WHITE PAPER

# **Sleep is a Superpower:** Overcoming Neurocognitive Fatigue in the Workplace

The science is indisputable.
**Fatigue, whether physical (body), mental (mind), or neurocognitive (brain), impairs human performance.**

The most insidious form is neurocognitive fatigue, which is caused by insufficient deep and restorative sleep that the human brain requires every 24 hours. Jason Bourne said it best, “Sleep is a weapon.”[1] Our need for quality sleep is not new. In fact, evolution requires it. We are programmed, at our very core, to sleep. When we sleep, one third of our life is spent not mating, not watching out for predators, not hunting for food, but simply sleeping.[2] Maybe sleep is important?

An insufficient amount of sleep or poor quality of sleep, either in a 24-hour period (acute fatigue) or across multiple days (cumulative fatigue),[3] causes neurocognitive fatigue. The part of the brain that suffers from neurocognitive fatigue is the cerebral cortex, which controls cognitive processes such as pattern recognition, auditory discrimination, visual processing, memory, speech, reasoning, planning, problem-solving, and decision-making—virtually everything to do with thinking.

Disturbances in our circadian rhythm heighten the likelihood of sleep deprivation, which in turn leads to neurocognitive fatigue. These disturbances are common among workers on night shifts, early-morning shifts, rotating shifts, and extended-day work, affecting employees across all occupational classes, including salaried supervisors and engineers.

In all cases, sleep disturbances make us less able to process information and mean we have to exert more effort to make decisions or perform routine tasks. The result: We are more vulnerable to high-risk exposures at work, including serious injuries and fatalities (SIFs).

## Risks Created by Fatigue

### Performance Errors

Mild to severe sleep deprivation results in corresponding levels of neurocognitive fatigue, with accumulating risks of performance errors on a wide range of cognitive tasks. For example, a 2009 study[4] found that subjects who reported having 5.5 to 6.4 hours of good-quality sleep in the last 24

**Sleepiness Error Risks[4]**

< 6.5 hours of sleep
**230% higher risk of errors**

< 5.5 hours of sleep
**5x higher risk of errors**

Poor-quality sleep
**~3X higher risk or errors**
no matter sleep duration

hours, or as a cumulative average over the past seven days, had a 230% greater relative risk for errors than subjects with more than 6.5 hours of good-quality sleep. When the amount of good-quality sleep dropped below 5.5 hours, the relative risk for errors was almost five times greater than the control subjects. And, if the quality of sleep was reported as poor, the relative risk rate almost tripled, independent of sleep duration.

## Impaired Performance

Studies of neurocognitive fatigue risks have shown that impairment from sleep loss at mild to severe levels is comparable to a blood alcohol content (BAC) level ranging from 0.04 (mild fatigue) to 0.12% (severe fatigue).[5,6] A BAC of .08% or greater is legally drunk in most countries. No risk-conscious organization would allow a legally drunk or even mildly intoxicated worker to control a high-risk process, operate heavy machinery, use sharp instruments, or drive a company vehicle. Yet, sleep-related neurocognitive fatigue continues to be the primary cause of human errors, near misses, and fatal accidents across all types of industries, including oil and gas[7], marine[8], nuclear[9], aerospace[10], aviation,[11,12,13] and the medical profession.

