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Beyond Compliance - The Evolution of Fatigue Risk and Safety Leadership in Modern Mining

Modernizing Prediction, Prevention, and Risk Reduction

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Question?

What Does It Take To Trust New Technology?

What Proof Points Do We Need To See?

How Do We Check And Validate?

Purpose

Inform You Of The Direction Fatigue Technology Is Taking

And not to make you fall asleep!

Agenda

Fatigue and Its Impact

Traditional Fatigue Assessment

Evolution of Fatigue Monitoring

Your Role

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Fatigue and Its Impact

Definition

“Fatigue” is a feeling of weariness, tiredness or lack of energy.

It encompasses feelings of tiredness, reduced energy, and increased effort needed to perform tasks, making it difficult to think clearly and react quickly.

Complex physiological state that will ultimately lead to:

- Operators' inefficiencies and performance errors
- Lapses in attention and vigilance
- Delayed reaction
- Impaired logical reasoning and decision making
- Low motivation to perform “optimal” activities, for example checklists
- **Poor assessment of risk** or **failure to appreciate consequences**

Fatigue Always Wins – supplements like energy drives, coffee and other stimulates can only temporarily suppress fatigue.

AN ESTIMATED

65%

MINING HAUL TRUCK ACCIDENTS

ARE ATTRIBUTABLE

TO OPERATOR FATIGUE

93% OF EMPLOYERS

FEEL FATIGUE IS A SAFETY ISSUE

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

~4%
Productivity Loss

Impact

Fatigue Negatively Impacts Employee Health, and Mining Productivity.

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Traditional Fatigue Assessment

SAFTE™ Biomathematical Model

Sleep, Activity, Fatigue & Task Effectiveness Model

Since the 1990s, the SAFTE™ Biomathematical Fatigue Model has been considered the “gold standard” for biomathematical sleep models by leaders in fatigue risk management throughout academia, military, and heavy industry.

The model was developed by the US Army Research Lab, has been studied in over 13 published and academic papers and is widely by the US Department of Transportation, Federal Aviation Administration, and US Department of Defense.

Prior to the launch of actigraphy solutions, the SAFTE model was already widely in use to conduct schedule assessments based on hypothetical sleep patterns, largely using FAST® (Fatigue Avoidance Scheduling Tool).

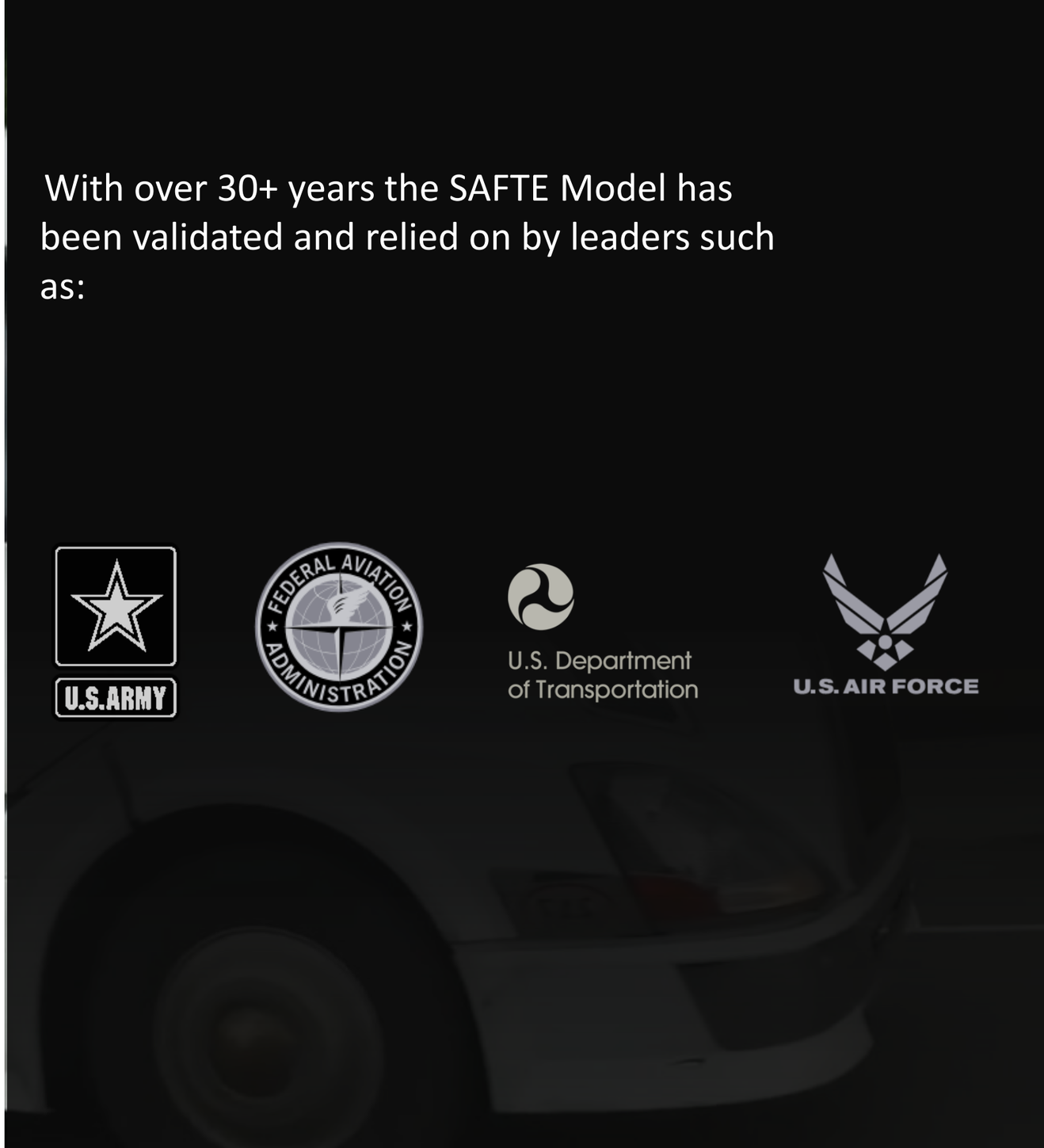
With over 30+ years the SAFTE Model has been validated and relied on by leaders such as:

