MANAGING DRIVER FATIGUE:
A RISK-INFORMED, PERFORMANCE-BASED APPROACH

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Introduction

Human fatigue is a central concern for the transportation industry, not only because drivers face the challenge of finding time for adequate sleep in their irregular schedules, but also because of the safety-critical nature of the job. Impaired mental capacity due to sleep deprivation, mixed with high demands on alertness and attentiveness, makes for a dangerous combination, one that has been attributed to some $12 billion in yearly costs,[1] and thousands of deaths. Driver fatigue, or more precisely, driver lapses in attention behind the wheel caused by sleep deprivation, has been named one of the leading safety hazards in the transportation industry.[2]

Approaches to reduce fatigue-related accidents include Hours-of-Service regulations that limit consecutive and cumulative work hours. However, their effectiveness has been compromised, as the incorporation of scientific sleep-wake principles is limited, and little guidance is given to companies and drivers on how to best use these principles to adapt the "one size fits all" regulation approach to their specific operational conditions. A more effective approach involves a broad evaluation of dispatch and operational practices, to assess the root causes and patterns of fatigue that result in costly—and deadly—accidents. Such an assessment would empower companies to...

- ...optimize work schedules.
- ...investigate fatigue-related accidents.
- ...train employees on shiftwork lifestyle management.

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[1] U.S. Department of Transportation

[2] National Transportation Safety Board, "Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue" (Safety report NTSB/SR-99/01, Washington, DC, 1999).

One approach developed by Circadian involves the company-wide assessment of driver fatigue and an intervention for its reduction. Specifically, the intervention is a risk-informed, performance based approach, which allows managers to a) identify individual work-rest patterns with the highest fatigue risk, and b) hold managers personally accountable for fatigue risk. The following describes a case study in which Circadian applied this approach in a major trucking company.

Assessing Driver Fatigue

Driver fatigue was assessed using proprietary analysis software: the Circadian Alertness Simulator (CAS). The software is based on scientific principles of circadian sleep-wake physiology. Individual driver logbook data, covering one month, were processed. Each driver was assigned a cumulative Fatigue Risk Score, in which driver fatigue was ranked on a scale from 0 (no fatigue) to 100 (extreme fatigue), describing the relative risk of accidents due to driver fatigue from any planned sequence of driving and resting hours. The distribution of individual fatigue risk scores within the entire driver population, as well as the group mean for the population, was then analyzed and tracked over consecutive months.

Intervention: Risk-informed, Performance-based Fatigue Management

To design an intervention to reduce the risk of driver fatigue, we took into account the fact that driver fatigue is influenced by several variables in the trucking industry, including a) the business that the carrier accepts, b) the sequence of trips constructed by the dispatchers, and c) the day-to-day decisions by the truck drivers who alternated work shifts in driving each truck.

We then designed an intervention to reduce the risk of driver fatigue that began with educating dispatchers on how they could reduce fatigue scores by adjusting the timing and duration of daily and weekly work and rest patterns. To achieve that end, some of the techniques included...

- ...providing rest breaks which allowed two consecutive nights of sleep.
- ...avoiding rapid rotations in the starting time of work.
- ...reducing the number of consecutive shifts worked.

We then provided managers and dispatchers in the trucking operation with monthly analyses of the CAS fatigue risk scores for each driver.

Results

The average fatigue risk scores for the driver population were significantly reduced from 47 to 29 within the first 9 months of the fatigue management intervention [Figure1]. Also, the percentage of high fatigue risk scores (61 and over) fell from 28.9% to 3.9%, and the percentage of minimum fatigue risk scores (1-20) increased significantly from 14.9% to 44.6%.