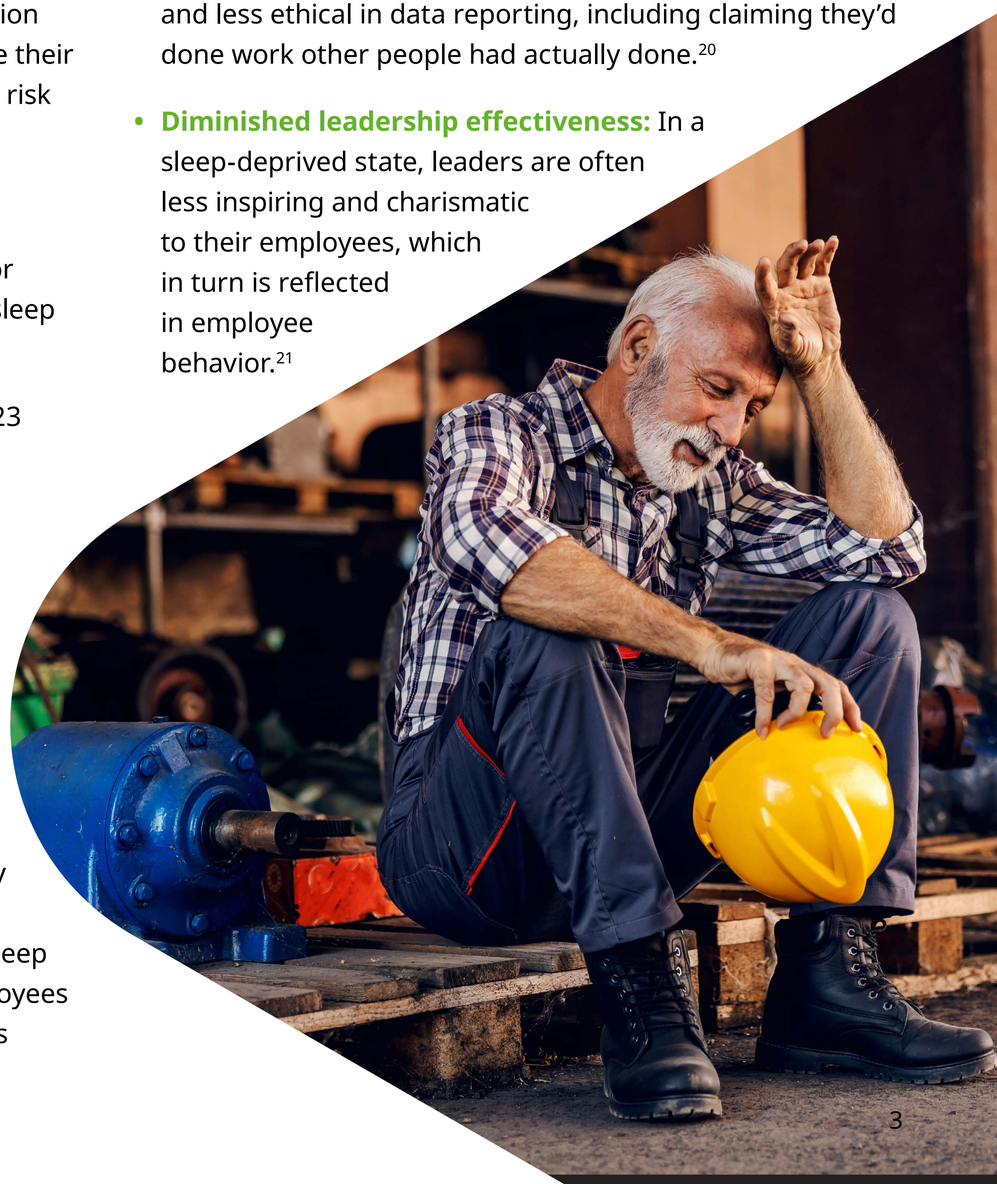
In fact, a robust study[14] found that senior surgeons who performed operations when moderately to severely sleep deprived (less than six hours of actual sleep in 24 hours) faced an 83% increased risk of complications.

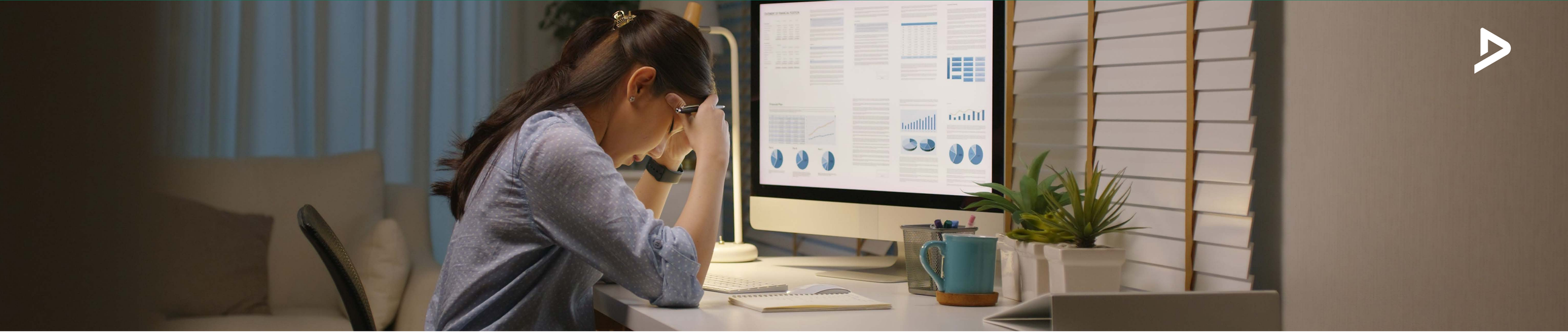
Human fatigue is a also grave issue affecting the safety of the traveling public in all modes of transportation. In fact, sleep deprivation and associated neurocognitive fatigue is considered Enemy #1 by the U.S. National Transportation Safety Board,[15] and companies are striving to optimize their operational reliability and safety with effective fatigue risk mitigation.[16,17]