U.S.ARMY

FEDERAL AVIATION ADMINISTRATION

U.S. Department of Transportation

U.S. AIR FORCE



Traditional Fatigue Assessment

Schedule Analysis

Analyzing schedules and rotation patterns to identify potential fatigue risks among equipment operators, considering long/night shifts and remote site conditions.

Wearable Sleep Monitoring

Utilizing wearable devices to monitor an operators sleep patterns, duration, and quality, providing real-time data for assessing individual fatigue levels in demanding environments.

Previous Nights Sleep

Relying on reported sleep capture from only the previous nights sleep

Operator Self Reporting

Relying on reported sleep capture from only the previous nights sleep

Traditional Fatigue Assessment Methods Have Resulted In....

Accurate Predictions

Wearable devices have delivered reliable fatigue predictions when properly utilized by operators

Enhanced Schedule Optimization

Companies now understand how scheduling directly affects **performance and critical safety outcomes operations.**

Heightened Fatigue Awareness

Acceptance that fatigue is a critical safety consideration requiring continuous monitoring **to prevent incidents and ensure worker well-being.**

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The Challenge with Traditional Fatigue Assessments

Scaling Hardware Can be Hard

Deploying and maintaining fatigue monitoring devices across geographically dispersed and transient personnel presents challenges.

Hardware Reliability

Devices can fail or require maintenance in some environments leading to critical gaps in fatigue monitoring for operators.

Limited Individual Insights

Generic schedule assessments fail to capture the unique physiological fatigue profiles of individuals.

Personnel Resistance

Operators can be resistant to continuously wearing a sleep capture device or monitoring technology, impacting compliance and the integrity of safety data.

Cost

Hardware is often more expensive than a software only solution.

Small Dataset/Unnecessary Risk

Using one or two nights of operator sleep does not capture the full picture of employee fatigue risk. This exposes operations to unnecessary risk.

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Evolution of Fatigue Monitoring