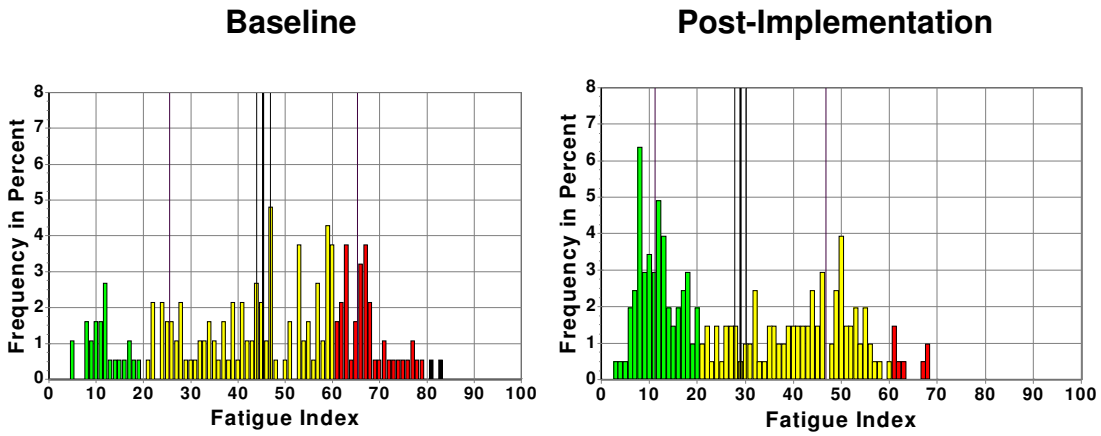

Figure 1: Frequency distribution of fatigue risk scores for individual drivers before (left) and after (right) the fatigue management intervention. The fatigue risk score scale (horizontal axis) ranges from 0 (no fatigue) to 100 (extreme fatigue). Fatigue score group averages are indicated by vertical lines. A significant shift towards lower fatigue risk scores was observed after the implementation of the fatigue management intervention.

The reduction in fatigue risk scores was associated with fewer incidences and lower costs of accidents [Figure 2]. The total number of truck accidents dropped 23.5% from an average rate of 2.30 per million miles for the three years prior to the intervention to 1.76 per million for the first year when fatigue risk score management was instituted. The average cost per accident dropped 65.8% from $14,088 to $4,820. Severity accidents (over $20,000 cost) dropped 55% from an average rate of 0.20 per million miles to 0.09 per million miles, and the average cost of severity accidents dropped 66.7% from $152,384 per accident to $ 50,809 per accident over the same time frame. Further, the total cost of loss-of-attention accidents (defined as collisions hitting the rear of another vehicle, loss of control) dropped 80.9% from a pre-intervention level of $1,187,699 per year to $226,627 per year.

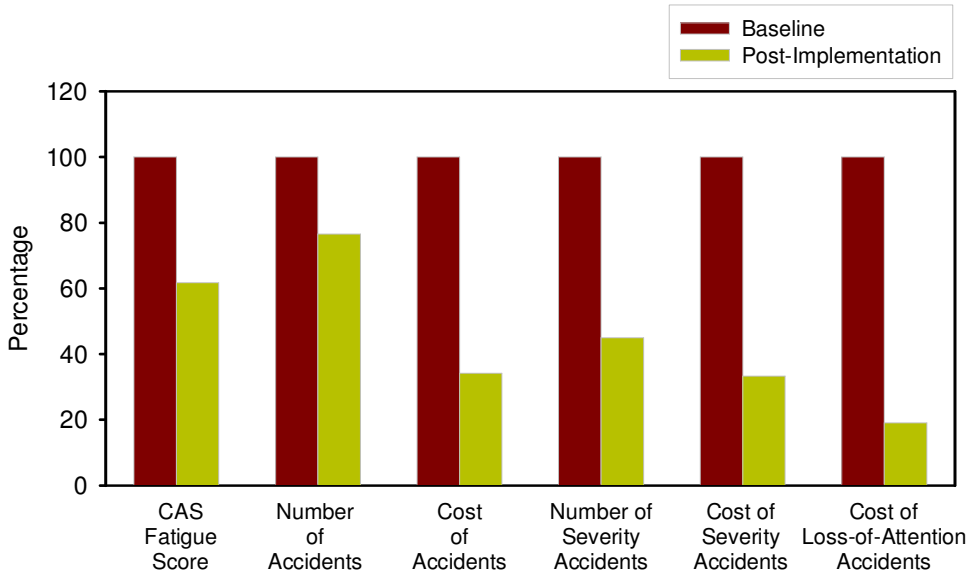

Figure 2: Effect of fatigue management intervention on fatigue risk score and accidents. Post-implementation data are shown as percentage of baseline.

