling tired at work (70%). While the percentage of Utilities employees who feel tired at work is lowest among the profiled industries, nearly 45% report feeling tired at work at least some of the time. Employees in Transportation and Utilities industries may not fall asleep less on the job; they may have more unsupervised hours at work, and therefore a decreased chance of being observed sleeping on the job by their employers.

#### Tired at work

Industry	Employees report feeling tired at work
Construction	65%
Manufacturing	63%
Transportation	70%
Utilities	45%
All industries	69%

#### Asleep on the job

Industry	Employers report finding employees asleep on the job
Construction	61%
Manufacturing	55%
Transportation	38%
Utilities	41%
All industries	50%

Note that employers may be reporting a single incident of falling asleep on the job, and these numbers do not necessarily reflect a significant issue or falling asleep at safety-critical times.



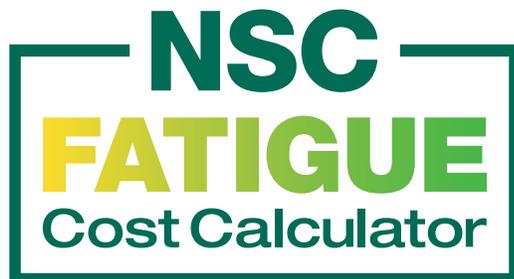
Fatigue affects employees' ability to think clearly, slows reaction time, decreases attention and vigilance, and impacts short-term memory, judgment and other functions. Tired employees are less effective (presenteeism) and more likely to miss work (absenteeism), creating a drag on productivity. Importantly for safety-critical industries, fatigued employees are also more likely to make mistakes that cause incidents and injuries. A 2014 meta-analysis of 27 observational studies estimated up to 13% of workplace injuries could be attributed to fatigue, and workers with sleep problems had a 1.62 times higher risk of being injured than those without (Uehli, 2014).

## Up to 13% of workplace injuries could be attributed to fatigue.

### Employers report the impact of fatigue on their organization

Industry	Feel the impact of fatigue	Experience productivity decreases	Experience safety incidents
Construction	94%	71%	45%
Manufacturing	89%	73%	44%
Transportation	97%	66%	45%
Utilities	91%	64%	41%
All industries	90%	67%	32%

Find out how much fatigue costs your company. Enter four data points and your email address in the **Real Costs of Fatigue Calculator** at [nsc.org/tiredatwork](https://nsc.org/tiredatwork) to get your customized results.





### Impact of Fatigue on Work-related Driving

One commonality between the safety-critical industries profiled in this report is the requirement to drive as part of the job and of course commuting to and from the job. There is shared agreement that operating a vehicle while tired can be dangerous. Motor vehicle crashes are the leading cause of workplace fatalities.

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### Percentage who agree it's unsafe to drive when tired

Industry	Employers	Employees
Construction	96%	78%
Manufacturing	98%	77%
Transportation	97%	77%
Utilities	95%	66%
All industries	94%	80%

One study found that a person who loses two hours of sleep from a normal eight-hour sleep schedule performs similarly to someone who has drunk two to three beers (Roehrs, 2003). Sleep loss and the resultant fatigue should be treated as seriously as drug or alcohol impairment on the job. The discrepancy between employers and employees who agree that fatigued driving is unsafe points to an urgent need to educate employees on this topic.



# FATIGUE

## RISK FACTORS

### Workplace Fatigue Risk Factors at a Glance

<b>Shift work:</b> Night shifts, early morning shifts, rotating and irregular shifts disrupt the body clock	<b>Quick shift returns:</b> Employees need at least 12 hours between shifts to recover	<b>Long shifts:</b> Working 10 or more consecutive hours
<b>Long weeks:</b> Working 50 or more hours a week	<b>High-risk hours:</b> Working at night or in the early morning, even infrequently	<b>Demanding jobs:</b> Work that requires sustained attention or is physically or cognitively demanding
<b>No rest breaks during shift:</b> Short breaks allow employees to rest and re-energize	<b>Sleep loss:</b> Getting less than the necessary seven to nine hours of sleep a day	<b>Long commutes:</b> Driving more than 30 minutes each way to work

An in-depth description of these risk factors can be found in the NSC report *Fatigue in the Workplace: Causes & Consequences of Employee Fatigue*.

Nearly every surveyed employee has at least one risk factor for fatigue, and with the exception of Utilities, safety-critical industries report a higher incidence of multiple risk factors than all industries. While a conclusion cannot be drawn in a definable fashion that two or more risk factors multiply risk, it is common sense that the more risk factors individuals have, the higher the probability that their work quality, productivity and safety will be affected. Minimizing factors that cause fatigue and implementing appropriate countermeasures to fatigue are ways to control health and safety risks in the workplace.