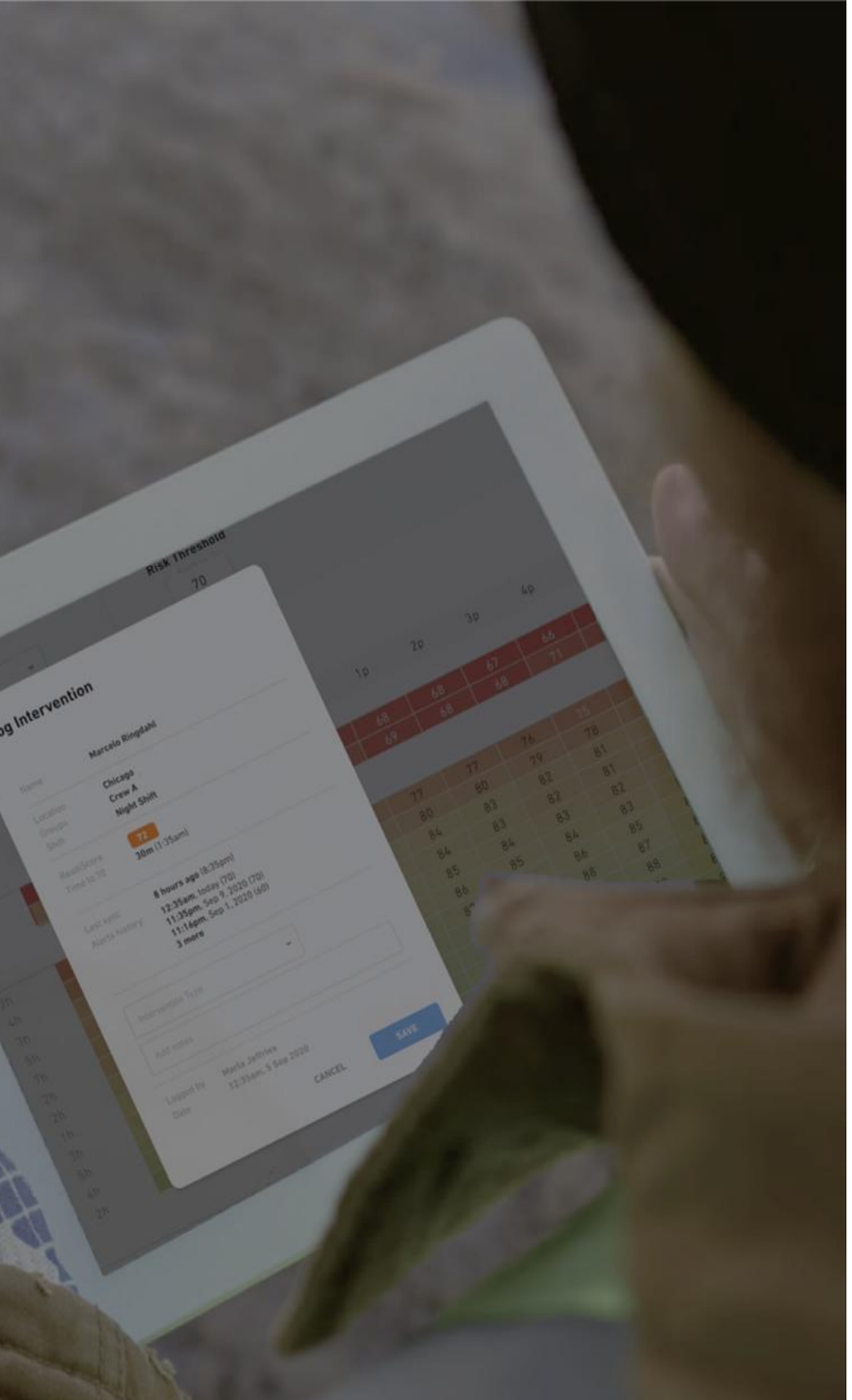
What Isn’t Changing?

The Science Isn’t Changing.

Predictive Fatigue Continues to Rely on Best-in-Class Validation Models

Ex: SAFTE Biomathematical Fatigue Model

Enhances Existing Systems.



Assessing and Predicting Fatigue is Evolving

Quantifying fatigue is rapidly evolving to address traditional limitations

AI and ML
Tools are now available to “fill in the gaps” where operators sleep isn’t captured

Sleep Profiles for Personalization
Unique “sleep profiles” are created for each operator that store their specific sleep patterns allowing for personalized fatigue predictions

Integration Tools
Worker schedules and shift patterns are automatically integrated and analyzed to provide viable sleep opportunities for operators.

Automated Data
Time of day and circadian rhythm information is automatically added to fatigue prediction algorithms

Validated Predictions
Fatigue predictions are automatically and continuously validated against a **>10M record sleep database** to ensure accuracy

Implementation Requirements

Getting started with non-wearable fatigue management requires minimal infrastructure and a **strong commitment to enhancing safety and operational efficiency.**

Existing Data or Survey

Either data from existing wearable users and/or have operators complete a one-time sleep survey.

Shift Schedule Access

Access to operators shift schedules for automated integration and analysis.