As a result, the cost of insurance claims (primary insurer) dropped significantly after the implementation of the fatigue management intervention. As shown in Figure 3, the costs of insurance premiums and claims for any given time period tend to have a gap that is largely due to the lag between claims dynamic and premium adjustment. As a result of the program, the loss ratio (insurer losses/Gross Written Premium) dropped from 147% to 26%.

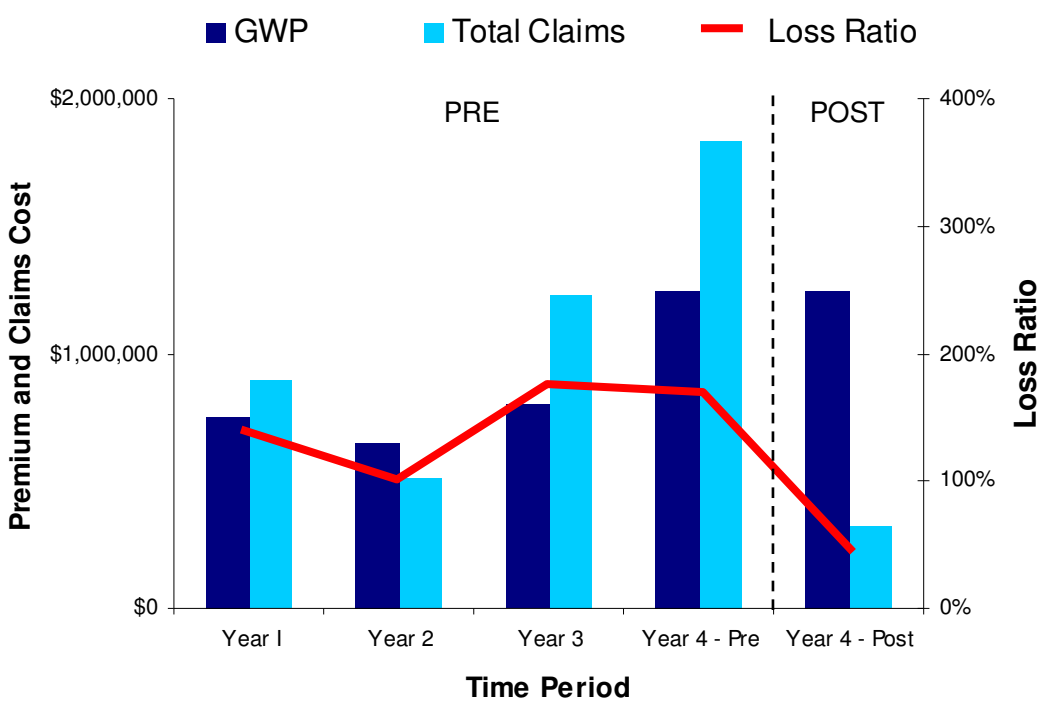

Figure 3: Gross Written Premium (GWP) and insurer losses (primary insurer only) before and after the fatigue management intervention. The loss ratio dropped from 147% to 26% as a result of the program.

Conclusions

Managing by performance-based measure is a well-established method of obtaining tangible results in a business. The key is determining the right performance measure. The most obvious measure might have seemed to be accident rate, but accidents are infrequent events and do not provide a measure of the risk of every driver on a month-to-month basis. Furthermore, implementing management initiatives based on reduction in accident or injury rates leads to an under-reporting of accidents, in part because this encourages managers to devise incentives for employees not to report events or injuries. In contrast, using the fatigue score in a risk-informed, performance-based safety program gives managers and dispatchers incentives to address some of the most important causes of driver fatigue, and therefore, or fatigue-related highway accidents. This approach to fatigue minimization enables managers and dispatchers to make safety-conscious operational decisions while having sufficient flexibility to balance specific business needs of the operation, and therefore, to stay competitive.