## Employee-reported number of risk factors by industry

Industry	One risk factor	Two or more risk factors
Construction	100%	92%
Manufacturing	98%	89%
Transportation	99%	94%
Utilities	97%	79%
All industries	97%	80%

## Employee-reported risk factors

Risk factor	Construction	Manufacturing	Transportation	Utilities	All industries
Shift work	8%	16%	26%	17%	17%
High-risk hours	46%	45%	64%	45%	41%
Demanding job	77%	86%	86%	83%	81%
Long shifts	27%	30%	42%	28%	21%
Long weeks	28%	28%	32%	24%	22%
Sleep loss	41%	46%	48%	34%	43%
No rest breaks	8%	8%	12%	0%	10%
Quick shift returns	18%	11%	23%	7%	14%
Long commutes	46%	34%	36%	45%	31%

These are just a few of the risk factors that may affect fatigue levels. Other risk factors include age, gender, health and lifestyle choices.

In general, employees in safety-critical industries were more likely to report fatigue risk factors compared to all industries. Of note are the percentage who reported working physically and mentally demanding jobs, working high-risk hours and having long commutes.

When possible, employers can look for ways to structure working days to minimize the number of concurrent fatigue risks. When concurrent fatigue risks are unavoidable, employees should be given additional recovery time.

### Sleep disorders

Sleep disorders are a major hurdle to getting enough sleep. Obstructive sleep apnea (OSA, a blockage of airflow during sleep) and insomnia (problems falling or staying asleep) are two of the most common sleep disorders that inhibit people from getting sufficient sleep. Innovative employers support screening and treating employees for sleep disorders so they become safer and healthier employees.



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## **SCHNEIDER**

*"Lack of sleep is detrimental to any driver, so I believe it is imperative that we as professional drivers are tested for any sleep-related condition that will affect our ability to safely and legally drive on our nation's highways. I started driving for Schneider in 2006 and got my CPAP in 2007. I use my machine every night and even if I nap during the day. My quality of life has improved overall since I started using the CPAP: I feel well rested, have more energy, and generally, am happier. If you think you have any symptoms of sleep apnea, please get tested. It could save your life."*

**Steven Frey**

# Schneider reaps rewards from treating obstructive sleep apnea

Schneider provides transportation, logistics and intermodal services, so it depends on healthy, alert drivers to move materials around the country efficiently and safely. By developing and implementing an innovative OSA treatment program, Schneider was able to cut health care costs, improve driver retention, and achieve a five-fold reduction in DOT-reportable crashes.

Schneider's occupational health team suspected that drivers who were returning to work after a critical medical event might also have been suffering from untreated OSA. Drivers' personal physicians and biannual DOT screenings often missed the symptoms. The traditional method of diagnosing this condition—an overnight sleep study at a sleep health center—would have been costly for the company and logistically cumbersome for drivers. A new model of screening, testing, diagnosing and monitoring OSA was developed:

- Screening survey identifies at-risk drivers
- Portable testing for at-risk drivers is conducted at home, in their bunk or hotel
- Sleep physician analyzes results the next day and immediately informs the driver of the results
- Continuous positive airway pressure (CPAP) machine, specifically outfitted to the truck's sleeper berth as needed, is dispensed within 24 hours
- Driver is paired with a sleep clinician for assistance in adjusting to the machine
- CPAP equipment is covered on employee health care plan as preventive care with no out-of-pocket cost to the driver

A 2016 study of commercial truck drivers using Schneider's data concluded that treatment for OSA dramatically reduced crash risk. Drivers diagnosed with OSA who used CPAP treatment had crash risks similar to drivers who did not have OSA, while drivers who were diagnosed but did not use CPAP treatment had five times greater preventable crash risk after adjustment for miles driven and driving experience (Burks, 2016).

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**Schneider's decision to treat drivers diagnosed with OSA saved \$400 a month on health plan costs per driver, increased retention, reduced crash risk and decreased DOT-reportable crashes.**

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Additionally, a review of medical claims under the Schneider health care plan confirmed savings of \$300–\$400 per driver per month for diagnosed drivers receiving OSA treatment.

## Risk Factors Due to Work Schedules

Employers may be able to strategically schedule shifts and shift returns to mitigate fatigue. Forward-rotating shifts (day to afternoon to night) are an easier adjustment for the circadian clock. Employees should ideally stay on shifts for a couple weeks before rotating, allowing them time to adapt to their schedules and develop new routines. However, people working night shifts may have trouble getting restorative sleep, and may find themselves sleep-deprived during their night shift rotation. Limiting the length of night shift rotations, or scheduling no more than four consecutive night shifts with opportunities for nighttime rest during off-duty periods, can help provide opportunities for restorative sleep. It is important to consider on-duty and off-duty hours when scheduling to ensure employees get enough time between shifts to allow for recuperative rest.