Proactive Safety Mindset

Willingness to embrace advanced fatigue management solutions to ensure the safety and well-being of operators.

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How to predict fatigue without hardware

1. Data Collection

Capture data from T&A/schedules and combine it with a survey data on sleep hygiene and environmental data.

2. Sleep Profiles

Using survey data "**sleep profiles**" are created for each operator. These profiles help predict sleep and are validated against an existing **sleep database**

3. Rolling 10-Day Data

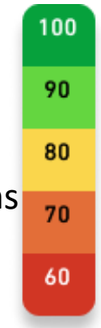
Analyze each operators work and rest periods over the past 10 days to determine sleep opportunity

4. Continuous Learning

Continuously adjust and fine-tune predictions based on operator schedules, environmental and demographics changes

5. Output

A personalized fatigue score is produced and continuously updated with changing conditions



The Results?

Minimal Operational Burden

No wearables, no charging, no syncing, and no compliance headaches for operators, simplifying deployment.

Far Easier to Scale

Scaling across thousands of operators can be as simple as having them fill out a survey

Enhanced Risk Prediction

Predictive insights pinpoint fatigue risk hotspots up to 30 days ahead, enabling proactive intervention for critical shifts and high-risk tasks.

Reduced Privacy Concerns

Absence of hardware and real-time sleep tracking minimizes privacy concerns, fostering smoother adoption with unions and individual team members.

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The Results?

86 – 92%+ Accuracy

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The Evolution of Fatigue Management is Complimentary

Is Non-Wearable Fatigue Assessment Right for Your Operation?

Non-wearable Technology Complements Existing Systems

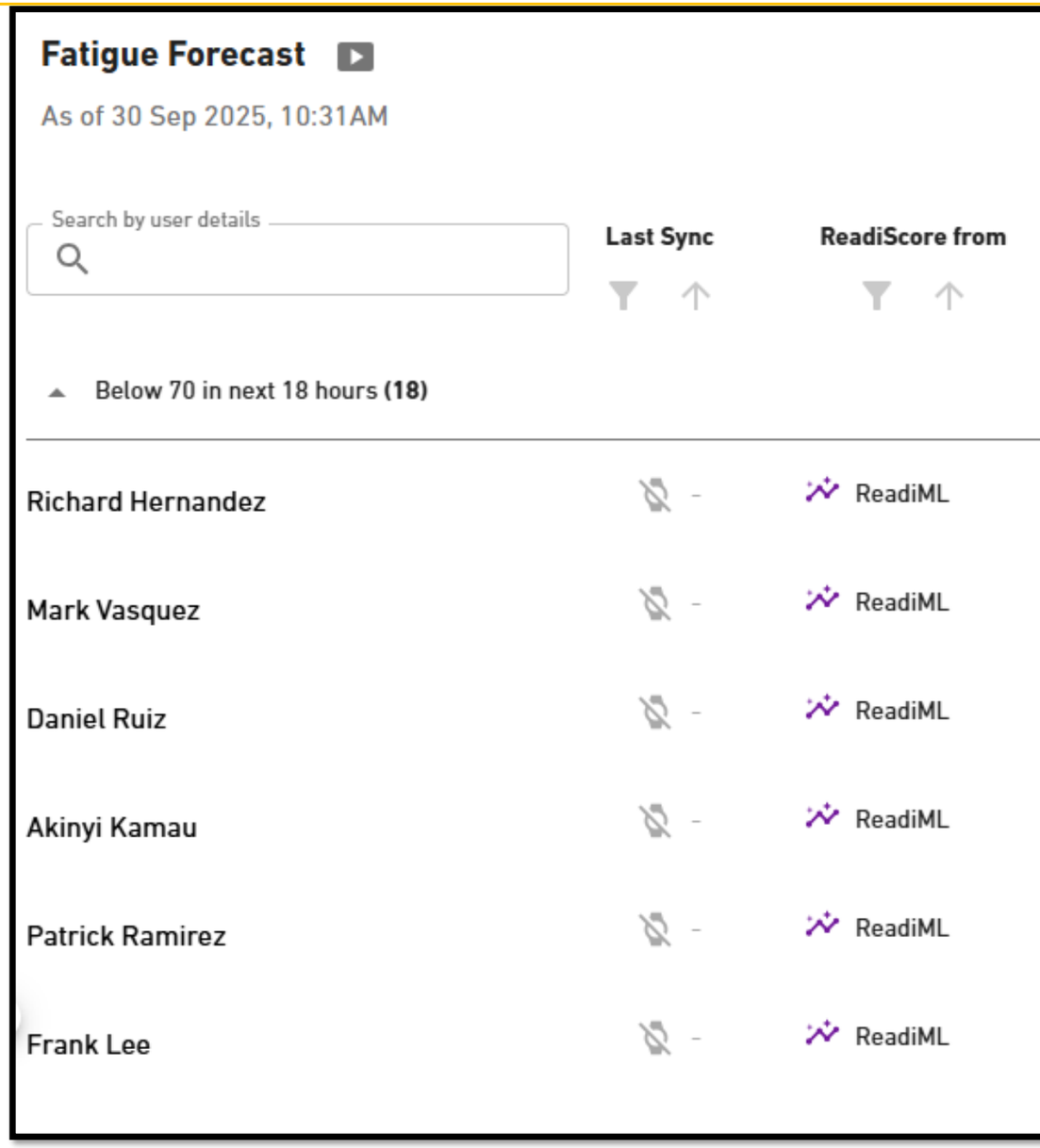
Implemented alongside existing fatigue monitoring systems non-wearable technology will fill critical monitoring gaps in traditional tools.

