California Training Institute

Science based solutions to human factor issues

Predicting Fatigue: Recent Research & Findings

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Scientific research conducted by Dawson & Reed in 1997 clearly defined the relationship between hours of wakefulness and a performance under a corresponding blood alcohol content (BAC). [1]

The Federal Aviation Administration has set a maximum allowable limit of 0.04 BAC for pilots. This level corresponds to FAA research that has documented the number of serious errors committed by pilots dramatically increases at or above concentrations of 0.04% blood alcohol. This is not to say that problems don't occur below this value. Some studies have shown decrements in performance with blood alcohol concentrations as low as the 0.025%. In part, this research has provided scientific evidence, indicating an association between increasing fatigue and decrements in cognitive function, impaired performance, increasing error rates, and ultimately, reduced safety. Accordingly, governments and safety professionals have argued that mental fatigue is an identifiable work place hazard that warrants regulatory attention.

In 2005, Drew Dawson and Kirsty McCulloch developed a new Fatigue Model [2] that is being used worldwide in aviation Fatigue Risk Management Programs. The concept is based upon a prior sleep/wake model, which determines fatigue-risk thresholds by the amount of sleep individuals have acquired in the prior 24 and 48 hours. It is a simple tool that can be used to predict performance levels prior to starting a shift or work cycle.

Dawson and McCulloch state, "At best, we can suggest that based on the published literature:"

1. "Error rates increase exponentially with linear increases in psychometric measures of fatigue;"
2. "Errors are broadly comparable in nature and frequency with other forms of impairment (e.g. alcohol intoxication)"
3. "We can make only general predications about the susceptibility of certain types of tasks to fatigue related error."

Most regulatory frameworks to date have not considered fatigue as a hazard to be managed as part of a SMS. Instead, fatigue has been managed through compliance with a set of externally imposed prescriptive rules. While this is understandable, there is no reason, other than historical bias, that precludes the use of the same SMS principles that would apply for any other identifiable safety hazard. As the National Park Service moves closer to a Safety Management System concept this tool can assist you in better managing fatigue as an identifiable safety hazard. "

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[1] Dawson, D., and Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature, pp. 388: 235.*

[2] Dawson, D., and McCulloch, K. Managing sleep: it's about fatigue. Sleep Medicine Reviews (2005) 9, 365–380

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Dawson-McCulloch Predictive Model

Dawson, Kirsty McCulloch
Model Worksheet

This model considers the prior 48 hours in determining your overall fatigue level.

Step 1: Select a start point where you want to evaluate your fitness to work.

This can be at the start of a shift or you can plan ahead and select a time at the end of a shift. If you consider the end of shift include your drive home time and end when you are home.

Step 2: Hrs. slept in prior 24 hrs. ____
Use scale below to determine points

0	1	2	3	4	5+
20	16	12	8	4	0

Step 3: Hrs. slept in prior 48 hrs. ____
Use scale below to determine points

0	1	2	3	4	5	6	7	8	9	10	11	12+
24	22	20	18	16	14	12	10	8	6	4	2	0

Step 4:

Hrs. awake in prior 24 hrs. ____

Minus Hrs. sleep in prior 48 hrs. - ____

Total: ____

If total is 0 or negative = 0 points

If total is positive add these points.

Step 5: Add the total points ____

What action should I consider?	
Scale	**Control Level**
1 - 8	**Safe** (0.01 - O.O4)
5 - 13	**Caution** – Carefully consider the demand of the task being performed (O.05 – 0.09 BAC)
14 - 16	**Danger** - Only consider performing simple tasks which have little chance for any adverse consequences (0.10)
≥ 16	**Unacceptable** - If feasible, completely cease operations (≥ 0.10)