## Consider on-duty and off-duty hours when scheduling to ensure employees get enough time between shifts to allow for recuperative rest.

In addition, working 10 or more hours a day and 50 or more hours a week increases fatigue risk. However, scheduling eight-hour shifts for no more than five consecutive days is not always possible in safety-critical industries. Work schedules may be affected by storms, natural disasters or seasonal demand. Transportation may be affected by unexpected traffic, road closures or weather conditions. Because these factors may be unpredictable or unscheduled, employers should take care to actively monitor the number of consecutive hours and days worked, and give employees sufficient recovery time.

## Job duties may contribute to fatigue

The type of work performed may significantly affect fatigue risk. When workers spend time on a single task for a long duration, it can become monotonous and physically draining, increasing risk of fatigue. This is especially important to address in Manufacturing and Transportation, where higher output may be achieved by keeping employees on a single task with minimal breaks. Manufacturing settings can rotate employees through different tasks to keep them mentally fresh and reduce the chance of repetitive stress injury. Transportation employees should schedule rest breaks for 15 minutes every two hours to relieve visual fatigue and stretch muscles that have been contracted in the same position.

Fatigue also increases with:

- **Low workload tasks** that are unstimulating and monotonous, such as highway driving
- **High workload tasks** that require vigilance, such as assembly line work
- **Repetitive motion tasks** that involve a limited number of muscle groups, such as data entry

For all these situations, rotating tasks and/or scheduling regular rest breaks mitigates fatigue. Employees need to feel comfortable reporting fatigue and asking for a rest break or to be rotated to a different task. In addition, because employees are not good judges of their own fatigue, supervisors need to be alert to signs such as excessive yawning, errors in judgment or other atypical actions, reduced concentration, microsleeps or falling asleep. Supervisors should give employees rest breaks or implement other strategies to reduce fatigue.

## Calculating the Cost of Fatigue

As shown in the Schneider case study on page 15, workplace fatigue costs include increased health care plan costs and higher numbers of reportable incidents. Managing workplace fatigue helps the bottom line. Some fatigue risks can be managed for little cost: forward rotating shifts, for example. Other strategies for fatigue management, such as hiring more employees or implementing a sleep disorder screening program, are upfront expenditures that may require budget justification to the leadership. NSC has a resource to help.

The image shows a screenshot of the NSC Fatigue Cost Calculator web interface. At the top, the logo reads "NSC FATIGUE Cost Calculator" in green and yellow text. Below the logo is the heading "Real Costs of Fatigue in the Workplace". The main content area is divided into two columns. The left column contains a brief introduction: "How much is fatigue costing the workplace? The National Safety Council has teamed with Brigham and Women's Hospital to develop an easy-to-use online tool, where employers can receive a tailored estimate of how much fatigue is costing their bottom line. The calculator will estimate how much of the burden can be avoided with programs implemented in the workplace." Below this is a section titled "Calculate Your Costs" with four input fields: "Where are your facilities/offices located?" (dropdown menu), "What is your industry?" (dropdown menu with a green checkmark), "How many employees in your organization?" (text input field), and "Do you have any shift workers in your organization?" (dropdown menu with a green checkmark). At the bottom of this section is an "Email Address" input field and a green "Get Your Report" button. Below the input fields is a small note: "We will email you the results of this calculator." The right column contains information about the National Safety Council and the Brigham and Women's Hospital Sleep Matters Initiative. It includes the text: "About National Safety Council Founded in 1913 and chartered by Congress, the National Safety Council is a nonprofit organization whose mission is to eliminate preventable deaths at work, in homes and communities, and on the road through leadership, research, education and advocacy." Below this is the "Education Content Partner" logo for "BRIGHAM HEALTH BRIGHAM AND WOMEN'S SLEEP MATTERS INITIATIVE". At the bottom of the right column is a section titled "About the Sleep Matters Initiative" with the text: "The mission of the Sleep Matters Initiative, led by investigators from Brigham and Women's Hospital and Harvard Medical School, is to foster excellence in the treatment of sleep and circadian disorders in order to improve health, safety, and performance; and to promote widespread change in social norms that will engender a culture of sleep health."

The methodology used to create the cost calculator is detailed in *Calculating the Cost of Poor Sleep: Methodology* at [nsc.org/tiredatwork](https://nsc.org/tiredatwork).

NSC in collaboration with the Brigham and Women's Hospital Sleep Matters Initiative developed an online fatigue cost calculator that estimates the cost of sleep deficiency for individual businesses. Entering four data points into the calculator—workforce size, industry, location, and shift scheduling practice—generates an estimated dollar cost that helps the organization quantify the cost of fatigue and justify the implementation of a fatigue risk management system (FRMS).