## Absenteeism, Conflict, Tuning Out

In addition to workplace accidents resulting in injury or death, other issues can arise in the workplace due to sleep deprivation, such as:

- **Missed work:** Every year, the United States loses 1.23 million working days due to insufficient sleep. When compared to those who get sufficient sleep, sleep-deprived workers are twice as likely to miss work.[18]
- **Interpersonal conflict:** Without sufficient sleep, people can become irritable, easily frustrated, anxious, and depressed. These changes can lead to poor communication or team difficulties.[19]
- **Decreased engagement and effectiveness:** Organizational Citizenship Behavior (OCB) is defined as employee behaviors that are not formally recognized by the company reward system but contribute to organizational effectiveness. Lack of sleep decreases positive OCB. Studies suggests that employees who are sleeping for 6 hours or less often select less challenging work problems; produce fewer creative solutions to the problems they do select; “slack off” and let others work (social loafing); and become more deviant and less ethical in data reporting, including claiming they’d done work other people had actually done.[20]
- **Diminished leadership effectiveness:** In a sleep-deprived state, leaders are often less inspiring and charismatic to their employees, which in turn is reflected in employee behavior.[21]





## Root Causes of Fatigue

Many people in industry leadership believe that the root cause of fatigue risks is primarily employee lifestyle choices. They see employees who "burn the candle at both ends" and do not use the rest time available to them as the root of the problem. True, this is a problem. But there are two even more deeply rooted causes of workplace fatigue that must be addressed to mitigate fatigue risk—one linked to the business side of operations and the other linked to the cultural side.

### Short-Staffing

On the business side, to curb labor costs and be "lean," financial managers have created a vicious circle in many process industries and manufacturing plants by hiring only the base headcount needed to cover the recognized job positions across the 24/7 hours of operation. Inadequate staffing is a pervasive issue, with many organizations failing to adequately accommodate planned absences, turnover, and the demands of special projects and stretch assignments. Compounding this challenge, some organizations design their staffing models under the assumption of planned overtime, making the negative effects of their existing shortage of qualified workers even worse. Too few skilled personnel at the site level leads to escalating levels of overtime. Relying on overtime not only strains the current labor pool but also amplifies the effects of sickness absences and staff turnover. Higher absenteeism further fuels the cycle, driving up both overtime requirements and levels of sleep deprivation among the remaining workforce.

This self-perpetuating pattern underscores the critical need for companies to be proactive to address staffing deficiencies and mitigate their adverse effects on both employee well-being and operational efficiency. In the future, potential hidden costs of the base-labor staffing model—including elevated turnover, safety incidents, and error rates, along with overtime costs—must be factored into the equation.

### Sleeplessness as a Source of Pride

On the cultural side, established by the organization's leadership, we find another deeply rooted cause of neurocognitive fatigue. Like surgeons who were trained to operate on little to no sleep, many leaders believe it is both possible and desirable—a sign of real toughness and a point of pride—to be able to function on as little sleep as possible. The problem with this macho mindset, and the cultural infusion that occurs when leaders' beliefs become common organizational practices, is that this mindset is flawed. Just because you survived one night or one thousand nights with little or no sleep and have managed to complete your tasks the next day does not mean that your work was error-free. Humans cannot accurately judge their own performance when they are in a state of brain fatigue, and they all too easily reinforce their own sense of infallibility. You may think you perform just fine with little sleep, but the reality is likely quite different.