Functions as a Primary Fatigue Assessments Tool

Non-wearable technology can be deployed as the primary fatigue assessment tool for operations without the traditional assessment tools or those looking to modernize operations

Fill Coverage Gaps

If your operation experiences coverage gaps with improper wearable usage non-wearable technology can accurately fill these gaps using existing sleep profile and schedule information.



Eit’s Complimentary

Non-Wearable Fatigue Risk Management Can Work Independently…

But it Doesn’t Have to.

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FATIGUE DETECTION TECHNOLOGY IN MINING

42% OF COMPANIES HAVE INVESTED IN FATIGUE DETECTION TECHNOLOGY

37% ARE EXPECTING TO INVEST IN IT IN THE NEXT TWO YEARS

THE GLOBAL MINING FATIGUE MONITORING MARKET IS PROJECTED TO GROW AT 10.1% REACHING $1.6B BY 2031

Compliment Existing Fatigue Management Practices

32%

Of wearable clients rely on non-wearable sleep profile predictions to maintain a safe working environment

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The Human Component

No Technology Can Replace Discussions & Interventions

Let The Technology Enhance, Augment and Contextualize Your Conversations.

- Leverage data and tools to enable greater depth
- Update Policies, Procedures and Work Instructions

Non-Punitive!

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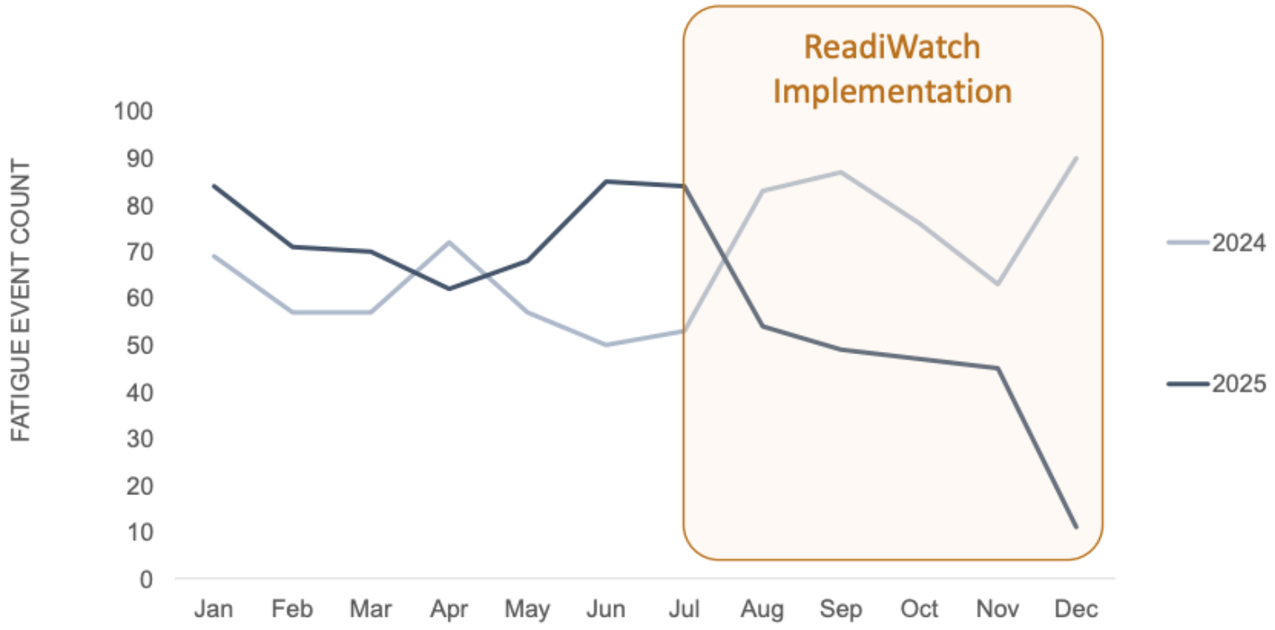
Case Study – The Impact is Quick & Significant