# MANAGING FATIGUE

Fatigue is a human factor that affects every workforce, but systems and processes can be put into place to reduce its impact. Many employers are beginning to recognize that long days and overly tasked employees do not produce better results, but instead produce mental and physical burnout, directly affecting employees' health and safety. Recognizing fatigue as a hazard in the workplace is the first step to managing the risks.

## **Safety Management Systems for Fatigue**

An effective and comprehensive safety management system should recognize and address fatigue as a potential hazard in the workplace. The best way to identify fatigue risk is to conduct an assessment and include fatigue factors in incident reporting. Identifying and addressing factors that cause fatigue allow employers to better control health and safety risks in the workplace.

## **Fatigue risk management systems**

Fatigue risk management systems include policies, practices, programs and procedures that incorporate fatigue management into an existing safety management system.

## **Driver alert systems**

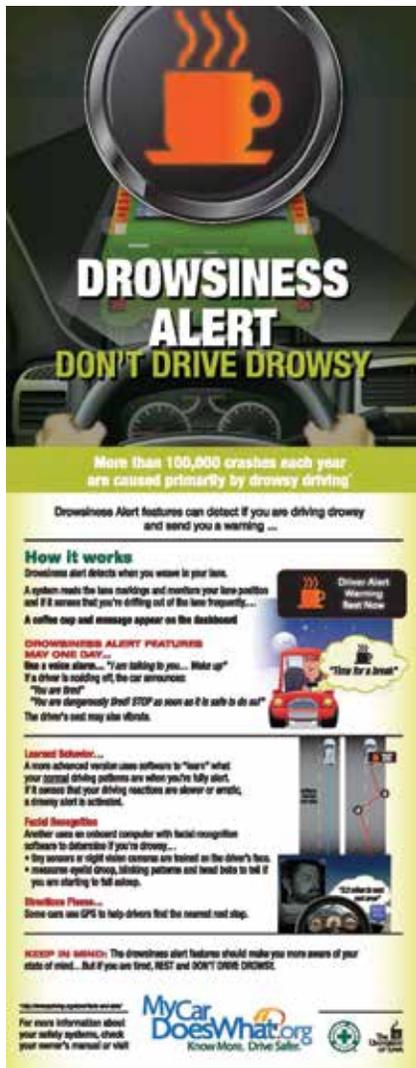
Many vehicles are equipped with technologies that alert drivers to potential fatigue. There are several paths to detecting fatigue, ranging from lane departure warning systems to driver-state monitoring systems that detect head position or eyelid movement, to heart-rate monitoring sensors and software. These systems detect when the driver is drifting into another lane, if their eyes are closing too frequently or if they are exhibiting other drowsy driving behaviors, and issue an alert. This technology has the potential to save lives, but it should not be used to allow fatigued drivers to continue driving. It is meant as a warning for drivers to assess their fatigue level and implement fatigue-mitigating behaviors before a crash occurs.

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**Driving alert systems are not a substitute for proper sleep. They are meant as a warning for drivers to assess their fatigue level and implement fatigue-mitigating behaviors if necessary.**

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If organizations have these systems in their vehicles, they should also have established policies about how the systems work and the interventions that should take place when alerts do occur. This technology should be used as a part of an overall fatigue risk management system, and should not supplant other worthwhile fatigue management actions.



Download and post this infographic where drivers will see it: [nsc.org/drowsygraphic](http://nsc.org/drowsygraphic)

## Workplace culture and communication

Of all recommended changes, workplace culture may be the most difficult to address because it requires a change in perspective, not just a change in policy. Disciplining employees for reporting fatigue prevents open and honest communication and can hamper future reporting. Working while fatigued is at best less productive and at worst dangerous for the employee, the organization and the public.

When an organization acknowledges that fatigue is an unacceptable risk factor and decides how to address it, the change must be communicated to employees:

- Have an open dialogue about fatigue as a workplace safety hazard
- Give a 5-minute safety talk about fatigue in the workplace
- Have human resources or a health care representative discuss the importance of sleep health, how to get better sleep, and how to get screened for a sleep disorder

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## National Safety Council is leading the conversation on workplace fatigue in the U.S.

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### How many of these fatigue-mitigating changes could your organization embrace?

- Scheduling employees for less than 10 hours a day
- Scheduling employees for less than 50 hours per week
- Scheduling night shift employees for no more than four days in a row
- Forward-rotating shift schedules
- Allowing recovery rest before a shift change
- Scheduling rest breaks during all shifts
- Providing a rest area for short naps during nonday shifts
- Creating a fatigue reporting system for employees who are too fatigued to work safely
- Educating employees on fatigue and sleep health
- Adding sleep disorder screening and treatment to the health care plan
- Implementing a fatigue risk management system

**Learn more and get needed resources at  
[nsc.org/fatigue](https://nsc.org/fatigue)**



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