## Battling Back: Fatigue Countermeasures

### Fatigue Risk Mitigation Systems

Because there are multiple root causes of the sleep deprivation that results in neurocognitive fatigue, including undiagnosed sleep disorders, high overtime levels, life status (e.g., parents of newborns), and some work schedules, companies committed to allaying fatigue risks need a comprehensive FRMS—Fatigue Risk Mitigation System.[22] Like any management system, it is crucial for an FRMS to be:

- Strategically aligned
- Scientifically sound
- Data informed
- Risk focused
- Performance based

The FRMS must be fully integrated into the operating fabric and the culture of all departments that are subject to overtime work hours, whether hourly or salaried. Buy-in is essential! Unless operating unit leaders embrace the fundamental value of an FRMS, the critical risk of human fatigue will continue to present a danger in today's workplaces. The fundamental purpose of this systemic solution must be to enable at least two unrestricted sleep and rest opportunities at every off-time period between work blocks. In addition, the following components are essential for managing the continuous risk created by sleep deprivation.

### Robust Fatigue Education

Both inside and outside of the workplace, sleep deprivation and poor sleep quality have adverse effects on overall physical and mental health. Education on sleep and attention to sleep hygiene (good sleep habits) are crucial steps to improving sleep, bettering health, and promoting safety in and out of the workplace.

Many companies provide their employees with "tips" on how to manage fatigue only to find that it has little to no sustained impact. Long-term studies have shown that in-depth, up-to-date education on sleep fundamentals is essential for improving employees' sleep quantity and quality. Too often, sleep education is still focusing on the importance of REM sleep rather than the deep "Delta-wave" sleep that is now known to be necessary to restore our brains every day. If we expect employees to actively prevent potential fatigue risks caused by their personal life choices, including their sleep hygiene and sleep patterns, they need to be fully educated on the impact of those choices.

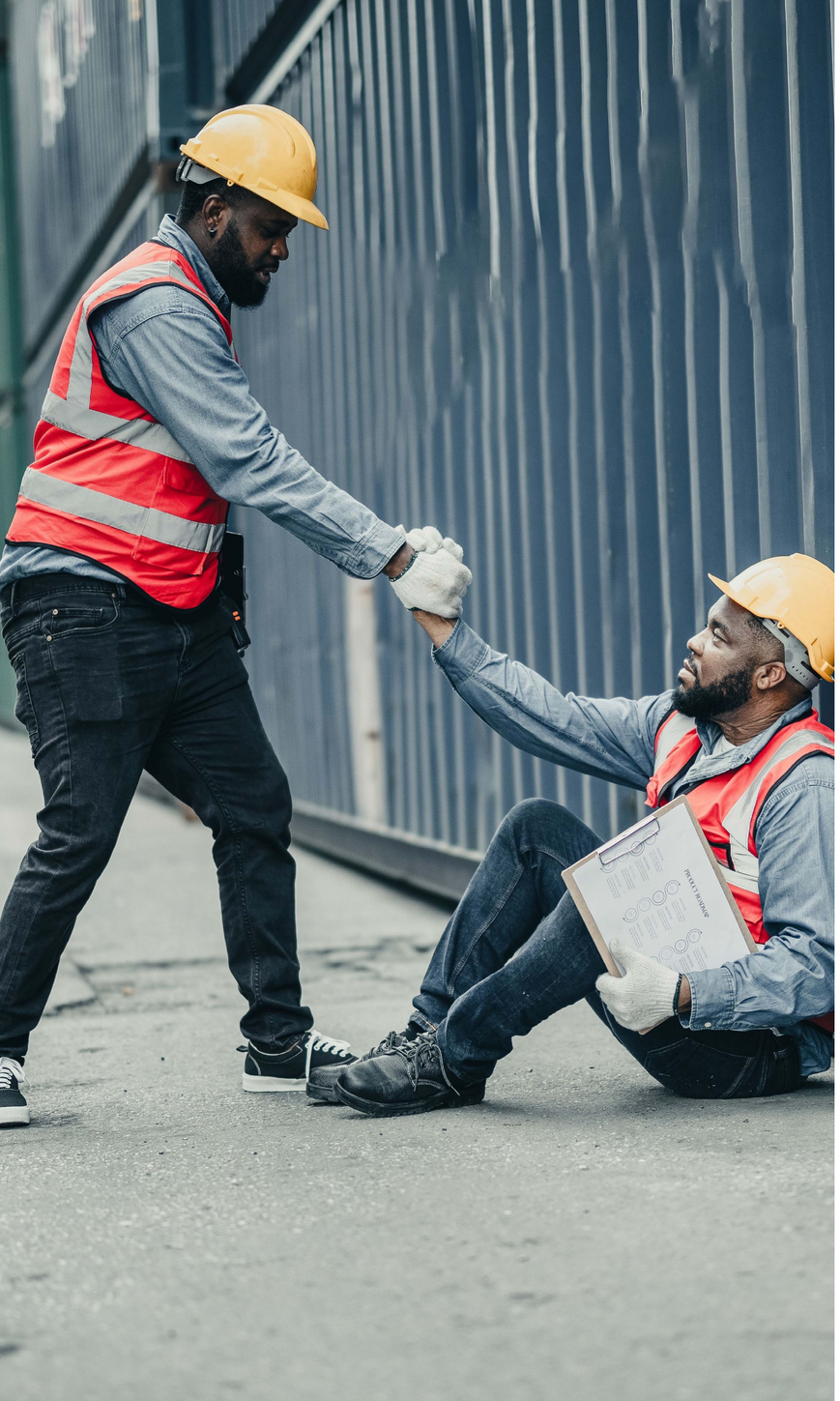
This starts at the top. Leaders need fatigue awareness and mitigation training as well so they can competently monitor the risk of fatigue in the workplace. Leaders who are aware of the hazards of fatigue can create an environment where workers feel comfortable reporting fatigue; participate actively in the fatigue conversation with each other; recognize the major fatigue concerns within their company and outside of their workgroups; and think ahead to mitigate potential with fatigue risk, such as during task planning/design or when making control plans. A properly implemented FRMS will have resources available to cope with fatigue.