When leveraged together, HSE practices, traditional fatigue technologies and predictive fatigue technologies can have a significant and immediate impact.

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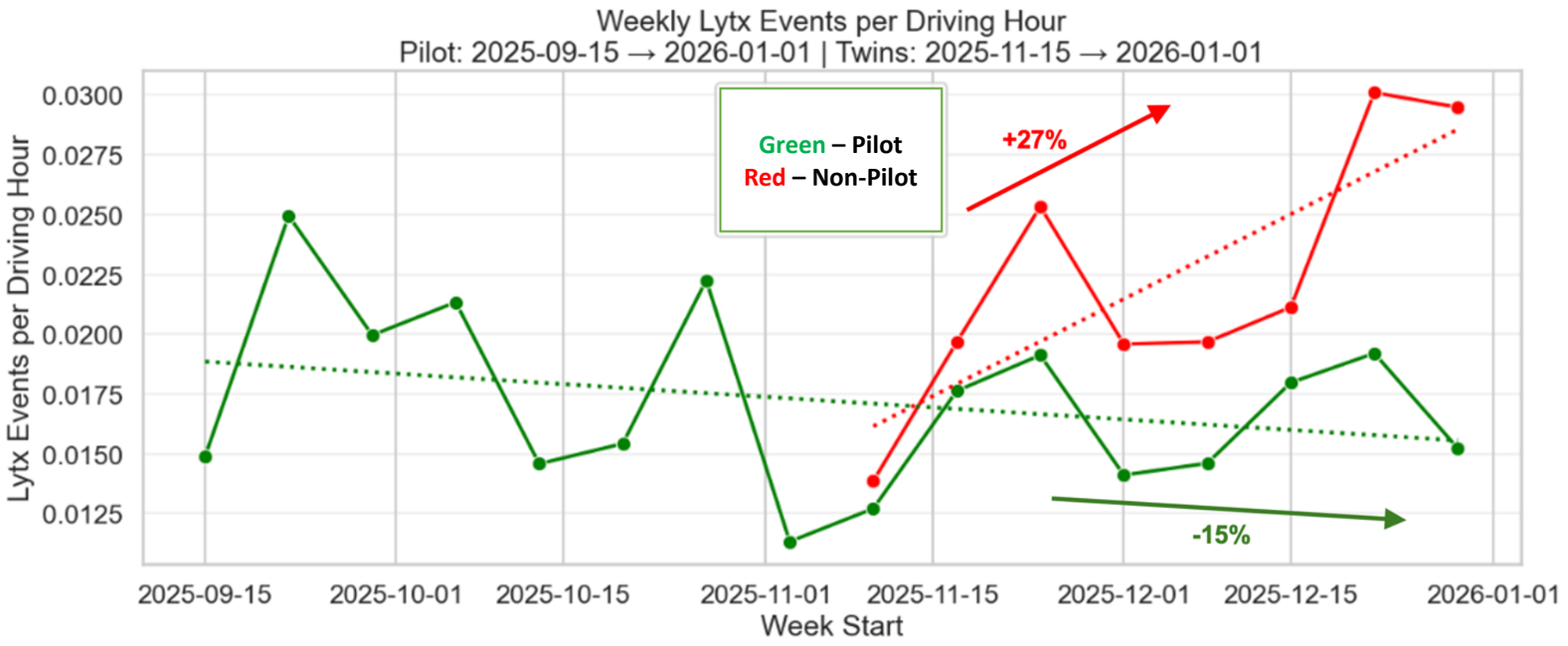
Case Study – Material Impact When Compared With Non-Users



Predictive, and Preventative

Fatigue Management

Works!

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Thank You!

Q & A

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