### Protected Rest Periods

Since unrestricted sleep and rest time opportunities are fundamental to managing fatigue, no FRMS would be complete without provisions to ensure that sufficient rest breaks occur daily and weekly to preserve high-performance reliability on the job. At a minimum, daily time away from work needs to be 10 hours long to allow for commuting time, wind-down time, optimally a meal with family, and critically, at least 6.5 or 7 hours of sleep. On a weekly basis, the goal must be to prevent cumulative cognitive fatigue due to long consecutive work periods. Achieving this means there needs to be at least two uninterrupted sleep periods following every work block, with more planned rest after four or more consecutive night shifts.

### Individual Fatigue Risk Assessments

The last line of defense against the potential consequences of workplace fatigue is a real-time, objective, field-validated



fatigue risk assessment tool, such as psychomotor vigilance task (PVT), which can be easily implemented on a smartphone. The PVT, frequently used in the aviation realm, is a 5-minute assessment of fatigue based on reaction time. Participants are instructed to respond by pressing a button when a stimulus appears (e.g., a bull's-eye) on the screen. The time from presentation of the stimulus to button response is recorded as reaction time. The stimulus reappears at random intervals across the duration of the task, so vigilance is required to maintain reaction times.[23,24] Another solution is to train Qualified Fatigue Assessors who can administer other fatigue assessment tools requiring more technical expertise.

Importantly, both examples recognize that neurocognitive fatigue can result in a loss of self-judgment. After all, relying on a fatigued individual to accurately and objectively assess their fitness for error-free work, and especially their fitness for safety-critical tasks, is like relying on an intoxicated individual to assess their fitness to drive. No company wants to bet their reputation or their people's safety solely on a fatigued person's self-assessment.

## Well Rested = Improved Well-being, Safety, and Productivity

Engaging an expert organization to help develop a comprehensive Fatigue Risk Mitigation System (FRMS) is crucial for companies aiming to address the multifaceted causes of neurocognitive fatigue. Experts can guide you to strategically align and integrate scientifically sound and data-informed FRMS approaches into your operating systems and processes to effectively manage sleep deprivation risks.

Key components include robust fatigue education, comprehensive fatigue awareness and mitigation training for leaders, protected rest periods, and individual fatigue risk assessments using validated tools like the psychomotor vigilance task (PVT). These measures collectively aim to create an environment conducive to promoting safety, health, and high performance reliability.

How can you quantify the gains of an FRMS? You'll see them through examples of improved employee well-being, enhanced safety records, and sustained high productivity levels.

Ultimately, investing in an FRMS is an investment in people and performance, essential for mitigating the critical risk of human fatigue and safeguarding organizational success.

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